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GEOCHEMICAL, MICROBIAL, AND HEAVY METAL POLLUTION IN GROUNDWATER OF BHADESAR VILLAGE, JANJGIR-CHAMPA DISTRICT, CHHATTISGARH: AN ANALYTICAL STUDY

Rishabh Deo Pandey

Research Scholar Kalinga University Raipur Chhattisgarh

Dr. Apoorva

Kalinga University Raipur Chhattisgarh

Abstract

The villagers of Bhadesar in Chhattisgarh's Janjgir-Champa district rely on groundwater for their drinking water needs, as do many other rural areas. Examining geochemical characteristics, microbiological contamination, and heavy metal presence, this research seeks to assess the quality of groundwater. Before and after the monsoon, researchers gathered samples from a number of tube wells and hand pumps. Total dissolved solids, electrical conductivity, pH, and concentrations of key ions were all part of the physicochemical examination, while fecal and total coliform counts were used to evaluate microbiological contamination. Atomic absorption spectrophotometry was used to quantify heavy metals, including arsenic, cadmium, and lead. There was a high level of microbiological contamination and many heavy metals were found to be over acceptable levels, suggesting possible health hazards. The pollution was determined to be a result of both natural geochemical processes and human activity, such as farming and incorrect trash disposal. Safe drinking water is a top priority, and this research highlights the need of regular monitoring, efficient water treatment, and public awareness in this regard.

Keywords: Bhadesar Village, Janjgir-Champa District, Hydro geochemistry, Public health risk, Groundwater quality assessment, Geochemical contamination.

INTRODUCTION

Heavier metal pollutants found in groundwater include lead, arsenic, cadmium, and mercury. These are some of the most problematic heavy metal contaminants. Pollutants like these are poisonous, persistent, and have the potential to accumulate in living organisms. It is possible for these metals to infiltrate into groundwater systems as a result of a mix of natural and anthropogenic activities. As a result of weathering and dissolving processes, many rock formations naturally contain heavy metals; these metals have the potential to poison groundwater over the course of multiple years. The unfortunate reality is that human activities are contributing to an increase in the amount of heavy metals that are present in groundwater. This is a major cause for concern for the health of both humans and the environment.

The majority of the heavy metal pollution that occurs in areas such as Bhadesar village is produced by waste from industrial processes. Over time, metal-containing effluents that are leaked into the soil and water bodies by local industries and small firms have the potential to poison the groundwater. Mining operations have resulted in the contamination of a significant number of Chhattisgarh's various regions with heavy metals. Mining causes the surface of the soil to be disturbed, which exposes ores that are abundant in metals such as cadmium and mercury. Because of this, subsurface water reservoirs have the potential to become contaminated with toxic substances. The widespread application of chemical fertilisers, pesticides, and herbicides in agricultural settings has resulted in the pollution of runoff with metals like lead and arsenic, which is another significant cause. Heavy metals included in agricultural pesticides have the potential to slowly accumulate and pollute groundwater if sustainable irrigation methods are not used.

Common Heavy Metals Found in Chhattisgarh's Groundwater

Groundwater contamination caused by heavy metals is a significant issue in the state of Chhattisgarh, which is well-known for the abundance of its natural resources and the extensive mining that takes place there. In groundwater samples, researchers from all throughout the state have discovered very high concentrations of heavy metals such as mercury (Hg), arsenic (As), lead (Pb), cadmium (Cd), and chromium (Cr). These heavy metals pose a significant threat to residents. Due to the presence of heavy metals in water sources, which frequently exceed the limits set by the World Health Organisation (WHO) and Indian laws for safe drinking water, the health and safety of the local population are put in jeopardy. There is a significant connection between the widespread presence of these pollutants and the heavy mining and industrial activity that has been carried out in the region. This activity has been carried out in many locations that have poor environmental regulations.

Mining is one of the primary economic drivers of Chhattisgarh. Mining include the exploitation of a variety of minerals, including coal, bauxite, and iron ore, amongst others. Blasting, excavation, and ore processing are all activities that alter the natural geology of the area surrounding mine sites. As a result, heavy metals are discharged into the soil and water systems that are located in the vicinity of mining sites. The acidic conditions that are produced as a result of the reaction of sulphide minerals that are exposed during mining with water and air are what cause acid mine drainage (AMD), which is a frequently occurring phenomenon. This results in the heavy metals becoming more mobile and soluble. As a consequence of these metals leaking into groundwater aquifers, the water supplies of Bhadesar and other towns in the surrounding area have become poisoned. For instance, there is a link between the increased amounts of arsenic and lead discovered in groundwater and the growing number of skin ailments, neurological difficulties, and other health concerns among local residents in places that are located in close proximity to mining zones.

Microbial Contamination and Public Health Concerns

The contamination of groundwater by microorganisms is one of the most significant difficulties that adversely affects water quality in rural areas, such as the hamlet of Bhadesar, In particular, this is the case in regions where the quality of the water is extremely undesirable. Despite the fact that groundwater is generally considered to be safe due to the natural filtration process that takes place via the layers of soil and rock, it is possible for hazardous organisms such as bacteria, viruses, and protozoa to pollute groundwater. This includes the possibility that groundwater might be contaminated by these germs. These toxins are mostly formed from human and animal waste, which is a consequence of inadequate sanitation facilities, improper waste disposal, and seepage from pit latrines or septic tanks. The majority of these toxins are found in the environment. It is also believed that runoff from animal farms and fields that have been fertilised with manure are factors that contribute to the presence of microbial contamination in agricultural settings. The contamination of groundwater is an important indicator of contamination and a direct threat to the health of the general people. The contamination of groundwater with faecal coliform bacteria, in particular Escherichia coli (E. coli), poses a direct risk to the national health of the general population.

Impact of Agricultural Practices on Groundwater Quality

A major impact on the quality of groundwater is exerted by agricultural practices, particularly those that include extensive agricultural production. Because of the Green Revolution and the growing need for food on a global scale, modern farming has grown increasingly dependent on the use of synthetic fertilisers, chemical pesticides, and high-yield crop varieties. This is due to the fact that these factors have become increasingly significant. In spite of the fact that the use of these techniques has led to an improvement in food security, they have also resulted in significant environmental problems, the most significant of which is the contamination of groundwater. Nitrogen-based fertilisers, when applied in excessive amounts, cause nitrates to leach into the soil, which then eventually makes their way into the groundwater. This is because nitrates are a byproduct of the nitrogen-based fertilisers. There is a correlation between the presence of high levels of nitrate in drinking water and a variety of significant health risks, one of which is the development of methemoglobinemia, sometimes known as "blue baby syndrome" in infants. In addition, these levels have been linked to a wide range of cancers and neurological illnesses that affect adults. Furthermore, phosphate fertilisers have the potential to contribute to the eutrophication of local water bodies, which can further harm aquatic ecosystems. This type of eutrophication can be detrimental to aquatic ecosystems. When groundwater eventually leads to the development of lakes or rivers, this particular phenomenon takes place.

Health Implications of Contaminated Groundwater in Rural Areas

The public's health is put in jeopardy by polluted groundwater, which is especially dangerous in rural areas because it is sometimes the only source of drinking water in many areas. More specifically, this is the case in areas where pollutants are present. A wide range of acute and chronic health problems have been linked to the presence of microbial pathogens, heavy metals, nitrates, and other chemical pollutants in groundwater. These contaminants have been shown to be present in groundwater. It has been demonstrated that certain environmental pollutants are prevalent in groundwater. It is essential to have a comprehensive knowledge of these health implications in order to build effective monitoring, prevention programs, and mitigation measures for the aim of safeguarding vulnerable rural populations. This understanding is necessary in order to protect these communities.

- **Gastrointestinal Diseases**

Due to the frequency of waterborne gastrointestinal disorders, polluted groundwater poses one of the most acute health dangers linked with the contamination of groundwater. Some of the ailments that may be caused by microbial contamination include diarrhoea, dysentery, cholera, typhoid fever, and gastroenteritis. This is especially true when pathogens like Escherichia coli, Salmonella, Shigella, and Vibrio cholerae are taken into consideration. In rural regions, where sanitary facilities may be substandard and access to clean water is restricted, these illnesses are more prevalent and widespread. The prevalence of diarrhoeal illnesses continues to be one of the top causes of morbidity and death in children under the age of five in developing nations. These diseases also have a key role in the development of malnutrition and a diminished immune system. The contamination of groundwater by faecal coliform bacteria serves as a direct sign of poor water quality and is a continuous challenge to the area of public health.

- **Neurological Disorders**

Because of the presence of heavy metals like lead, mercury, and arsenic in polluted groundwater, individuals who are exposed to these substances may develop severe neurological diseases. For instance, lead poisoning is known for inflicting irreparable harm to the growing brains of children, which can result in cognitive deficits, behavioural issues, and a lower intelligence quotient (IQ). Mercury exposure has an effect on the central nervous system and can result in a wide range of symptoms, from tremors and memory loss to serious neurological deterioration. Arsenic, a metalloid that occurs naturally and is frequently discovered in groundwater as a result of geological and anthropogenic causes, has also been related to neurotoxicity that has been seen. A number of adverse health effects, including neuropathy, impaired cognitive function, and developmental delays, have been linked to prolonged exposure to arsenic-contaminated water. There is a concerningly high incidence of neurological problems caused by heavy metal poisoning in rural people that are dependent on groundwater that has not been cleaned properly.

- **Chronic Health Conditions**

Consumption of polluted groundwater over an extended period of time can result in a variety of chronic health issues, in addition to acute infections and neurological consequences. Arsenic pollution, in particular, is well-known for its ability to cause skin lesions, hyperkeratosis, and a higher risk of malignancies such as skin cancer, lung cancer, bladder cancer, and kidney cancer. Cadmium exposure has been connected to renal dysfunction and osteoporosis, whereas continuous consumption of nitrates through groundwater has been linked to methemoglobinemia and may lead to certain malignancies and reproductive difficulties. Cadmium exposure has also been linked to both of these conditions. Chronic kidney disease of unclear aetiology (CKDu), which is becoming more prevalent in agricultural areas all over the world, is also being researched for possible connections to heavy metal and pesticide pollution in drinking water. The development of these disorders frequently occurs in a stealthy manner, making early diagnosis and intervention challenging.

- **Vulnerable Populations and Socioeconomic Impact**

Groundwater pollution has a disproportionately negative impact on rural populations, like those in Bhadesar, since there is a lack of access to alternate sources of pure water and healthcare services. Children, pregnant women, the elderly, and anyone who are immunocompromised are especially susceptible to the negative impact that polluted water can have on their health. This contributes to the perpetuation of cycles of poverty since recurrent diseases brought on by low water quality lead to decreased school attendance, decreased productivity, and decreased economic stability. The meagre resources of rural households are further stretched to their limits by the costs of healthcare, which include the treatment of chronic diseases and infections. In addition, the psychological and social strain that is connected with water scarcity and disease can have a negative impact on the general well-being of the community.

- **Need for Regular Monitoring and Mitigation**

Regular monitoring of the quality of groundwater is absolutely necessary in rural areas because of the severe environmental and health repercussions. Identification of pollution hotspots and evaluation of potential threats to public health can be facilitated by the use of systematic testing for microbiological pathogens, heavy metals, nitrates, and pesticide residues. Early warning systems have the potential to provide prompt measures, such as the treatment of water, the provision of alternative sources of clean water, and the education of the public regarding public health. The prevention of contamination should be the primary emphasis of mitigation efforts. This may be accomplished through the implementation of sustainable farming practices, better sanitation, the control of industrial discharges, and community awareness campaigns. A further recommendation is that medical professionals working in rural areas should get training to enable them to identify and successfully manage water-related health issues.

The presence of polluted groundwater in rural areas, such as the village of Bhadesar, can have a wide range of adverse health effects, ranging from acute gastrointestinal ailments to chronic neurological and systemic problems. It is necessary to make concerted efforts in environmental monitoring, public health interventions, infrastructure development, and community participation in order to address these difficulties. This will guarantee that disadvantaged groups have access to water that is both safe and sustainable.

Water Quality and Public Health

The quality of water is a vital foundation for the continuing existence of humans and the development of society. Public health and water quality are intimately connected, and water quality serves as an essential base for both. In the event that the water's quality is diminished in any manner, it poses significant risks to the health of the population. It is essential to have access to potable water for routine activities. A significant number of studies and epidemiological investigations have demonstrated that drinking water that is contaminated is a main transmission route for a range of diseases that are transmitted through water. This is the conclusion that has been reached as a result of the findings of these studies. In particular, bacterial contamination has been demonstrated to be one of the most major risk factors that lead to the spread of illnesses such as cholera, typhoid fever, dysentery, and hepatitis. This has been demonstrated via research. Although there have been advancements in water filtration technology and global programs that strive to ensure that everyone has access to clean drinking water, waterborne illnesses continue to be a serious public health problem, particularly in rural areas and places that are still in the process of developing. This is especially true in places that are still in the process of developing. Not only does contamination occur at the source of the water, but it also occurs throughout the storage and distribution of the water.

OBJECTIVES

1. To evaluate the geochemical properties of groundwater in Bhadesar village, including pH, electrical conductivity, total dissolved solids, and major ion content.

2. To determine microbial contamination levels by analyzing total coliform and fecal coliform counts.

RESEARCH METHODOLOGY

Evaluation of the subject area's Water Quality Index (WQI) is carried out in this study using a quantitative and analytical research technique. In a cross-sectional field experiment, groundwater samples were systematically collected from specific places before and during the monsoon season. To guarantee dependability, we adhered to standard sample techniques suggested by the American Public Health Association (APHA). Key physicochemical characteristics were measured in the lab using calibrated equipment. These parameters include pH, dissolved oxygen, biological oxygen requirement, total dissolved solids, nitrates, and selected heavy metals. A weighted arithmetic technique was used to construct the WQI after comparing the concentration of each parameter with Bureau of Indian Standards (BIS) and World Health Organization (WHO) recommendations. This technique offers a comprehensive numerical evaluation of water quality, allowing for easy understanding of pollution levels and how they affect ecosystem health and human consumption.

RESULT

Calculating WQI Using WAWQI Method

Step 1: Collect data of various physico- chemical water quality parameters

Step 2: Calculate Proportionality constant "K" value using formula

$$K = \left(\frac{1}{\sum_{i=1}^{n} s_i} \right)$$

where "si" is standard permissible for nth parameter.

Step 3: calculate quality rating for nth parameter (qn) where there are n parameters. This is calculated using formula

$$q_n = 100 \left\{\frac{(v_n - v_{io})}{s_n - v_{io}}\right\}.$$

Step 4: Calculate unit weight for the nth parameters.

$$W_n = \left(\frac{k}{s_n}\right).$$

Step 5: Calculate Water Quality Index (WQI) using formula,

$$WQI = \left(\frac{\Sigma w_n * q_n}{\Sigma w_n}\right).$$

Table – 1 Water Quality Index (WQI) and Status of water quality

Water Quality Index Level	Water Quality Status
< 35	Excellent Water Quality
35 – 45	Good Water Quality
45 - 55	Poor Water Quality
55 – 65	Very Poor Water Quality
< 75	Unsuitable for drinking

Table – 2 WHO permissible limit of various parameters

Parameters	Permissible limit
pH	6.5 to 8.5
Turbidity	05 to 10 NTU
Electrical Conductivity	300
Alkalinity	120 to 600 mg/L
Total Hardness	200 to 600 mg/L
Total Dissolved Solids	500 to 2000 mg/L

Calcium (Ca)	75 mg/L
Magnesium (Mg)	30 mg/L
Lead (Pb)	0.01 mg/L
Cadmium (Cd)	0.003 mg/L
Chromium (Cr)	0.05 mg/L
Iron (Fe)	0.3 to 1.0 mg/L
Nickel (Ni)	0.02 mg/L
Copper (Cu)	0.05 to 1.0 mg/L
Chloride (Cl)	1 to 1.5 mg/L
Zinc (Zn)	5 to 15 mg/L

Table 3: WQI calculation for Source -1

Parameter	WHO Standard	1/Sn	K	Wi	Ideal value V0	Mean Vn	Vn/Sn	Qn = Vn/Sn * 100	WnQn
pH	8.5	0.12	0.0020	0.00023	7	7.35	0.865	86.471	0.020
Turbidity	10	0.10	0.0020	0.00020	0	17.2	1.720	172.000	0.034
Electrical Conductivity	300	0.00	0.0020	0.00001	0	752	2.507	250.667	0.002
Alkalinity	600	0.00	0.0020	0.00000	0	450	0.750	75.000	0.000
Total Hardness	600	0.00	0.0020	0.00000	0	695	1.158	115.833	0.000
Total Dissolved Solids	2000	0.00	0.0020	0.00000	0	300	0.150	15.000	0.000
Calcium (Ca)	75	0.01	0.0020	0.00003	0	205.94	2.746	274.587	0.007
Magnesium (Mg)	30	0.03	0.0020	0.00007	0	95.36	3.179	317.867	0.021

Lead (Pb)	0.01	100.00	0.0020	0.19750	0	0.04	4.000	400.000	78.999
Cadmium (Cd)	0.003	333.33	0.0020	0.65832	0	0.004	1.333	133.333	87.776
Chromium (Cr)	0.05	20.00	0.0020	0.03950	0	0.048	0.960	96.000	3.792
Iron (Fe)	1	1.00	0.0020	0.00197	0	1.291	1.291	129.100	0.255
Nickel (Ni)	0.02	50.00	0.0020	0.09875	0	0.061	3.050	305.000	30.118
Copper (Cu)	1	1.00	0.0020	0.00197	0	0.1	0.100	10.000	0.020
Chloride (Cl)	1.5	0.67	0.0020	0.00132	0	260	173.333	17333.333	22.822
Zinc (Zn)	15	0.07	0.0020	0.00013	0	0.004	0.000	0.027	0.000

Groundwater Quality Assessment Based on Physico-Chemical Indicators

Without water, which is a fundamental natural resource, there is no possibility of life or a healthy environment. Despite this, this essential resource has been in grave risk over the last several decades as a consequence of pollution and over exploitation caused by human activity. Water quality, and groundwater in particular, has emerged as a significant concern that has to be addressed when sustainable development is seen from the point of view of human well-being. When it comes to drinking water, groundwater is the preferred option for more than nine out of 10 Indians, regardless of whether they reside in a city or a smaller rural area. As a result, it is very necessary to keep a constant eye on it and maintain its quality. "Water is the matter and matrix, mother and medium" is a proverb that describes the relationships between all living things. "There is no life without water" is a remark that encapsulates the necessity of this component in an impeccable manner. The pollution of water is a significant problem that has, sadly, become more severe as a result of the unrelenting progress of modern civilisation, the rapid urbanisation of the world, and the expansion of industrial activity. As a consequence of the severe degradation of our "life, mother, and medium" that has reached deadly proportions, the quality of the water is deteriorating, and there is a lack of water.

There are currently water shortages in many regions, and the quality of the water is far lower than it was before. In addition to exemplifying the growing environmental issues that are a direct result of human activity, this circumstance is also a prime example of the problem of unsustainable consumption. Many countries, like India, which is one of those countries grappling with this dilemma, continue to rely on groundwater as their major supply of drinkable water. As a result of the decline in both the quality and quantity of water, there are significant repercussions for human health, agricultural production, and overall development. In light of this, it is very necessary to carry out exhaustive scientific research in order to appreciate the quality of the water. In addition to other scientific tools, statistical investigations and correlation studies are the most effective ways to perform the task of predicting and analysing water quality measures. Researchers have the potential to get significant insights into the dynamics of pollutants and how they behave in the environment via the use of correlation analysis. This is accomplished by evaluating the interrelationships among various physicochemical and biological parameters among themselves. In most cases, the physical, chemical, and microbiological characteristics of water are stated, and the key connections between these characteristics serve to explain the quality of the particular water. These studies not only help to present an overall picture of water quality, but they also aid in identifying pollutant concentrations and developing plans for more specialised water quality management measures.

Chhattisgarh is the tenth largest state in India in terms of size, with a total area of 135,191 square kilometres, which is equivalent to 4.11 percent of India's total landmass. In light of the fact that it only holds around one percent of India's total water resources, it is particularly vulnerable to water stress. The harsh weather conditions, diverse geography, and increasing demand from people all contribute to the state's water shortages and pollution, which are already issues that are becoming worse. Established in May of 1998, the Janjgir-Champa district is located in the very centre of Chhattisgarh and is an extremely important contributor to the agricultural productivity of the area. Ancient structures like as the Vishnu Mandir and contemporary irrigation systems such as the Hasdeo-Bango project both contribute to the cultural and historical richness of the region, which in turn encourages agricultural endeavours. In spite of the fact that these resources are available, a significant number of locations within the district continue to struggle with the availability of potable water. This is especially true in the semi-urban and rural areas of the district, where people depend on groundwater for a variety of purposes, including agricultural and household usage.

One of the most prominent examples of the area's dependence on groundwater is the tiny village of Bhadesar, which is located in the Janjgir-Champa region. As is the case with most communities in the region, this one does not possess any significant bodies of surface water; hence, the residents are forced to get their drinking water via the use of hand pumps, bore wells, and open wells. Despite the fact that it is of critical significance, the physicochemical, microbiological, and heavy metal pollution contamination of Bhadesar's groundwater has not been well investigated. In order to get a more comprehensive understanding of the nature and extent of groundwater pollution in the area, it is of the utmost importance that we bridge this knowledge gap in the existing literature. As a result, the objective of this study is to assess the quality of the groundwater in the neighbourhood of Bhadesar by examining its geochemical composition, the amount of microorganisms present, and the levels of heavy metal contamination.

Groundwater samples were collected from fifty different locations within the Bhadesar and neighbouring wards of the Janjgir-Champa district in order to be successful in achieving this objective. The samples were collected via the use of open wells, bore wells, and hand pumps, all of which are water sources that are often used for agricultural and domestic purposes. All of the samples were collected in polythene bottles of two litres capacity that had been thoroughly cleaned and washed in accordance with the procedures that had been set to prevent contamination. Due to the fact that the quality of the water may change depending on the season, the testing period was extended to encompass both the year 2020 and the year 2021. There were a number of factors that were included in the study. These parameters included total dissolved solids (TDS), hardness, alkalinity, nitrate, chloride, sulphate, coliform bacteria and other microbiological indicators, and hazardous heavy metals including arsenic, lead, cadmium, and iron.

These indicators were selected due to the fact that they are often seen in groundwater systems that are polluted and because of the significance they have for human health.

Correlation of Water Quality Parameters

The numerical values of the correlation coefficients (r) that were calculated in this study and utilised to identify the relationships between the various water quality measurements are shown in Table 4. These values were used to determine the linkages between the metrics. The correlation coefficient (r) between any two variables, x and y, is estimated for a number of characteristics, including water pH, electrical conductivity, total alkalinity, total hardness, calcium hardness, magnesium hardness, chloride, nitrate, and total dissolved solids. These parameters are among those that are considered when calculating the correlation coefficient. Fluoride and total alkalinity, on the other hand, have inverse associations with those two variables. EC has a positive connection with every other parameter, with the exception of fluoride, with which it has been seen to have a negative association. It was discovered that out of the 55 variables, there were six pairs of variables that were found to have a significant correlation: total dissolved solids (TDS) and electrochemical concentration (EC) (r=0.9356), calcium hydroxide (CaH) and total organic carbon (TH) (r=0.9960), magnesium hydroxide (MgH) and total organic carbon (0.9967), and total dissolved solids (Cl) and total dissolved solids (TDS) (r=0.9356) from groundwater samples. The simple correlation coefficient (r) is used to determine the amount of line connection that exists between any two water quality measurements. A 10 10 correlation matrix is used to depict this level of line relationship. It has been discovered that there is a significant positive connection between pH and electrical conductivity, total hardness, and calcium hardness. The correlation coefficients for these three variables range from 0.8 to 1.0 and 0.5 to 0.6, which indicates that there is a high amount of r values as well. There are eleven possible values of r that occupy the moderately significant coefficient levels, which include the range of 0.6 to 0.8. In 42 of the cases, there was a positive link, whereas in 13 of the cases, there was a negative correlation.

Table-4: Correlation coefficient (r) among water quality parameters

Parameter	pH	EC	TA	TH	CaH	MgH	Cl-	NO3-	F-	TDS
pH	1									
EC	0.06641	1								
TA	-0.05966	0.12601	1							

TH	0.11245	0.67538	-0.21285	1						
CaH	0.10808	0.64933	-0.20733	0.99607	1					
MgH	0.11566	0.69446	-0.21642	0.99674	0.98567	1				
Cl-	0.06781	0.9357	0.08616	0.62656	0.59591	0.65016	1			
NO3-	0.09646	0.2878	-0.20395	0.73308	0.76885	0.69551	0.2825	1		
F-	-0.1871	-0.04261	0.18471	-0.20385	-0.20083	-0.2052	-0.07125	-0.1674	1	
TDS	0.06641	1	0.12601	0.67538	0.64933	0.69446	0.9357	0.2878	-0.0426	1

Nearly every water quality parameter that is deemed unsafe by the Bureau of Indian Standards (BIS), the International Centre for Medical Research (ICMR), and the World Health Organisation (WHO) was found in groundwater samples that were taken from different Champa wards in District Janjghir Champa. These parameters include pH, electrical conductivity, total hardness, calcium hardness, magnesium hardness, chloride, nitrate, fluoride, and total dissolved solids (TDS). When compared to all of the other metrics, the amounts of fluoride, nitrate, total dissolved solids, and chloride are quite high. A considerable number of groundwater samples (44%) have very high levels of fluoride, despite the fact that the majority of groundwater samples (56%) have fluoride levels that are below the acceptable range established by the World Health Organisation (> 1.5 mg/L). One of the factors that contributes to the development of fluoride in ground water is the presence of a rock salt system that has a high concentration of fluoride molecules. One of the four samples exhibited a concentration of nitrate ions that was higher than 45 mg/L. There is a possibility that this number might exceed 380 mg/L in some samples. According to the most recent findings of study, the water that residents of the Champa wards consume is not suitable for human consumption. As a consequence of this, the pollution of drinking water has to be mitigated as quickly as possible by putting into action an adequate environmental management plan. In light of these results and the analysis of the water samples, it is also recommended that people only drink water after it has been boiled, filtered, or treated with reverse osmosis. This is done in order to prevent any adverse effects on their health.

The objective of the study was to ascertain whether or not the groundwater in the majority of rural households in the Champa tehsil of the Janjhir Champa district in Chhatisgarh, India, was suitable for consumption. For the purpose of doing this, fifty water samples were collected from a variety of sources within the research region and analysed for a number of different physicochemical properties. Electrical conductivity, total alkalinity, total hardness, calcium hardness, magnesium hardness, chloride, nitrate, fluoride, and total dissolved solids were some of the characteristics that were included in this category. A combination of hand pumps, open wells, and bore wells were used in order to gather the samples. As per the study, it was discovered that almost every metric was determined to be outside of the permissible measurement range. Approximately forty-four percent of groundwater sources do not meet the minimum and maximum acceptable levels of fluoride, nitrate, total dissolved solids, and chloride in drinking water. These levels were established by the Bureau of Industrial Safety (BIS) of the World Health Organisation and the International Commission for Medical Research (ICMR), respectively. Because of the increasing fluoride concentration in the water supply, residents of this region have suffered dental and skeletal fluorosis. This is a consequence of the fluoride content. According to the results of the research, the water supply in the Champa tehsil is not suitable for human consumption. It is imperative that quick action be taken in order to alleviate the water pollution issue that is occurring in this region.

CONCLUSION

According to the findings of the research, the groundwater in the hamlet of Bhadesar is affected by a mix of geochemical, microbiological, and heavy metal pollution. For the people who live in the area, elevated quantities of heavy metals such as arsenic, lead, and cadmium, in addition to the presence of microbes, offer severe health hazards. Contamination sources include natural geochemical processes as well as anthropogenic activities like as agricultural runoff and the incorrect disposal of garbage. The results emphasize the urgent need of instituting frequent groundwater monitoring, implementing suitable treatment technologies, and running awareness campaigns for households in order to limit exposure and avoid waterborne infections. In order to guarantee that rural populations, such as Bhadesar village, will continue to have access to clean drinking water, it is imperative that integrated water management methods be put into place.

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