IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 7.105 ⋇ Vol. 9, Issue 4, April 2022

DOI: 10.17148/IARJSET.2022.9411

PHYSICO- CHEMICAL PROPERTIES OF WATER OF THREE VILLAGES AS FLUOROSIS PRONE AREA IN NUAPADA DISTRICT (ODISHA)

Dr M. Pandey[1], A. Kunda[2], Dr M. K. Patel[3]

[1] Department of Zoology, Rajendra University, Balangir, Odisha, India

[2]Reserch Scholar, Rajendra University, Balangir, Odisha, India

[3]Department of Anesthesiology, VIMSAR, Burla, Odisha, India

Abstract: Life is not possible on this planet without water as it is one of the most indispensable resources and is the elixir of life. But due to the rapid growth of population, urbanization and industrialization the water has become polluted. Water is considered as one of the nutrients, although it yields no calories, yet it enters into structural composition of the cell and is an essential component of diet having safe water is a basic human right which must be sufficiently available, accessible, and affordable for personal and domestic use to everyone. This is important for public health and hence, crucial for a developed, stable and prosperous world. Physico- chemical changes may be natural or human induced. Naturally by leaching and percolation toxic metals and chemicals may enter the ground water and contaminate the aquifer. Human induced or anthropogenicaly pesticides and fertilizers which are applied to crop can accumulate and migrate to ground water table. The study was conducted from Feb-2018 to April-2018, and the aim of this study was to examine the levels of some physico-chemical parameters of drinking water of Nuapada district.

Keywords: Water pollution, Ground water, Surface water, Physico-chemical parameters

I.INTRODUCTION

Water pollution is the pollution or contamination of natural water bodies like lakes, rivers, streams, oceans, and groundwater due to inflow or deposition of pollutants directly or indirectly into water systems. Any modifications or change in the chemical, physical and biological properties of water that can cause any harmful consequences on living things and the environment is known as water pollution (Manjare et al, 2010). Groundwater is a source of drinking water for millions rural and urban people, nearly 80% in rural area and 50 per cent of the urban areas in India (Abdus et al, 2010). Groundwater is generally less susceptible to contamination and pollution when compared to surface water bodies. 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 resource (Handa, 1975). Fluoride content in groundwater is mainly due to natural contamination, but the process of dissolution is still not well understood (Saxena and Ahmed, 2001). Fluoride, an electronegative element, is highly reactive, therefore, almost never occurs in elemental state in natural water. It combines with most of the elements to form ionic or covalent fluorides. The origin of fluoride in groundwater is through weathering of alkali, igneous and sedimentary rocks (Deshmukh et al., 1995). Apart from natural sources, a considerable amount of fluoride may be contributed due to anthropogenic activities. Burning of coal, manufacturing process of aluminum, steel, bricks, phosphate fertilizers industries, often contain fluoride as an impurity and are being leached down to the ground water (Rao, 2009).

II. MATERIALS AND METHODS

STUDY AREA

Nuapada one of the economically backward district of western Orissa with a geographical area of 3852 sq. km is an integral part of Western Orissa Development Council constituted by Govt. of Orissa and very often reels under severe drought condition. About 93 percent of the population of the district lives in rural areas and agriculture is the main stay of the people. The agriculture is mostly rain fed and due to lack of adequate irrigation facilities and recurring severe drought conditions in the district, the agricultural production is very often curtailed. Severe drought occurred in the year 1974, 1996, 2000 and 2002. Nuapada district lies between North latitudes 21° 0’ and 21° 06’ and East longitude

 ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 7.105 ⁘ Vol. 9, Issue 4, April 2022

DOI: 10.17148/IARJSET.2022.9411

82° 19' and 82° 60'. It is bounded on the north by Raipur district of Chhattisgarh; on the east by Bargarh and Bolangir districts, on the south by Kalahandi districts, and on the west by Chhattisgarh. The district has only one subdivision. There are 5 community development blocks in the district. The district is well connected by rail and roads. The Nuapada railway station falls on Bhubaneswar- Raipur broad gauge railway tracts. All the block headquarters are connected by metal led roads. The district comprises only one subdivision and 5 Community Development Blocks with the district headquarters at Nuapada. According to 2001 census data, the total population of the district is 5, 30,690 constituting 1.44 % of the total population and 2.47% of total land area of Odisha. The rural and urban populations are 5, 00,652 and 30,038 respectively.

Geographical location of study areas

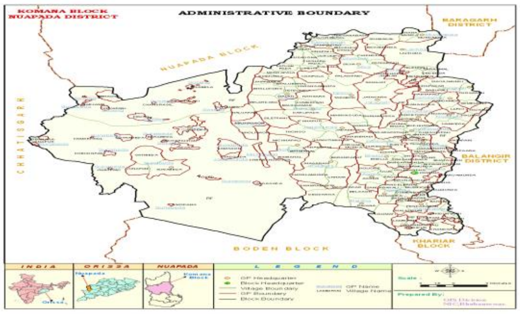

Fig-1 (Komna Block)

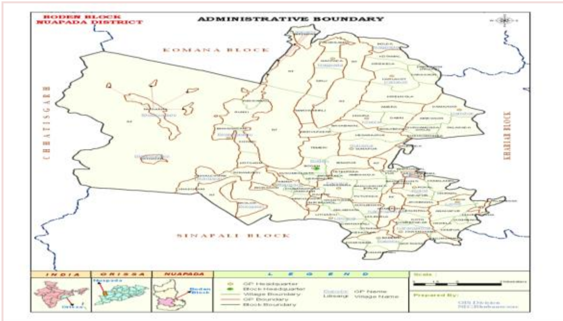

Fig-2 (Boden Block).

One village from Boden blocks and two villages from Komna of Nuapada district were selected as study area. Karlakot is a large village located in Boden Block, with total 477 families residing and total population Approximately 2019 of which 998 are males while 1021 are females as per Population Census 2011.Water samples are collected from three different Padas, and from three different sources. Another two villages know as Haripur and Pandarapathar located in Komna Block, with total 5 families residing. Having population of 20 of which 11 are males while 9 are females as per Population Census 2011 and in Pandarapathar total 379 families residing has population of 1435 of which 703 are males while 732 are females as per Population Census 2011. Only tube well water was collected for analysis from Haripur village, because there is no other source of drinking water there. The water samples collected from tube well, dug well and supply water (river) of Pandarapathar village and the collected water samples were brought to the laboratory and relevant analysis was performed.

The present study was carried in 3 different villages, of Nuapada district. Sampling was done during morning hours and all water samples were collected in the polyethylene bottles. Form Tube well, dug well and supply water samples were collected in the closed 250ml plastic bottle. The water samples were preserved by adding chemical preservatives and by lowering the temperature. The water temperature, TDS were analyzed immediately on the spot after the collection, where as the analyses of remaining parameters were done in the laboratory. The study was carried for a period of four month (March 2018 to June 2018). The collected water samples were brought to the laboratory and relevant analysis was performed.

TABLE- 1. METHODS USED FOR THE PHYSICO CHEMICAL PARAMETERS OF WATER.

Water quality test	**Instrument/ method**
Temperature	Thermometer
Colour	Platinum cobalt (visual comparison) method
pH	pH meter
TDS	TDS meter
EC	Potentio-metric method
Total Hardness(TH)	Titrimetric method (complexometric)
Alkalinity	Titrimetric method
Chloride	Ion selective electrode
Iron	Spectophotometric method
Fluoride	Ion selective electrode

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IV. RESULTS

TABLE-2. (PHYSICO- CHEMICAL PARAMETERS OF TUBE WELL DUG WELL WATER AND SUPPLY WATER)

SL NO	SOURCE	LOCATION	Colour (Unit)	Temp (ºC)	pH	EC (mg/l)	TDS (mg/l)	TH (mg/l)	Sodium (mg/l)	Chloride (mg/l)	Iron (mg/l)	Fluoride (mg/l)
1	Tube well	Karlakot village	<1	21.4 ± 2.72	7.81 ± 0.87	402± 44.9	272± 30.41	160± 17.8	0.1 ±0.001	40± 4.47	0.3± 0.03	4.4± 0.49
2	Dug well	Karlakot village	<1	21.5 ± 2.40	7.86 ± 0.87	561± 62.72	402± 44.94	240± 26.83	7.48 ±0.83	60± 6.70	0.75± 0.08	4.2± 0.46
3	Supply Water	Karlakot village	<1	21.8 ± 2.43	7.69 ± 0.85	685± 76.5	489± 54.6	260± 29.0	0.44± 0.04	100± 11.18	0.03± 0.001	0.62± 0.006
4	Tube well	Haripur village	<1	17± 1.95	8.28 ± 0.92	667± 74.57	152± 0.001	240± 26.83	14.96 ±1.67	100± 11.18	0.04± 0.004	1.62± 0.18
5	Dug well	Haripur village	<1	17.6 ± 1.96	7.94 ± 0.88	184.5 ± 20.72	132± 14.7	80± 8.94	7.04± 0.78	20± 2.23	0.74± 0.08	1.06± 0.11
6	Supply Water	Haripur village	<1	17.6 ± 1.96	8.1± 0.90	102± 11.40	90± 10.0	50± 5.59	0.02± 0.002	10± 1.11	0.105± 0.1	1.01± 0.3
7	Tube well	Pandarapathar village	<1	18± 1.99	8.02 ± 0.89	403± 45.05	287± 32.08	160± 17.88	31.24± 3.49	60± 6.70	0.79± 0.08	0.98± 1.10

V.RESULT AND DISCUSSION

Dissolved organic matter from decaying vegetation concentrations of dissolved (Fe and Mn) ions, measured in (mg/l) causes color in water. The color is estimated by comparing sample color with a standard solution color (1.245 gm of chloro-platinium potassium added to 1.0 gm of crystalline cobalt chloride in one liter distilled water (Saha and Ray 2018). From table- 2 it showed that water collected from different sources have standard colour i.e <1. Temperature effects the seasonal and diurnal variation. It controls the rate of all biochemical and biological reactions including growth, multiplication, decay, mineralization, production etc. Temperature is recorded with the help of thermometer. The pH values of the samples ranged from 5.0-9.0, where most of the water samples different location tested in the

DOI: 10.17148/IARJSET.2022.9411

study were found to be in the permissible range of pH value recommended by several health and pollution control organizations , Andezhath and Ghosh (2000) reported that in most raw water sources pH lies in the range of 6.5- 8.5. It has no direct adverse affect on health, however, a low value, below 4.0 will produce sour taste and higher value above 8.5 shows alkaline taste. The pH of sample water was showing alkaline character during the study period at all different sites, may be due to addition of some ions and heavy metals. The pH value ranged between7.69 to 8.28 in bore well, dug well and supply water of Karlakot village are 7.81, 7.86 and 7.69 respectively. Value of pH of tube well water of Haripur village is 8.28. The pH value of dug well, supply water and bore well of Pandarapathar village are 7.94, 8.1 and 8.02 respectively. The higher pH values observed suggests that carbon dioxide, carbonate-bicarbonate equilibrium is affected more due to change in physico-chemical condition (Karanth ,1987) (Table-2).

Temperature of water may not be as important in pure water because of the wide range of temperature tolerance in aquatic life. The fluctuation in river water temperature usually depends on the season, geographic location, sampling time and temperature of effluents entering the stream (Aiyesanmi, 2006).The variation is mainly related with the temperature of atmospheric and weather condition (Ackah et al, 2012). It is found that the temperature of the water collected from Karlakot, Haripur and Pandrapathar villages are within the permissible limit as per WHO. Temperature of sample water i.e., bore well, dug well and supply water of Karlakot village are 21.4°C, 21.5°C and 21.8°C respectively. Temperature of bore well water of Haripur village is 17°C. Temperature of dug well, supply water and bore well water of Pandarapathar village is 17.5°C, 17.6°C and 17.8°C respectively. The average variation in Temperature of groundwater samples in the study area varied from 17 to 22° C. (Table-2).

From table -1, It depicted that total dissolved solids describes the amount of inorganic salts of calcium, magnesium, sodium etc. and small proportion of organic matter present in the water, where a high value of the same have been reported to be related to acute myocardial infarction as well as ischemic heart diseases in few studies (Singhal et al, 2005). TDS can be taken as an indicator for the general water quality because it directly affects the aesthetic value of the water by increasing turbidity. High concentrations of TDS limit the suitability of water as a drinking source and irrigation supply. As prescribed limit of TDS for drinking water is 500 mg/l, all the water samples have TDS concentration well below the prescribed limit.

Electrical conductivity is a useful tool to assess the purity of water. The total load of salts of water is in direct relation with its conductivity. Conductivity is an index of the total ionic content of water, and therefore indicates freshness or otherwise of the water (Huang et al, 1970). Electric conductivity is varying much having low at open well, Pandrapathar 185.4 mg/l. In supply water Karlakot was recorded as 685 mg/l. The values of EC from different water samples of bore well, dug well & supply water of karlakot village are 402, 561 and 685 mg/l respectively. EC value of bore well of Haripur village is 667mg/l. EC value of dug well, supply water and bore well water of Pandarapathar village are 185.4, 102 and 403mg/l. The high electrical conductivity in some of the samples could be due to prolonged and extensive agricultural practices such as irrigation coupled with the inherent geological conditions acquiring high concentrations of the dissolved material (Table-2).

Hardness of water is an important consideration in determining the suitability of water. Hardness is caused by multivalent metallic cations and with certain anions present in the water to form scale. The principal hardness-causing cations are the divalent calcium, magnesium, strontium, ferrous iron and mangnous ions. However the permissible limit of Hardness for drinking water is 300 mg/l by WHO. Hardness was below the permissible limit in all samples and might have caused increased concentration of salts by excessive evaporation as also observed by Bhor et al. (2013). The value of total hardness in sample water of bore well, dug well and supply water of Karlakot village are 160, 240 and 260mg/l, bore well of Haripur village is 240mg/l and dug well, supply water and bore well of Pandarapathar village are 80, 50 & 160 respectively (Table-2). Based on present investigation, hardness varied from 40.2 to 45.2mg/l.

Fluoride is a substance that occurs naturally in drinking water. Health concerns regarding fluoride in drinking water have been raised because of fluorosis (Susheela, 2001). In the study area of surface water, the fluoride content ranges from 0.62 to 4.40 mg/l. The permissible limit is 1.5 but the desirable limit is 1.0. Highest amount of fluoride present in water collected from tube well (4.40 mg/l) and dug well (4.20mg/l) of Karlakot, higher than the permissible limit. Higher value might be due to the presence of fluoride compounds like CaF_2, Na_3AlF_6 and $Ca_5(PO_4)_3F$ in the underground water. So there is high risk of fluorosis. The supply water of Karlakot village has 0.62 mg/l fluoride, which is below than permissible limit. The amount of fluoride in bore well of Haripur village is 1.62 mg/l. In case of dug well and supply water were 1.06 and 0.01 mg/l respectively, in case of Pandarapathar village the tube well water the fluoride concentration is 0.98 mg/l, shown in table-2.

The iron content of the study area ranges from 0.03 to 0.79. The permissible limit of iron is 1.0 (Rao, 2009). So it coming under permissible limit. The iron content is normal. The iron value in collected sample water of bore well, dug well and supply water of Karlakot village are 0.3, 0.75 and 0.01 mg/l, tube well of Haripur village had 0.04 mg/l and dug well, supply water and tube well of Pandarapathar village are 0.74, 0.0 and 0.96mg/l respectively (Table-2).

Sodium is essential for normal functioning of the human body (Saxena and Ahmed, 2001). EPA recommends that sodium concentrations in drinking water not exceed 30 to 60 mg/l, a threshold for taste-sensitive segments of the population. In case of tube well of Pandrapathar, the sodium amount is high (31.24mg/l). The sodium value in collected

DOI: 10.17148/IARJSET.2022.9411

sample water of tube well, dug well and supply water of Karlakot village are 0.1, 7.48 and 0.44mg/l, tube well of Haripur village had 14.96 and 7.04, 0.02mg/l for dug well and supply water. Pandarapathar village water from tube well was 31.24mg/l respectively (Table-2).

Chloride occurs naturally in all types of waters. High concentration of chlorides is considered to be the indicators of pollution due to organic wastes of animal or industrial origin. (Raju et al, 2009). Higher concentration of chloride is hazardous to human consumption and creates health problems. The concentration of chloride is the indicator of sewage pollution and also imparts laxative effect. Desirable limit of chloride by ISI (1991) for drinking purpose is 250 mg/l. The chloride value in collected sample water of bore well, dug well and supply water of Karlakot village are 40, 60 and 100mg/l, tube well of Haripur village had higher amount of chlorides I.e. 100 mg/l as compared to other sources of water showed in (Table-2).

VI. CONCLUSION

In our studies, it reveals that the physico-chemical properties of the water samples from all the stations and WHO standard indicate that the water samples is not in stipulated range for acceptability. So there should be a constant monitoring of the physicochemical parameters in future because of the increase in anthropogenic activities around the area. It is further recommended that proper education, monitoring and clean up procedure be carried out promptly in these regions.

ACKNOWLEDGEMENTS

The authors are also grateful to Rural Water supply and Sanitation Division, Nuapada District, Odisha of their support and kindness and also to the lab faculty who helped us in the experimental work.

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