

Physico- Chemical Analysis of Surface and Ground Water of Abhanpur Block in Raipur District, Chhattisgarh, INDIA

Pramisha Sharma, Amit Dubey, S.K. Chatterjee

Abstract—A segment of this investigation was carried out to study the ground water as well as surface water quality and its physico-chemical characteristics of Abhanpur block district Raipur of Chhattisgarh, India. The geographical area at study is situated between $21^{\circ} 3' N$ to $21^{\circ} 35' 4'' N$ latitude and $81^{\circ} 43' E$ to $49.64' 5'' E$ longitude. The present work has been conducted by monitoring of ground and surface water i.e. well water, bore - well water of 8 wards of Abhanpur block as well as pond and tap water of the Abhanpur. Attempts were made to study and analyze the physico-chemical characteristics of water, i.e. , temperature, pH, total dissolved solids, alkalinity, hardness, and chloride.

Key words—Ground water, Surface water, Physicochemical parameter, Raipur district.

I. INTRODUCTION

Much of current concern with regard to environmental quality is focused on water because of its importance in maintaining human health and the ecosystem. Fresh water is a finite resource, essential for agriculture, industry and even human existence, without fresh water of adequate quantity and quality, sustainable development will not be possible¹. There is an extensive literature available that underscores deterioration of water quality²⁻⁵. The addition of various kinds of pollutants and nutrients through urban sewage, industrial effluents, agricultural runoff etc. into the water bodies brings about a series of changes in the physicochemical quality and its characteristics of water. This has been subject of several investigations⁶⁻¹⁰.

Fresh water resource is becoming day by day at the foster rate of deterioration of the water quality is now a global problem¹¹. Discharge of toxic chemicals, over pumping of qualifier and contamination of water bodies with substance that promote algae growth are some of the today's major cause for water quality degradation. Organic manure, municipal waste and some fungicides often contain fairly high concentration of heavy metals. Soils receiving repeated applications of organic manures, fungicides and pesticides have exhibited high concentration of extractable heavy metals and that thereby increase their concentration in runoff, while falling as rain, water picks up small amounts of gases,

ions, dust and particulate matter from the atmosphere¹²⁻¹³. These added substances may be arbitrarily classified as biological, chemical, physical and radiological impurities¹⁴.

These impurities may give water a bad taste, color, odour, turbidity and cause hardness, corrosiveness, staining or frothing¹⁵. The composition of surface and ground water depend on natural factors (geological, topographical, metrological, hydrological and biological) in the drainage basin and varies with seasonal difference in run off volume, weather conditions and water levels.¹⁶

Groundwater is one is the important resource all over the world. The term groundwater is usually reserved for the subsurface water that occurs beneath the water table in soils and geologic formation that are fully saturated¹⁷. It supports drinking water supply; livestock needs irrigation industrial and many commercial activities¹⁸. Groundwater is generally less susceptible to contamination and pollution when compared to surface water bodies¹⁹. Also the natural impurities in rainwater, which replenishes groundwater systems, get removed while infiltrating through soil strata. But, in India, where groundwater is used intensively for irrigation and industrial purposes, a variety of land and water based human activities are causing pollution of this precious resource²⁰. Importantly, groundwater can also be contained by naturally occurring sources. Soil and geologic formation containing high levels of heavy metals can leach those metals into groundwater. This can be aggravated by over-pumping wells, particularly for agriculture. Pollution caused by fertilizers and pesticides used in agriculture, often dispersed over large areas, is a great threat to fresh groundwater ecosystems.

Pollution of groundwater due to industrial effluents and municipal waste in water bodies is another major concern in many cities and industrial clusters in India. Groundwater is very difficult to remediate, except in small defined areas and therefore the emphasis has to be on prevention. Owing to the human activities, the ponds have become dumping ground of domestic wastes and other refuse of the society²¹. So, the knowledge of extent of pollution and the status of water become essential in order to preserve the valuable sources of water for future generation. Water quality guidelines provide basic scientific information about water quality parameter and ecologically relevant toxicological threshold values to protect specific water uses. Important physical and chemical parameters influencing the aquatic environment are temperature, pH, alkalinity, hardness, chloride, and total dissolved solid. The main objective of this work has to analyze various physico-chemical parameters of the surface and ground water of (Abhanpur Block) Raipur District C.G.

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II. MATERIALS AND METHOD

Sampling & Preservation: - The water samples were drawn during post monsoon (Nov-Jan). The ground and surface water were collected from different wards of Abhanpur Block in Raipur district C.G. Water samples from different location were collected in the plastic bottles of 250 ml from well, Bore well, pond and tap water. Samples collected were analyzed within 2 days go in order to avoid special preservation required. However sample in the bottles were kept in the refrigerator. Standard testing methods are used to evaluate different parameter²².

The pH of the ground water was estimated by pH meter. The alkalinity of water is generally due to present of carbonate and hydroxide ion. Alkalinity provides an idea of the nature of salts present in the water. The total alkalinity of ground water was calculated by standard titration method. The total solid (TS) present in 100 ml of sample water was at 103⁰ to 105⁰ c to dryness in drying oven. Cooling is done desiccators and then weight. The TS in mg/l. = (A-B)×100/sample volume in litre. Where A = weight of (dried residue + dish) & B = weight of dish. The total suspended solid (TSS) was calculated by the following formula: Total suspended solid (mg)/liter = (A-B) × 100/sample vol. in liter, where, A = weight of filter + dried residue. B = weight of filter paper. The total dissolved solids (TDS) term is used to describe the inorganic salts and small amount of organic matter present in solution. It was calculated by adding calcium and magnesium hardness derived by EDTA titration method. The chloride was estimated by silver nitrate titration method. Temperature of the samples measure by thermometer.

III. RESULTS & DISCUSSION

The physico-chemical characteristics of surface and ground water of the study area (Abhanpur Block) of Raipur District

Table: 1 The physico-chemical characteristics of Tap water samples in (Abhanpur Block) of District Raipur.

Parameter	BIS-standards	Abhanpur (1)	Galapur (2)	Manikchauri (3)	Bojarangpur (4)	Kurra (5)	Gobranawapara (6)	Tarri (7)	Paragan (8)
	(mg/l)	TW1	TW2	TW3	TW4	TW5	TW6	TW7	TW8
pH	6.5-9.2	8	8	8.2	8.5	8	9	9	8
ALKALINITY	Desirable 200mg/l. permissible 600mg/l	220	225	180	230	120	190	190	70
HARDNESS	Desirable 300mg/l. permissible 600mg/l	150	150	180	190	250	150	160	180
TDS	Desirable 500mg/l. permissible 2000mg/l	456	782	520	600	520	228	468	240
CHLORIDE	Desirable 250mg/l. permissible 10000mg/l	10	40	80	70	80	50	40	50
TEMPERATURE		21.8	21.6	22	21	21.5	21	22	21

Table No. 2 The physico-chemical characteristics of Bore-well water samples in (Abhanpur Block) of District Raipur.

Parameter	BIS-standards	Abhanpur (1)	Galapur (2)	Manikchauri (3)	Bojarangpur (4)	Kurra (5)	Gobranawapara (6)	Tarri (7)	Paragan (8)
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	(mg/l)	BW1	BW2	BW3	BW4	BW5	BW6	BW7	BW
pH	6.5-9.2	8.5	8.0	8.5	8.5	8.0	8.0	8.5	8.5
ALKALINITY	Desirable 200mg/l. permissible 600mg/l	170	380	170	280	80	310	230	270
HARDNESS	Desirable 300mg/l. permissible 600mg/l	240	270	190	200	280	170	190	130
TDS	Desirable 500mg/l. permissible 2000mg/l	612	828	528	660	528	552	444	576
CHLORIDE	Desirable 250mg/l. permissible 10000mg/l	100	40	80	70	80	80	50	180
TEMPERATURE		21.8	21.6	22	21	21.5	21	22	21

Table: 3 The physico-chemical characteristics of well water samples in (Abhanpur Block) of District Raipur.

Parameter	BIS-standards	Abhanpur (1)	Galapur (2)	Manikchauri (3)	Bojarangpur (4)	Kurra (5)	Gobranawapara (6)	Tarri (7)	Paragan (8)
	(mg/l)	WW1	WW2	WW3	WW4	WW5	WW6	WW7	WW8
pH	6.5-9.2	8.5	8.0	8.0	8.0	8.0	6.5	8.5	8.0
ALKALINITY	Desirable 200mg/l. permissible 600mg/l	140	130	280	190	130	140	330	140
HARDNESS	Desirable 300mg/l. permissible 600mg/l	180	110	190	300	110	260	100	180
TDS	Desirable 500mg/l. permissible 2000mg/l	396	420	852	840	336	684	612	456
CHLORIDE	Desirable 250mg/l. permissible 10000mg/l	10	0	240	210	40	270	80	60
TEMPERATURE		21.8	21.0	22	21	21.5	21	22	21

Table: 4 The physico-chemical characteristics of pond water samples in (Abhanpur Block) of District Raipur.

Parameter	BIS-standards	Abhanpur (1)	Galapur (2)	Manikchauri (3)	Bojarangpur (4)	Kurra (5)	Gobranawapara (6)	Tarri (7)	Paragan (8)
	(mg/l)	PW1	PW2	PW3	PW4	PW5	PW6	PW7	PW8
pH	6.5-9.2	8.0	8.5	8.0	7.5	8.0	8.5	8.5	8.5
ALKALINITY	Desirable 200mg/l. permissible 600mg/l	100	160	230	60	100	150	160	110
HARDNESS	Desirable 300mg/l. permissible 600mg/l	110	150	100	150	100	110	140	100
TDS	Desirable 500mg/l. permissible 2000mg/l	312	456	552	168	276	360	408	312
CHLORIDE	Desirable 250mg/l. permissible 10000mg/l	50	70	130	30	30	40	40	50
TEMPERATURE		21.8	21.6	22.0	21.0	21.5	21.0	22.0	22.1

Temperature:

The temperature of tap water ranged from a minimum of 21°C ± 0.5°C to a maximum of 22°C in ward no 4, 6, 8, 5, 2 and 1 respectively (Table-1). Similarly the variation in temperature of a bore well water ranged from a minimum 21°C ± .5°C to a maximum 22°C in ward no. 3, 5, 7, 1, 5 and 2 respectively (Table-2).



The temperature of well water ranged minimum of $21^{\circ}\text{C} \pm .5^{\circ}\text{C}$ and maximum 22°C in ward no. 1, 6, 8, 5, 2 and 7 respectively (Table-3). The temperature of pond water ranged minimum of $21^{\circ}\text{C} \pm .6^{\circ}\text{C}$ and maximum 22°C in ward no. 4, 6, 8, 2, 1 and 3, 7 and 8 respectively (Table-4). During the present investigation, there was no great difference between the temperature of the tap water, bore well, well and pond water.

pH:

The pH of tap water from a minimum of $8.0 \pm .5$ and maximum of 9 of ward no. 1, 2, 5, 6, 3, 4, 6 and 7 respectively (Table-1). Similarly the variation of pH of bore- well water ranged from a minimum 8 and maximum 8.5 of ward no. 2, 5, 6 and 1, 3, 4, 7 and 8 (Table-2). Similarly the variation of pH of well water ranged from a minimum 6.5 and maximum 8.5 of ward no. 6, 1 and 7 (Table-3). The pH of pond water ranged from a minimum 7.5 and maximum 8.5 of ward no. 4 and 2, 5, 7, 8 (Table-4). The results show that water quality of Abhanpur block shows no remarkable variation from the BIS recommended value of pH.

Alkalinity:

(Table-1) represents the variation in total alkalinity of tap water ranged from a minimum of 70 mg/l. and maximum of 230 mg/l. in ward no. 8 and 4. Similarly the variation in total alkalinity of bore well water ranged from minimum 170 mg/l. and maximum 380 mg/l. in a ward no. 1 and 2 respectively (Table-2). The alkalinity of well water ranged from minimum of 130 mg/l. and maximum 330 mg/l. in a ward no. 5 and 7 (Table-3). Similarly the alkalinity ranged from pond water was minimum 60 mg/l. and maximum 230 in a ward no. 4 and 3 respectively (Table-4). The alkalinity of some places was above and some places were below the BIS desirable level 200 mg/l. in all the samples of ground and surface water but was less than the maximum permissible limit.

Hardness:

The Hardness of tap water ranged from a minimum 150 mg/l. and maximum of 250 mg/l. in ward no. 1, 2, 6 and 5 respectively (Table-1). Similarly the variation in hardness of bore well water ranged from a minimum 130 mg/l. and maximum of 280 mg/l. in ward no. 8 and 5 respectively (Table-2). The hardness of well water ranged from a minimum 100 mg/l. and maximum of 300 mg/l. in ward no. 7 and 4 respectively (Table-3). Similarly the hardness ranged of pond water from a minimum 100 mg/l. and maximum 150 in ward no. 3, 5, 8 and 2, 4 respectively (Table-4). In present investigation the total hardness to be equal the BIS desirable level of 300 mg/l.

Total Dissolved Solid (TDS):

The total dissolved solid of tap water ranged from a minimum 228 mg/l. and maximum 782 mg/l. in ward no. 6 and 2 respectively (Table-1). Similarly the variation of total dissolved solid of bore well water ranged from a minimum 444 mg/l. and maximum 882 mg/l. respectively (Table-2). The total dissolved solid of well water ranged from a minimum 336 mg/l. and maximum 852 mg/l. in ward no. 5 and 3 respectively (Table-3). Similarly the total dissolved solid of pond water ranged from a minimum 168 mg/l. and maximum 552 mg/l. in ward no. 4 and 3 respectively (Table-4). The water samples of all the wards contains higher amounts of TDS than the desirable limits. The maximum TDS was detected in Manikchouri 852 mg/l. and Bajarangpur 840 mg/l. in Abhanpur block.

Chloride:

(Table-1) represent the variation in total chloride of tap water ranged from a minimum of 10 mg/l. and maximum of 80 mg/l. in ward no. 1 and 3, 5. Similarly the chloride of bore well water ranged from minimum 40 mg/l. and maximum 180 mg/l. in a ward no. 2 and 8 respectively (Table-2). The chloride of well water ranged from minimum of 10 mg/l. and maximum 270 mg/l. in a ward no. 1 and 6 (Table-3). Similarly the variation of chloride ranged from pond water ranged from minimum 30 mg/l. and maximum 130 in a ward no. 4, 5 and 3 respectively (Table-4). In present investigation the chloride content of ward no. 6 (270 mg/l.) (well water sample) shows above the BIS desirable level 250 mg/l.

IV. CONCLUSION

The study assessed the evolution of water quality in ground water and surface water of Abhanpur Block in Raipur District. A comparative study of both type of ground water and surface water was carried out by taking certain important parameters like temperature, PH, total dissolved solid, alkalinity, hardness and chloride.

The water samples of all the Abhanpur block contain higher amount of TDS than the desirable limits. No sample crossed the maximum permissible limit for TDS Alkalinity, hardness chloride and PH.

In this present investigation it was found that the maximum parameters were not at the level of pollution. So both type of ground water satisfy the requirement for the use in various purposes.

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REFERENCE

1. N. Kumar, "A View on Freshwater environment", Ecol, Env & cons.3, 1997 (3-4)
2. T.N. Tiwari, and M. Mishra, "Pollution in the river Ganga at Varanashi". Life Science Advances 5, 1986.pp. 130-137.
3. T.N. Tiwari, and M. Ali, "River pollution in Katmandu valley variation of water quality index", JEP 1, 1987,pp.347-351.
4. P.M Reddy, and V. Venkateswar, "Assessment of water quality in the river Tungabhadra near Kurnel", A.P.J. Environ. Biol. 8, 1987, pp. 109-199.
5. R.D.khulab, "Prospective in aquatic biology". Papyrus Pub. House, New Delhi. ed 1989.
6. R.A. Vollenweidre, "Scientific fundamental of the eutrophication of lakes and flowing waters with special reference to nitrogen and phosphorus as factoring eutrophication". O.E.C.D. Paris. 1986.
7. National Academy of science. Eutrophication causes consequences and correctives. Nat.Acad.Sci. Washington,D.C.
8. C.P.Milway, "Educational in large lakes and impoundments". Proc. Upplasale Symp. DECD Paris.1969.



9. T. Olimax, and U. Sikorska, "Field experiment on the effect of municipal sewage on macrophytes and epifauna in the lake littoral". Bull. Acad. Pol. Sc. clii 23, 1975, pp.445-447.
10. E. Piecznska, Usikorna and T. Olimak, "The influence of domestic sewage on the littoral of lakes". Pol.Arch. Hydrobiol. 22, 1975, pp.141-156.
11. H.B.Mahanand, M.R. Mahanand, and B.P. Mohanty, "Studies on the Physico-chemical and Biological Parameters of a Fresh Water Pond Ecosystem as an Indicator of Water Pollution". Ecol. Env & Cons 11(3-4), 2005, pp537-541.
12. P.D.Moore, Jr.T.C. Daniel, J.T. Gilmour, B.R. Shereve, D.R. Edward, and B.H.Wood, "Decreasing Metal Runoff from Poultry Litter with Aluminum Sulfate". J.Env. Qual.27, 1998, pp. 92-99.
13. A. Kumar, Periodicity and Abundance of Plankton in Relation to physico-chemical Characteristics of Tropical Wetlands of South Bihar. Ecol. Env. And Cons. Vol., 1995, pp.47-54.
14. Gay and Proop, "Aspects of Rive pollution, Butterworth's Scientific Publication", London. 1993.
15. R.A. Vollenwider, "water Management research. Scientific fundamentals of the eutrophication of lakes and flowing waters with particular reference to nitrogen and phosphorus as factor in eutorophication," 1998, pp.45-72.
16. B.A. Muller: Residential Water Source and the Risk of Childhood Brain Tumors. Env. Health. Perspt.Vol.109 (6), 2001.
17. P.G."Parivesh Groundwater", Ed Dilip Biswas, July 2003 p.3.
18. P.J. Veslind, "National Geographic Senior Writer", national Geographic, Vol. 183, No.5. 1993.
19. C.L. Zaman, "A Nested Case Control Study of methemoglobinemia Risk Factors in Children of Transylvania, Romania". Env. Health Perspt. Vol. 110 (B), 2002
20. R.K. Trivedy, "Physico-Chemical Characteristics and Phytoplankton of the River Panchganaga near Kolhapur, Maharastra". River Pollution in India (Ed. R.K. Trivedy) Ashish Publishing House, Delhi, 1990, pp.159-178.
21. Welch Limnology 2nd Edn. McGraw Hill Book Co., New York. 1952.
22. APHA, "standard method for examination of water and waste and waste water", American Public Health Association, Washington, D.C. 1989.



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