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A Review of a Groundwater Quality Study based on the theoretical and literature evidence

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Abstract - The most important and significant source of potable water in the world is groundwater. In the state of Jharkhand, groundwater is utilised for a variety of reasons, including irrigation, mining, residential usage, and even drinking water. Because the groundwater in many areas of Jharkhand is contaminated with dangerous chemicals such as fluoride, arsenic, heavy metals, and iron, amongst others, certain populations in Jharkhand are forced to endure water shortages due to a lack of access to clean drinking water, while other populations only have limited access to this resource. This study looks at the present situation of groundwater in Jharkhand, as well as the pollution of several water quality metrics based on the chemistry of key ions. Water temperature, pH, electrical conductivity, total dissolved solid, total hardness, calcium, magnesium, iron, sodium, potassium, chloride, fluoride, arsenic, carbonate, bicarbonate, phosphate, nitrate, and sulphate are the water quality characteristics that are covered in this research.

Keywords: Groundwater, Contamination, Ion Chemistry, Jharkhand, and Water Quality Parameters are some of the topics that will be discussed.

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INTRODUCTION

Water is a substance that is both very valuable and widely available all over the earth. Without water, the continued existence of any living thing in our cosmos is mathematically impossible. The amount of water that exists on our globe in vast quantities, yet the quality of that water is a concern for us. Because of the widespread usage of polluted water, all plants and animals, including humans, are experiencing difficulties, and humans are also suffering from a variety of illnesses that are transmitted by water. In general, the groundwater in India was clean and drinkable for humans to utilise for a variety of reasons; but, owing to a variety of factors that are contributing to the problem today, the groundwater is being polluted. As a result, just a few treatments would be necessary to make the potability of the groundwater in a few areas of India 1. As a result, there is a need for new sources in order to satisfy the demand for potable water in our nation.

In addition, the most important source of potable water in the state of Jharkhand is groundwater. As a result of the limited availability of groundwater in several parts of the state, the residents of certain parts of the state have been dealing with major issues stemming from a lack of access to drinking water. In today's world, one of the most significant challenges facing industrial and mining growth in Jharkhand is the dearth of water that is suitable for human use. 2. The amount of rain that falls across time and space is not consistent, and the ability of the soil in the region to retain water is quite low. In this region, the use of ground water for drinking is the predominant use of ground water, with just a small amount of ground water being utilised for irrigation, industrialization, and other activities. The groundwater in some parts of the state of Jharkhand is contaminated with chemicals that make it unsafe for human consumption. These chemicals include fluoride, heavy metals, and arsenic, amongst others. 3, 4, 5, 6, 7, 8. The majority of the state is made up of hilly terrain, grazing land, undeveloped land, and forests. Jharkhand is home to a number of different businesses, including a steel factory, coal mines, thermal power plant, and others, and the water in the part of Jharkhand that is most densely populated by these enterprises is highly polluted. Because coal mining operations produce such large amounts of waste water, the quality of the groundwater in areas of Jharkhand that are dominated by coal mining is being severely degraded. 2, 9. People living in various mining areas are enduring a tremendous amount of hardship as a result of a lack of access to clean drinking water. This is due to the fact that the water in these areas is easily contaminated as a result of the numerous mining activities that take place, such as the clearing of forests, the degradation of land, the discharge of mine water, the disposal of waste materials, the washing of rejects, coal washing, and so on. It has been shown via comparison studies that the water quality in

metropolitan locations across the globe is much lower and more polluted than that in rural places. 10. The lack of sufficient understanding, education, and management of sanitary facilities on the part of the majority of people is the primary source of water pollution. 11. The quality of the groundwater may be affected by factors such as the non-scientific disposal of solid and liquid wastes, the depth of the wells, and the character of the geological elements with which the groundwater comes into touch. 12. In our nation, a large-scale public awareness campaign and water plan should be established to foster a feeling of knowledge about the harvesting of rain water and the conservation of water near residents' homes, among other things. 13. Obtaining an accurate picture of the standard of the ground water in the state of Jharkhand is the primary purpose of this research.

Places to Study

Jharkhand was chosen as the location for our research investigation's primary focus area. Jharkhand is one of the most recent states to be formed in India and can be found in the northeastern region of the country.

Because a significant amount of the territory that makes up the state of Jharkhand is still comprised of woodland or bushland, the word "Jharkhand" literally translates to "the country of bush or woods." It was established on November 15, 2000, with Bihar serving as its parent state. It is a state that is completely surrounded by other states; its borders are shared with the states of Bihar to the north, Uttar Pradesh to the northwest, Chhattisgarh to the west, Odisha to the south, and West Bengal to the east. It is a landlocked state. The state is divided into 32,620 villages, broken up into 260 blocks and 24 districts. The state of Jharkhand has an area of 79,714 square kilometres and may be found between the coordinates of 21 degrees 55 minutes north and 25 degrees 15 minutes north, as well as 83 degrees 15 minutes east and 87 degrees 55 minutes east.

In terms of land mass, it is the 15th biggest state, but in terms of people, it is the 14th largest. The majority of the state is made up of hilly terrain, pastureland, waste land, and forests. The state has an abundance of a wide range of natural resources, including iron ore, coal, copper ore, mica, bauxite, graphite, limestone, and uranium, amongst others. Despite the fact that farmers make up virtually all of Jharkhand's population, the state is home to almost more than 40 percent of India's mineral resources. There is an extremely high level of poverty in this area, with 39.1 percent of the population living below the poverty line. Agriculture is the primary means of subsistence for the state's populace. The majority of the state's population lives in rural areas, with village 16 being home to about 76% of its inhabitants. The cities of Ranchi, Dhanbad, Jamshedpur, Bokaro, Hazaribag, and Dumka, among others, are considered to be the most important in the state. According to the results of the Indian Census in 2011, the country has a total population of 32.96 million people, of whom there are 28 million tribal people and 12 million people who belong to reserved castes. The state has 947 females for every 1000 men, making the female-to-male ratio 14.

A significant chunk of the state may be found on the Chota Nagpur Plateau. The state is home to a plethora of plant and animal species, in addition to massive mountains, waterfalls, and rivers. These four waterfalls—Jonha Falls, Hundru Falls, Dassam Falls, and Panchghagh Falls—are among the most well-known in the state. In addition to this, Jharkhand is famous for its breathtaking forests. Jharkhand is home to five different national parks, including Singhbhum Elephant Reserve, Belta National Park, Dalma Wildlife Sanctuary, and Hazaribug Wildlife Sanctuary, as well as Udhwa Lake Birds Sanctuary and Dalma Wildlife Sanctuary. Parasnath hill, Rajmahal hill, Netarhat hill, Trikut hill, and Tagor hill, amongst others, are among the most well-known hills in the state. Damodar, Barakar, Ajoy, Mayurakshi, Darka, North Koel, South Koel, Sankh, Brahmani, and Subarnarekha rivers are only few of the numerous that flow through this state. Some sacred sites may also be found in the state of Jharkhand. These include the "Baba Dham" in Deoghar, the "Chinno Mossta" in Rajrappa, the "Jain temples of Shikharji" in Parasnath, and the "Bhadra Kali Mandir" in itkhari, amongst others. The northern part of the state has a climate that is humid subtropical, while the southern part of the state has a climate that is tropical with both rainy and dry seasons. Temperatures in Jharkhand often range from roughly 3 degrees Celsius to somewhere over 450 degrees Celsius. The average rainfall for the state is between 1,000 and 1,500 millimetres (40 and 60 inches) each year, of which 85 percent is obtained between the months of June through September 17 as a result of the south-western monsoon. In 2013, the Central Ground Water Board reported that Jharkhand 18 had a net groundwater availability of 5.99 billion cubic metres (BCM), an annual replenishable groundwater resource of 6.56 billion cubic metres (BCM), an annual groundwater draught of 0.50 billion cubic metres (BCM) for domestic and industrial use, and a gross annual groundwater draught of 1.35 billion cubic metres (BCM).

THE RESULTS AND RESEARCH OPINIONS:

A Review of the Scientific Literature Concerning the Quality of Groundwater in Jharkhand

In the course of our research, a number of well-known national and worldwide research journals have been given for the purpose of conducting a review of the quality of the groundwater in Jharkhand. Poonam Tirkey et al. (2017) 19 have reported on the quality of the groundwater in Ranchi city, which is located in the state of Jharkhand. Asbestos, manganese, nickel, selenium, copper, lead, cadmium, chromium, and lead were the 10 heavy metals that were analysed, and of those, Asbestos, manganese, nickel, and selenium all had

levels that were too high according to BIS and WHO criteria for drinking water. Rakesh Ranjan et al. (2017) 9 have provided an update on the level of chemical contamination in the groundwater of Dhanbad, which is located in the state of Jharkhand. They chose ten different sample stations and a variety of characteristics, including pH, total dissolved solids, turbidity, alkalinity, hardness, chlorides, sulphates, phosphates, and iron. They also claimed that the mining regions of Dhanbad have seen alterations in the quality of the ground water as a result of the contamination caused by coal-based effluents. Shiv Kumar Gupta and Kumar Nikhil (2016) 2 have conducted research on the contamination of groundwater in areas of Jharkhand that are known for their coal mining. The water quality index approach was used by Prabhunath Singh et. al. (2015) 20 in order to evaluate the quality of the groundwater in the Ranchi townshiparea in Jharkhand. According to the water quality index value, the research found that 18% of the water samples fell into the "Very Good" water category, 67% of the water samples went into the "Good" category, and 15% of the water samples fell into the "Poor" category. In the Ranchi township region of Jharkhand, Prabhunath Singh et al. (2014) 21 conducted an investigation of the groundwater to determine whether or not it is suitable for drinking, residential, or irrigation use. They obtained 27 groundwater samples from wells and tube wells and tested them for pH, total dissolved solids (TDS), electrical conductivity (EC), Ca2+, Mg2+, Na+, K+, HCO3–,F–, Cl–, NO3–, and SO42-. They made the discovery that the groundwater in the Ranchi township region had a slightly alkaline composition and was appropriate for consumption as well as irrigation uses. It has been stated by Mousumi Banerjee and Ambarish Mukherjee (2013) 22 that the condition of the water quality in the vicinity of Deogharh Town in Jharkhand has been reported. They made the discovery that the groundwater in the region did not contain any heavy metals like cadmium, lead, chromium, or arsenic, as well as faecal bacteria and other such contaminants. A hydro geochemical investigation of the groundwater in the Jharkhand districts of Dumka and Jamtara has been reported by Abhay Kumar Singh et.al (2012) 17 as having been conducted. During the course of their research, they collected and analysed a total of thirty groundwater samples. The parameters that were examined included pH, electrical conductivity, total dissolved solids (TDS), total hardness, F–, Cl–, NO3–, HCO3–, SO42–, as well as Ca2+, Mg2+, Na+, and K+. In the Palamu area of Jharkhand, A. C. Pandey et.al (2012) 5 also recorded a significant fluoride content. They made the discovery that a very deep aquifer is a safer option than a shallow aquifer, and that artificial recharge has the potential to lower the fluoride content. The study effort that was described by Kirti Avishek et. al. (2010) 4 included an evaluation of the water quality in the Majhiaon block of the Garwa district in the state of Jharkhand, with a particular focus on fluoride levels. According to the information that was provided, the Majhiaon block located inside the Garwa district of Jharkhand is suffering from severe fluoride contamination. In the Sahibganj area of Jharkhand, Bishwajit Nayak et.al (2008) conducted research on the poisoning of groundwater with arsenic and the severe impact it has on human health. They also analysed 367 biological samples (nails, hair, and urine) from impacted villages and found that an average of 88 percent of samples had arsenic at a level that was higher than what was considered acceptable.

A significant chunk of the state of Jharkhand is located on the Chota Nagpur Plateau, which is composed of the Chotanagpur Granite Gneissic Complex (CGGC). Granite, gneiss, schist, and phyllite, together with other rocks that belong to CGGC, occupied about 85 percent of the state's total geographical area. In this particular geological formation, the phreatic aquifer is made up of worn mantle and the secondary porosities that lie underneath it, such as cracks, joints, and fissures. However, in certain isolated spots, the thickness of the weathered zone is more than 35 metres. In general, the thickness of the weathered zone ranges between 10 and 25 metres. The weathered zone acts as the primary storage area for ground water, and the fissures that lie just under the weathered zone make up the possible phreatic aquifer. The hydrogeological map presented in Figure 223 depicts the potential for groundwater resources in the state of Jharkhand.

The generally observed level of groundwater is divided into four groups, which are 0–2 metres, 2–5 metres, 5–10 metres, and more than 10 metres. During the 2015-2016 academic year, the Central Ground Water Board reported that the groundwater level (depth) in Jharkhand ranged from 0.1 to 21.18 mgbl. At Ranchi the groundwater level has been recorded as having a minimum depth of 0.1 mgbl, while at Gumla it has reached a maximum depth of 21.18 mgbl.

During the summer season (May 2015), approximately 67.3 percent of the total water level throughout the state varied in the range of 5 – 10 mbgl, 18.5 percent of the total water level varied in the range of 2 – 5 mbgl, 1.8 percent of the total water level were 2, and 12 percent of the water level were >10 mbgl (Fig 3)23.

During the monsoon season (August 2015), 58 percent of the total water level across the state fluctuated between the ranges of 5 and 10 mbgl, 18.0 percent of the total water level fluctuated between the ranges of 2 and 5 mbgl, 22.7 percent of the total water level were 2 mbgl, and 1.3 percent of the water level were >10 mbgl. In conclusion, it was shown that the groundwater level (depth) over the bulk of the state fluctuated within the range of 2–5 mbgl during the course of the whole year (Fig. 4)23.

AN EVALUATION OF THE GROUNDWATER'S QUALITY BASED ON VARIOUS PARAMETERS

The use of chemistry is the primary method used to evaluate water quality. Before putting water to any

kind of use in today's world, it is very necessary to do tests to determine its level of purity and safety. The quality of water is governed by a variety of physicochemical factors, and the selection of criteria for assessing water quality is largely dependent on the ultimate goal for which the water will be used. The following indicators of water quality are taken into account in this review research that we conducted.

Temperature

Temperature is one of the most important environmental factors and parameters, since it affects practically every chemical, physical, and biological feature of water. Temperature is one of the most important environmental factors and parameters. As a consequence, the measurement of temperature is fundamentally extremely essential for the analysis of water from various sources. Generally The temperature of groundwater is determined by a number of factors, including the depth of the water column, the climate, the surroundings, and variations in topography, among other things. 28. According to the findings of Kumar Pruthvi et al (2017) 8, the temperature of the groundwater in the Ranchi area varied from 23.1 to 26.9 degrees Celsius.

PH Value

The pH scale is often used to rank the quality of water. The acidity or alkalinity of the water, solvent, or solution may be determined based on its pH value. The pH scale runs from 0 to 14, with 7 representing neutrality, anything with a pH lower than 7, and anything with a pH higher than 7 representing a basic environment. According to the findings of Poonam Tirkey et.al (2016) 7, the pH of the ground water in Ranchi city varied anywhere from 6.0 to 7.5. It was discovered that the pH of the groundwater in the Dhanbad area ranged anywhere from 6.095 to 8.345. 2. The pH of the groundwater in the districts of Dumka and Jamtara varied anywhere from 7.24 to 8.25, with an average of 8.25. The research conducted by Prabhunath Singh et al. (2014) 21 found that the pH of the groundwater in Ranchi city ranged anywhere from 7.0 to 8.0.

Conductivity

It is a measurement of the amount of electric current that is carried by water, solvent, or solution. The number of ions, salts, and contaminants that are present in water may be determined by measuring the electrical conductivity of the water. Groundwater in Ranchi city has an electrical conductivity that ranged from 10 S/cm to 1520 S/cm 19. The total conductivity of groundwater in Dhanbad district 2 varied from 2.2 microS/cm all the way up to 3010 microS/cm in 2016, according to a study. The electrical conductivity of the groundwater in the Dumka and Jamtara area ranged from 79 S/cm to 1667 S/cm 17, with an average value of 550 S/cm. According to the findings of Prabhunath Singh et al. (2014) 21, the electrical conductivity of the groundwater in Ranchi city ranged from 238 to 1357 S/cm.

Alkalinity

It is a chemical measurement that determines how well water is able to neutralise acid. The water will have a sour flavour because it has high levels of total alkalinity. The presence of OH–, CO3–, and HCO3– ions in water contributes significantly to the water's total alkalinity, which is measured to be 30. There are a number of other salts of weak acids that contribute to the total alkalinity of water. These include ammonium, phosphate, silicates, borates, and organic bases. The total alkalinity of the groundwater at Ranch City varied anywhere from 28 mg/l to 340 mg/l 19, according to the study.

Total Hardness

The water's hardness is another crucial factor that must be considered when comparing the quality of water obtained from various sources. Carbonates, bicarbonates, chlorides, and sulphates of calcium and magnesium are the primary components responsible for the presence of hardness in freshwater sources. In theory, the total hardness of water is defined as the sum of the calcium hardness and the magnesium hardness, expressed in mg/lit as CaCO3. A high concentration of hardness may be the result of leaching from the soils or the high background concentration of the waters. Both of these factors may contribute to a high concentration. The presence of a high concentration of hardness has been linked to the development of heart disease as well as renal stones. Research conducted by Poonam Tirkey and colleagues (2017) 19 found that the hardness of groundwater in Ranch City ranged anywhere from 32 to 508 mg/l. The total hardness of the groundwater in the districts of Dumka and Jamtara varied anywhere from 19 to 531 mg/l 17, respectively. According to the findings of Prabhunath Singh et al. (2014) 21, the total hardness of the groundwater in Ranchi city varied from 120 mg/l all the way up to 598 mg/l.

Calcium and Magnesium

Both calcium and magnesium are very significant components to consider when analysing water. The content of calcium and magnesium in the water also has a role in the hardness of the water. The range of calcium and magnesium concentrations in the groundwater of the Dumka and Jamtara districts was found to be between 3.4 and 102.5 mg/l and 2.6 to 66.9 mg/l respectively17. According to the findings of Prabhunath Singh et al. (2014) 20, the levels of calcium and magnesium in the water in Ranchi city ranged from 21.8 mg/l to 164 mg/l and 9.8 mg/l to 46 mg/l, respectively.

Iron

Iron is another kind of metal that may be discovered in groundwater. Iron in water is not considered to be

particularly harmful; nonetheless, if the content is allowed to exceed the acceptable level, it may have a negative impact on the human body. Groundwater in Dhanbad district 2 has an iron content that varies from 0.039 mg/l to 1.40 mg/l.

Amount of Solids Dissolved in Total (TDS)

The amount of salts, ions, minerals, and other substances that have completely dissolved in water is referred to as the "total dissolved solids." TDS is used as a measurement tool for determining how pure drinking water is. There is a possibility that the variances in TDS levels are due to geological formations, hydrological processes, and the prevalent mining conditions in the area 19. The range of readings for the total dissolved solids (TDS) in the groundwater at Ranch city 19 was from 51 to 772 mg/l. The total dissolved solids content of the groundwater in Dhanbad district 2 ranged from 58.2 mg/l all the way up to 1489 mg/l. In the districts of Dumka and Jamtara, the average values of total dissolved solid (TDS) in the groundwater were 348 mg/l, and it varied from 19 to 531 mg/l 17. According to the findings of Prabhunath Singh et al. (2014) 20, the concentration of total dissolved solids (TDS) in the groundwater under the city of Ranchi varied from 200 to 1157 mg/l.

Carbonate

There is a connection, either direct or indirect, between carbonate and the pH and alkalinity of water. When the pH level of water hits 8.3, it is an indication that there are carbonates present. When the pH of the water is lower than 8.3, carbonates in the water are transformed into bicarbonates. In each of Jharkhand's regions, there is not the slightest trace of carbonate ion concentration.

Bicarbonate

One of the anions that is found in the greatest abundance in fresh water is bicarbonate. There was a wide range of bicarbonate concentrations in the groundwater of the Dumka and Jamtara areas, ranging from 37 to 258 mg/l 17. The content of bicarbonate was found to range anywhere from 90 mg/l to 488 mg/l according to the findings of Prabhunath Singh et al. (2014) 20.

Nitrate

Nitrate is a naturally occurring inorganic ion that may be found in our environment. It is a significant characteristic that can be found in water. Nitrate levels in groundwater are a primary indication of anthropogenic pollution. In particular, the presence of nitrate in groundwater shows the usage of inputs such as detergent, soap, toothpaste, shampoo, and fertiliser in both home and agricultural settings. The level of nitrate in the city of Ranchi's groundwater is lower than what the BIS considers to be an acceptable limit, which is 45 mg/l 19. The percentage of nitrate in the groundwater in the districts of Dumka and Jamtara varied anywhere from 0.1 to 191.9 mg/l 17. According to the findings of Prabhunath Singh et al. (2014) 20, the concentration of nitrate in the groundwater samples analysed in the city of Ranchi ranged anywhere from 2.5 to 53.7 mg/l.

Chloride

One of the most prevalent inorganic anion found in natural water derived from a variety of sources is chloride. The dissolving of salts results in a generally low presence of chloride in typical fresh water; in contrast, chlorine is the predominate ion found in sea water. This is because chlorine is more able to dissolve salts. The levels of chloride that were found in the ground water in rural, urban, and peri-urban regions of Ranch city during the monsoon season ranged from 2 mg/l to 200 mg/l, according to research conducted by Poonam Tirkey et al. (2017). The districts of Dumka and Jamtara had chloride concentrations in their groundwater that varied from 1.2 to 302 mg/l 17, respectively. According to the findings of Prabhunath Singh et.al (2014) 20, the concentration of chloride in the groundwater under the Ranchi township area ranged from 30 to 176.3 mg/l.

Sulphate

Sulfate is an essential component of the water's makeup. Nonetheless, the maximum permissible level of sulphate in the water of the research region is not exceeded by the current concentration. As a result of the fact that numerous sulphate compounds, including sulphate ores, gypsum, shale, industrial waste, and so on, are easily soluble in water, sulphate ions are often present in waterways that exist in their natural state. The production of sulphur dioxide in the atmosphere comes from the metallurgical industry (via the roasting processes of the metallurgical industry), and the combustion of fossil fuels by vehicles, engines, and industries may also contribute, either directly or indirectly, to the formation of sulphate compounds in water. The amount of sulphate that was present in the groundwater underneath the city of Ranchi ranged anywhere from 0 to 268 mg/l 19. The groundwater in the districts of Dumka and Jamtara had a sulphate content value that varied from 0.7 to 134 mg/l 17, on average. According to the findings of Prabhunath Singh et al. (2014) 21, the concentration of sulphate in the groundwater under the city of Ranchi ranged from 10 to 126 mg/l.

Phosphate

The growing use of detergents, fertiliser, and residential sewage all contribute significantly to the excessive loading of phosphorus that is found in the water 30, 31. According to the findings of Poonam Tirkey et al. (2017), the concentration of phosphate 19 in the groundwater under Ranchi city ranged from 0.004 to 0.16 mg/l. In the region under investigation, there was less of a difference in the concentration of phosphate between different zones and different sources (wells and bore wells).

Sodium

The amount of sodium that is present in water is a significant consideration for both ingesting it and using it for irrigation. In the systems of plants, animals, and even the human body, sodium plays a crucial function. The sodium concentration in sea water is often found to be quite high, while the sodium content in regular fresh water is typically observed to be low. In Ranchi City, the sodium content of the groundwater ranged from 18.2 mg/l to 303 mg/l 19. The districts of Dumka and Jamtara in Jharkhand have salt concentrations ranging from 6.6 to 70.8 mg/l 17, respectively. According to the findings of Prabhunath Singh et al. (2014) 21, the sodium content of groundwater in Ranchi city ranged anywhere from 14.2 to 75.2 mg/l.

Potassium

It is also a key factor in the quality of drinking water and the water used for agriculture. The amount of potassium present in water and soil is also an important factor that influences plant growth and crop yields. The range of potassium concentrations in the city of Ranchi's groundwater was from 0.2 mg/l up to 22.4 mg/l 19. The value of potassium content in groundwater in the districts of Dumka and Jamtara varied from 0.8 to 18 mg/l 17, respectively. According to the findings of Prabhunath Singh et al. (2014) 21, the potassium content in the groundwater under the city of Ranchi varied from 1.6 to 19.3 mg/l.

Fluoride

As fluoride, fluorine may be found in both natural water and water that has been polluted. Typically, the concentration of fluoride in natural water is dependent on the geological formation of the area, with the exception of pollution caused by businesses or other sources. The primary sources of fluoride that may be discovered in groundwater are likely to be naturally occurring through the decomposition of rocks, soil minerals, or weathering (also known as geogenic), as well as waste due to human activities (also known as anthropogenic) 19. Fluoride may be an essential element for both animals and humans, but an excessive consumption of fluorine (greater than 2 mg/l) can lead to a dental disease known as fluorosis (dental cavities in children), and a regular consumption of fluorine in excess can lead to bone fluorosis and other skeletal fluorosis. According to the findings of Poonam Tirkey et al. (2017) 19, the content of fluoride in Ranchi city ranged from 0 to 2.19 mg/l. In the districts of Dumka and Jamtara, the fluoride content of the groundwater varied from 0.17 to 1.07 mg/l 17. There was a significant fluoride content in the Majhiaon block in the Garwa district of Jharkhand, according to a study by Kirti Avishek et al. (2009) 4. Fluoride was found in significant concentrations in the groundwater of the Palamu area in Jharkhand, as was noted by A.C. Pandey et al. (2012) 5. According to the findings of Prabhunath Singh et al. (2014) 20, the concentration of fluoride in the groundwater under Ranchi city ranged from 0.1 to 1.4 mg/l.

CONCLUSION

Both the quality and quantity of groundwater are deteriorating over time in every region of the planet, and the ramifications of this are having a terrible impact not just on human beings but also on every other living thing in the world. A review of the ground water resources of Jharkhand has been carried out as part of the current research that we have been doing in order to establish the groundwater quality system based on the chemistry of the principal ions. This will assist in the planning of Jharkhand's present water resources and offer an overall notion for the pollution of ground water in the state of Jharkhand. Fluoride, nitrate, iron, selenium, manganese, nickel, and zinc pollution have been found in certain areas; arsenic contamination has been found in the Sahebganj district. However, other main chemical elements are often found to be below the acceptable level. It may be concluded from this that the quality of the ground water across the whole state is appropriate for drinking, irrigation, and industrial use with the exception of places that are contaminated with chemicals such as arsenic, fluoride, and others. Because of the current review research, the people of Jharkhand will have a far better understanding of the characteristics of their groundwater. Jharkhand requires a proper awareness campaign as well as a water management plant for groundwater quality. These may assist both individuals and communities in the state in using clean drinking water and reducing the amount of water pollution that occurs.

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