A Study on Groundwater Quality Based on Major Ion Chemistry of Jharkhand State in India: (A-Review)

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ABSTRACT

Groundwater is the prime and major source of drinking water in our world. Groundwater in Jharkhand is also used for drinking, domestic, irrigation, mining and industrial etc. purposes. In Jharkhand some population are suffering from scarcity of pure drinking water and some population have partial facility with drinking water as groundwater of many areas of Jharkhand are contaminated with fluoride, arsenic, heavy metals and iron etc. dangerous chemicals. This review paper focuses on current status of groundwater and contamination of different water quality parameters based on major ion chemistry in Jharkhand. The discussed water quality parameters in this study are water temperature, pH, electrical conductivity, total dissolved solid, total hardness, calcium, magnesium, iron, sodium, potassium, chloride, fluoride, arsenic, carbonate, bicarbonate, phosphate, nitrate and sulphate.

Keywords: Jharkhand, Groundwater, Contamination, Ion chemistry, Water quality parameters.

INTRODUCTION

Water is one of the most precious and abundant compounds in our world. All living bodyies in our universe are impossible without water for their survival. The quantity of water in our planet is huge but we are facing problems for quality of water. All plants and animals are being troubled and human beings suffer from various water borne diseases due to use of contaminated water. Generally in India groundwater was safe and potable for drinking and other purposes of human beings but nowadays due to various causes groundwater is getting contaminated. Hence, few treatments would be required to make groundwater potable in a few areas of India[1]. Therefore, it is also required to have additional sources to fulfill the requirement of fresh water in our country.

Groundwater is also the prime source of drinking water in Jharkhand. The availability of groundwater in many parts of the state is very low and so people in that area have been facing serious problems from scarcity of drinking water. Nowadays the scarcity of good quality portable water is a serious problem in industrial and mining development area of Jharkhand[2]. Rainfall is uneven with time and space and water retention capacity of the soil in the area is very poor. Here, utilisation of groundwater is mainly for drinking purpose and a low percentage of groundwater are used for irrigation, industrialisation and other purposes. In some areas of Jharkhand state, groundwater is

not suitable for human consumption for chemical contamination such as fluoride, heavy metals and arsenic etc.[3,4,5,6,7,8]. Mainly the state is covered by forest, pastures-land, waste land and hill area. Various industries such as steel plant, coal mines, thermal power plant etc. are situated in Jharkhand and in the industry area of Jharkhand; the water is heavily contaminated. The groundwater quality of coal mining area of Jharkhand is seriously affected because coal mining operation generate huge amount of waste water[2,9]. People in different mining areas are tremendously suffering from lack of pure drinking water because in that area water are easily polluted due to various mining activities such as deforestation, land degradation, discharge of mine water, disposal of waste materials, washing of rejects, coal washing etc. Some comparative studies reveal that the water quality in urban areas in the world is more contaminated as compared with rural area[10]. Improper awareness, improper education and improper sanitation management for major people are the main causes of water pollution[11]. The unscientific disposal of solid and liquid wastes, the depth of the wells and nature of the geological materials with which the groundwater comes in contact may influence the quality of the groundwater[12]. In our country a huge public awareness program and water plan should be initiated to create a sense of awareness to harvest rainwater and save water around their habitants etc.[13]. The objective of this study is to draw a clean idea about the quality of ground water in Jharkhand.

Study Area

The selected study area for our review study is Jharkhand (Fig. 1). Jharkhand is one of the newest states of India and located in the eastern part of India.

Fig. 1. District of Jharkhand State and Jharkhand State in India

Here the name of the state "Jharkhand" means "the land of bush or forests" because major portion of the Jharkhand state is still covered by bush or forest. It was created on 15 November 2000 from its parent state Bihar. It is landlocked state and it shares its border with Bihar state to the north, Uttar Pradesh state to the northwest, Chhattisgarh state to the west, Odisha state to the south and West Bengal state to the east. The state has 24 districts, 260 blocks, and 32, 620 villages. Jharkhand state has an area of 79, 714 square kilometres and it lies between latitude 21°55′00″N and 25°15′00″N and longitude 83°15′00″E and 87°55′E[14].

It is the 15th largest state by area but by population 14th largest. Maximum portion of the state is covered by forest, pastures-land, waste land and hill area. The state is rich with a vast variety of minerals like iron ore, coal, copper ore, mica, bauxite, graphite, limestone, and uranium. Almost more than 40% of the mineral resources of India are in the state even though almost 80% of people in Jharkhand are farmer[15]. Here people are very poor and 39.1% of its population is below the poverty line[16]. Main occupation of the people in the state is agriculture. The state is mainly rural and almost 76% of its population live in village[16]. Major cities in the state are Ranchi, Dhanbad, Jamshedpur, Bokaro, Hazaribag, Dumka etc. According to the Indian Census 2011, it has 32.96 million population out of which 28% is tribal while 12% of the people belong to scheduled castes. Sex ratio in the state is 947 females to 1000 males[14].

Major portion of the state lies on the Chota Nagpur Plateau. The state has a wide variety of flora and fauna and huge hills, falls and rivers. The famous waterfalls in the state are Jonha Falls, Hundru Falls, Dassam Falls and Panchghagh Falls. Jharkhand is also known for his beautiful forest. There are five national parks in Jharkhand such as Belta national Park, Dalma wildlife sanctuary, Hazaribug wildlife sanctuary, Udhwa lake birds sanctuary, Singhbhum elephant reserve. The famous hills in the state are Parasnath hill, Rajmahal hill, Netarhat hill, Trikut hill and Tagor hill etc. Here many rivers pass through the state such as Damodar, Barakar, Ajoy, Mayurakshi, Darka, North Koel, South Koel, Sankh, Brahmani and Subarnarekha rivers etc. Some holy place also situated in Jharkhand such as Deoghar for "Baba Dham", Rajrappa for "Chinno Mossta", Parasnath

for "Jain temples of Shikharji" and itkhari for "Bhadra Kali Mandir" etc. The Climate of the state varies from humid subtropical in the north to tropical wet and dry in the southeast. The temperatures in Jharkhand usually vary from about 3°C to around 45°C. The annual rainfall of the state is about 1,000–1,500mm (40–60inches), out of which 85% is received through south-western monsoon during the months June–September[17]. According to Central Ground Water Board, net groundwater availability was 5.99 BCM, annual replenishable groundwater resource was 6.56 BCM, annual groundwater draft for domestic and industrial use was 0.50 BCM and gross annual groundwater draft was 1.35 BCM in 2013 in Jharkhand[18].

RESULT AND DISCUSSION

### Literature Review of Groundwater Quality in Jharkhand

In our study various famous international and national research journals have been presented for review of groundwater quality in Jharkhand. Poonam Tirkey *et al.,* (2017)[19] has reported the groundwater quality of Ranchi city in Jharkhand. They analysed 10 heavy metals namely As, Mn, Ni, Se, Fe, Cu, Cd, Co, Cr and Pb in which As, Mn, Ni and Se were above the acceptable limits as per BIS and WHO standards for drinking purpose. Rakesh Ranjan *et al.,* (2017)[9] has reported the status of chemical pollution in groundwater in Dhanbad of Jharkhand. They selected 10 sampling stations and the parameters such as pH, total dissolved solids, turbidity, alkalinity, hardness, chlorides, sulphates, phosphates and iron. They also reported the changes in quality of ground water at the mining areas of Dhanbad due to pollution from coal based effluents. Shiv Kumar Gupta and Kumar Nikhil (2016)[2] have investigated the contamination of groundwater in the coal mining area of Jharkhand. Prabhunath Singh *et al.,* (2015)[20] used water quality index method for assessment of groundwater quality of Ranchi township area in Jharkhand. In the study, according to water quality index value, 18% of water samples fell in the 'Very Good' water category, 67% water samples fell in 'Good' category and 15% of water samples fell in the 'Poor' category. Prabhunath Singh *et al.,* (2014)[21] has also investigated the groundwater for the suitability of drinking, domestic and irrigation purposes in Ranchi township area of Jharkhand. They collected 27 groundwater samples from

wells and tube wells and analyzed for pH, electrical conductivity (EC), total dissolved solids (TDS) , Ca^{2+}, Mg^{2+}, Na^+, K^+, HCO_3^-, F^-, Cl^-, NO_3^- and SO_4^{2-}. They observed that the groundwater of Ranchi township area was slightly alkaline in nature and suitable for drinking and irrigation. Mousumi Banerjee and Ambarish Mukherjee (2013)[22] have reported the status of water quality in the proximity of Deogharh Town in Jharkhand. They observed that the groundwater in the area was free from heavy metals like cadmium, lead, chromium and arsenic and fecal bacteria etc. Abhay Kumar Singh *et al.,* (2012)[17] has reported a hydro geochemical study of groundwater in Dumka and Jamtara districts of Jharkhand. In their study thirty groundwater samples were collected and analysed parameters were pH, electrical conductivity, total dissolved solids (TDS), total hardness, F^-, Cl^-, NO_3^-, HCO_3^-, SO_4^{2-} and Ca^{2+}, Mg^{2+}, Na^+, K^+. A. C Pandey *et al.,*(2012)[5] also reported high fluoride concentration in Palamu district of Jharkhand. They observed that a very deep aquifer is safer than shallow aquifers and also the artificial recharge may reduce fluoride concentration. Kirti Avishek *et al.,* (2010)[4] has reported a research work involving an assessment of water quality with special reference to fluoride in Majhiaon block of Garwa district in Jharkhand. They reported

that the Majhiaon block in Garwa district of Jharkhand is seriously affected by fluoride. Bishwajit Nayak *et al.,* (2008)[3] investigated on groundwater arsenic contamination and adverse health effects in the Sahibganj district of Jharkhand. They also analysed 367 biological samples (nail, hair, and urine) from affected villages and revealed that an average 88% of samples were contained by arsenic above the permissible level.

Potential of Groundwater in Jharkhand

Major portion of the Jharkhand state lies on the Chota Nagpur Plateau and the plateau consisted of Chotanagpur Granite Gneissic Complex (CGGC). Granite-gneiss, schist, phyllite and other rocks belonging to CGGC which covered almost 85% of the geographical area of the state. The phreatic aquifer in this formation consists of weathered mantle and underlying secondary porosities like fractures, joints and fissures. In general, the thickness of weathered zone varies between 10 and 25 m, however in localized patches it is > 35 m. The weathered zone is the main repository of ground water and the fractures underlying the weathered zones form the potential phreatic aquifer. The potential of groundwater in Jharkhand state is shown in hydrogeological map (Fig. 2)[23].
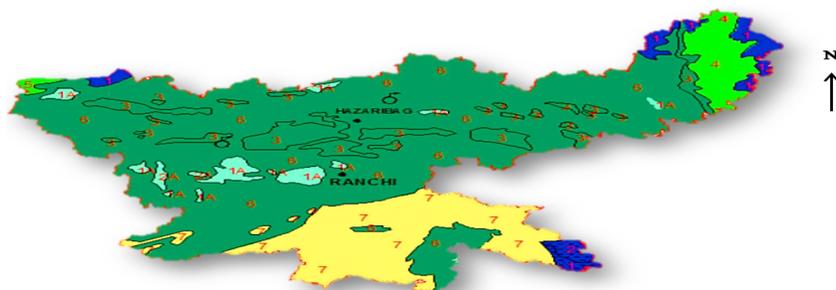
Colour	Area	Formation	Lithology	Groundwater Potential
	1	Alluvium	Clay, Slit, Gravel, Pebbles and Calc	>40 m^3/h
	1A	Alluvium	Clay, Silt and Sand	1-10 m^3/h
	2	Laterites	Laterites and Lithomarge	1-10 m^3/h
	2A	Tertiary	Sand, Silt, Clay, Pable and Gravel	10-40 m^3/h
	3	Gondwana	Clay, Silt, Grit, Sandstone and Shale	1->25 m^3/h
	4	Rajmahal Basalt	Basalt Flows with Intertrappeans	1-25 m^3/h
	5	Vindhyan	Quartzite, Limestone, Sandstone, Dolomite and Shale	1-25 m^3/h
	6	Chotnagpur Gneissc Complex	Gneisses and Granites	1->25 m^3/h
	7	Volcano Sedimentary	Schists, Phyllites, Basic and Acidic Intrusives	1-15 m^3/h

Fig. 2. Potential of Groundwater i.e., Hydrogeological Map of Jharkhand

Groundwater Level in Jharkhand

Generally observed groundwater level is categorised into four classes viz., 0-2 m, 2-5 m, 5-10 m and >10 m. According to CGWB, the groundwater level (depth) in Jharkhand varied between 0.1 to 21.18 mgbl during 2015-2016. The minimum and maximum depth of groundwater level has been recorded as 0.1 mgbl at Ranchi and 21.18 mgbl at Gumla.

In Summer (May 2015), about 67.3% of the total water level throughout the state varied in the range of 5-10 mbgl, 18.5% of the total water level varied in the range of 2-5 mbgl, 1.8% of the total water level were <2 and 12% of the water level were >10 mbgl (Fig. 3)[23]. In Monsoon (August 2015), 58% of the total water level throughout the state varied in the range of 5-10 mbgl, 18.0% of the total water level varied in the range of 2-5 mbgl, 22.7% of the total water level were <2 mbgl and 1.3% of the water level were >10 mbgl. Finally it was shown that the groundwater level (depth) of majority areas of the state varied in the range of 2-5 mbgl during the whole year (Fig. 4)[23].
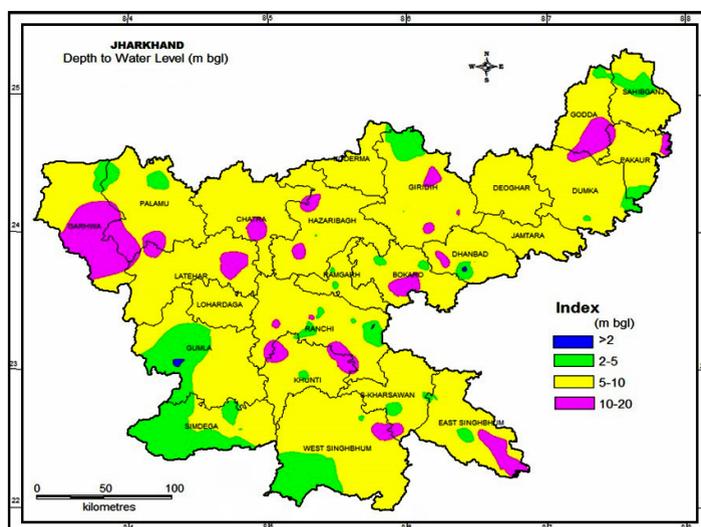

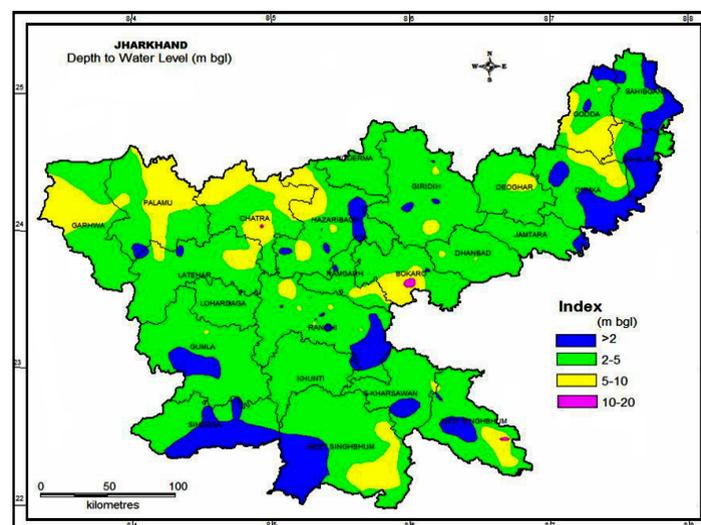**Fig. 3. Groundwater Level (depth) in the Summer in Jharkhand**

Fig. 4. Groundwater Level (depth) in the Monsoon in Jharkhand

Groundwater Quality of Jharkhand

Physico-chemical parameter study is very important to get an exact idea about the quality of water and we can compare the results of different physico-chemical parameter values with standard values of BIS[25] and WHO[26] for drinking purpose. The values of different water quality parameters of groundwater in Jharkhand[3,4,5,6,7,8,17,19,23,24] and standard values[25,26] of the water quality parameters for drinking are given in Table 1. Main chemicals contamination in groundwater in Jharkhand are summarised in Table 2.

Assessment of Groundwater Quality Parameters

Water quality analysis is mainly depended on chemistry. Nowadays, it is very important and

essential to examine the water quality before it is used for any purposes. Water quality is determined by different physico-chemical parameters and the selection of parameters for

testing of water quality is mainly depended upon for what purpose we going to use that water. For our review study the following water quality parameters are considered.

Table 1: Ground Water Quality of Jharkhand

Parameters	Unit	BISStandard (IS: 10500, 2012)		WHO Standard (2017)		Measured Values	
		Acceptable Limit	Permissible Limit	Acceptable Limit	Permissible Limit	Minimum Value	Maximu m Value
Temperature	^{0}C	-	-				
pH	-	6.5 - 8.5	-	7.0 - 8.5	-	6.7	8.68
Electrical conductivity	μs/cm	300	-	300	-	59.5	3321
TDS	mg/L	500	-	500	-	38.675	2158.65
Turbidity	NTU	10	25	10	25		
Total Hardness	mg/L	300	600	500	-	20	890
Calcium	mg/L	75	200	-	-	2	668
Magnesium	mg/L	30	-	-	-	4	120
Alkalinity	mg/L	200	600	100	-		
Chloride	mg/l	250	1000	200	600	11	811
Sulphate	mg/L	200	400	200	400	0	199
Fluoride	mg/L	1.5	1.9	1.0-1.5	-	0.15	8.68
Sodium	mg/L					2	448
Potassium	mg/L					0.52	12
Nitrate	mg/L					0	316
Silica	mg/L					2	67
Phosphate	mg/L	-		-	-	Nil	
Carbonate	mg/L					Nil	
Bicarbonate	mg/L					12	479.7
Copper	mg/L	0.05	-	1	-		
Iron	mg/L	0.3	1				
Arsenic	mg/L	0.01	0.05	0.05	-	0	0.015

Table 2: Main Chemicals Contamination of Groundwater in Jharkhand

Chemical Contamination	Name of District	References
Fluoride	Palamu, Garhwa, Dhanbad, Pakur, Koderma, Giridih, Bokaro, Gumla, Godda, Ranchi	Neeta Kumar *et al.,*(2014)[6], Kirti Avishek *et al.,*(2009)[4], A.C Pandey *et al.,* (2012)[5], Pruthvi Patolia *et al.,* (2017)[8]
Arsenic	Sahibganj and Ranchi	Bishwajit Nayak *et al.,*(2008)[3], Poonam Tirkey *et al.,*(2016)[7]
Nitrate	Dhanbad, Palamu and Godda	Neeta Kumar *et al.,*(2014)[6], Raju Thapa *et al.,*(2019)[24]
Iron	Deoghar, Dhanbad and Bokaro	Mousumi Banerjee *et al.,*(2017)[22], Sanjeev Kumar Sinha *et al.,*(2017)[27]
Heavy metals such as Selenium, Manganese and Nickel etc.	Ranchi	Poonam Tirkey *et al.,*(2016)[7], Poonam Tirkey *et al.,*(2017)[19]
Manganese and Zinc	Bokaro	Neeta Kumari *et al.,*(2014)[6]
Magnesium hazard and high salinity	Dumka and Jamtara	Avoy Kumar Singh *et al.,*(2012)[17]

Temperature

Temperature is one of the most important environment factors and parameters that influence almost all the chemical, physical and biological characteristics of water. Therefore temperature measurement is basically very necessary for water

analysis of different sources. Generally the Water temperature of groundwater depends on the depth of the water column, climatic, environment and topographic changes etc.[28] Kumar Pruthvi *et al.,* (2017)[8] reported the temperature of groundwater in Ranchi district ranged from 23.1 to 26.9^{0}C.

pH

pH is a prime parameter of water analysis. pH value indicates the acidity or alkalinity property of the water/solvent/solution. Simply pH is a scale of 0 to 14 where water, pH of 7 is neutral, pH less than 7 is acidic and pH greater than 7 is basic. Poonam Tirkey *et al.,* (2016)[7] has reported the pH of ground water in Ranchi city ranged from 6.0 to 7.5. The pH of the groundwater in Dhanbad district was found to be ranging from 6.095 to 8.345 2. The value of pH of groundwater in Dumka and Jamtara districts ranged from 7.24 to 8.25 17. According to Prabhunath Singh *et al.,* (2014)[21], the pH of the groundwater in Ranchi city varied from 7.0 to 8.0.

Electrical Conductivity

It is a measure of electric current that water/solvent/solution carries. Electrical conductivity of water indicates the amount of ions, salts and contaminant present within the water[29]. Electrical conductivity of groundwater in Ranchi city varied from 10 µS/cm to 1520 µS/cm[19]. The overall conductivity of groundwater in Dhanbad district[2] ranged from 2.2 µS/cm to 3010 µS/cm, 2016). The average value of electrical conductivity of groundwater in Dumka and Jamtara district was 550 µS/cm and it varied from 79 µS/cm to 1667 µS/cm[17]. Prabhunath Singh *et al.,* (2014)[21] has reported the electrical conductivity of the groundwater in Ranchi city varied from 238 to 1357 µS/cm.

Alkalinity

It is the chemical measurement of ability of water to neutralise acid. The large values of total alkalinity make bitter taste of water. The total alkalinity in water is mainly due to the presence of OH^-, CO_3^- and HCO_3^- ions in water[30]. Other salts of weak acid such as ammonium, phosphate, silicates, borates and organic bases are also responsible for total alkalinity of water. The value of total alkalinity of groundwater in Ranch City ranged from 28 mg/L to 340mg/L[19].

Total Hardness

Hardness of water is also an important characteristic to determine quality of water from different sources. The causes of hardness in fresh water mainly due to carbonates, bicarbonates, chlorides and sulphates of calcium and magnesium. Theoretically the total hardness of water is defined as the sum of calcium and magnesium hardness in mg/lit as $CaCO_3$. A high concentration of hardness may be due to leaching from of the soils or due to the high background concentration of the water. High concentration of hardness may cause the problem of heart disease and kidney stones. According to Poonam Tirkey *et al.,*(2017)[19], the hardness of groundwater varied between 32 to 508 mg/L in Ranchi City. The value of total hardness of groundwater in Dumka and Jamtara districts ranged from 19 to 531 mg/L[17]. Prabhunath Singh *et al.,* (2014)[21] has reported the total hardness of the groundwater in Ranchi city ranged from 120 to 598 mg/L.

Calcium and Magnesium

Calcium and magnesium are very important parameters for water analysis. Hardness of water is also depended on concentration of calcium and magnesium. The concentration of calcium and magnesium in groundwater of Dumka and Jamtara districts ranged from 3.4 to 102.5 mg/L and 2.6 to 66.9 mg/L respectively[17]. Prabhunath Singh *et al.,* (2014)[20] has reported the concentration of calcium and magnesium varied from 21.8 mg/L to 164 mg/L and 9.8 mg/L to 46 mg/L respectively in Ranchi city.

Iron

Iron is also a metal that is found in groundwater. Iron in water is not so toxic but concentration over permissible limit has some adverse effect in human body. Iron concentration in the groundwater of Dhanbad district[2] ranges from 0.039 mg/L to 1.40 mg/L.

Total Dissolved Solid (TDS)

Total dissolved solids are the measure of total dissolved salts, ions, minerals and materials in water. Simply purity of drinking water is measured in terms of TDS. The differences in TDS values may be dependent on geological formations, hydrological processes and prevailing mining conditions in the region[19]. The total dissolved solids (TDS) values of groundwater ranged from 51 to 772 mg/L in Ranchi city[19]. The TDS of groundwater in Dhanbad district[2] were varied from 58.2 mg/L to 1489 mg/L. The average value of total dissolved solid (TDS) of groundwater was 348 mg/L in Dumka and Jamtara districts and it ranged from 19 to 531 mg/L[17]. Prabhunath Singh *et al.,* (2014)[20] has reported the concentration of total dissolved solids (TDS) in the groundwater of Ranchi city ranged from 200 to 1157 mg/L.

Carbonate

Carbonate is directly or indirectly related with pH and alkalinity of water. Whenever the value of pH of water reaches to 8.3, the presence of carbonate is indicated. Carbonates in water are converted into bicarbonates at lower pH than 8.3. The concentration of carbonate ions in different ares of Jharkhand is zero.

Bicarbonate

Bicarbonate is one of the most abundant anion in freshwater. The concentration of bicarbonate in groundwater of Dumka and Jamtara districts ranged from 37 to 258 mg/L[17]. Prabhunath Singh *et al.,*(2014)[20] has observed the concentration of bicarbonate varied from 90 mg/L to 488 mg/L.

Nitrate

Nitrate is an important parameter in water and it is naturally occurring inorganic ion present in our environment. Nitrate in groundwater is a prime indicator of anthropogenic pollution especially as it indicates inputs of detergent, soap, toothpaste, shampoo, fertiliser used in the domestic and agricultural fields. The nitrate concentration of groundwater in Ranchi city is below the acceptable limits of BIS (45 mg/L)[19]. In Dumka and Jamtara districts the concentration of nitrate in groundwater ranged from 0.1 to 191.9 mg/L[17]. According to Prabhunath Singh *et al.,*(2014)[20] the concentration of nitrate in the analysed groundwater samples of Ranchi city varied between 2.5 to 53.7 mg/L.

Chloride

Chloride is one of the most abundant inorganic anion in natural water of various sources. Generally low existence of chloride is shown in normal fresh water due to the dissolution of salts but in sea water chlorine is predominant as an ion in the water. According to Poonam Tirkey *et al.,*(2017)[19] chloride values in the ground water of rural, urban and peri-urban areas of Ranchi city in the monsoon season varied from 2 mg/L to 200 mg/L .The chloride concentration in groundwater of Dumka and Jamtara districts ranged from 1.2 to 302 mg/L[17]. Prabhunath Singh *et al.,*(2014)[20] has reported the chloride concentration in the groundwater of Ranchi township area varied from 30 to 176.3 mg/L.

Sulphate

Sulphate is an important parameter in water. However, the sulphate concentration in water of the study area is within the maximum allowable limit. Generally many sulphate compounds such as sulphate ores, gypsum, shale, industrial waste etc. are readily soluble in water and so sulphate ions usually occur in natural waters. Atmospheric sulphur dioxide comes from metallurgical industry (by the metallurgical roasting processes) and the combustion of fossil fuels by vehicles, engines and industries may also contribute to the sulphate compounds of water directly or indirectly. The sulphate concentration of groundwater in Ranchi city was varied between 0 and 268 mg/L[19]. The sulphate concentration value of groundwater in Dumka and Jamtara districts ranged from 0.7 to 134 mg/L[17]. Prabhunath Singh *et al.,* (2014)[21] has reported the concentration of sulphate in groundwater of Ranchi city varied from 10 to 126 mg/L.

Phosphate

The increased application of fertilizers, use of detergents and domestic sewage greatly contribute to the heavy loading of phosphorous in the water[30,31]. According to Poonam Tirkey *et al.,* (2017)[19] phosphate in groundwater of Ranchi city was seen to be between 0.004 and 0.16 mg/L. Phosphate concentration variability irrespective of zone and sources (well or bore well) was less in the study area.

Sodium

Sodium concentration in water is an important factor for drinking and irrigation purposes. Sodium plays an important role in plants, animals and human body system. Generally extremely high sodium concentration is observed in sea water and normal fresh water bears low concentration of sodium. Sodium concentration of groundwater in ranchi city varied from 18.2 mg/L to 303 mg/L[19]. In Dumka and Jamtara districts of Jharkhand sodium concentration ranged from 6.6 to 70.8 mg/L[17]. Prabhunath Singh *et al.,*(2014)[21] has reported sodium concentration of groundwater in Ranchi city varied from 14.2-75.2 mg/L.

Potassium

It is also an important parameter of drinking water and irrigation water. Growth of plants and production crops depends also on potassium concentration in water and soil. Potassium concentration of groundwater in Ranchi city varied from 0.2 mg/L to 22.4 mg/L[19]. The value of potassium concentration in groundwater of Dumka and Jamtara

districts ranged from 0.8 to 18 mg/L[17]. Prabhunath Singh *et al.,*(2014)[21] has reported potassium concentration in groundwater of Ranchi city ranged from 1.6-19.3 mg/L.

Fluoride

Fluorine is present in natural water or contaminated water as fluoride. Usually fluoride concentration in natural water depends on geological formation except pollution due to industries or other. The main sources of the fluoride found in groundwater may be naturally occurring from the breakdown of rocks, soil minerals or weathering (geogenic) and waster due to human activities (anthropogenic)[19]. Fluoride may be an essential element for animals and humans but excessive consumption of fluorine (>2 mg/L) causes a dental disease (dental cavities for children) known as fluorosis while regular consumption in excess may give rise to bone fluorosis and other skeletal fluorosis. Poonam Tirkey *et al.,*(2017)[19] has reported the fluoride concentration varied from 0 to 2.19 mg/L in Ranchi city. The fluoride concentration of groundwater in Dumka and Jamtara districts ranged from 0.17 to 1.07 mg/L[17]. Kirti Avishek *et al.,* (2009)[4] has reported high fluoride concentration at Majhiaon block in Garwa district of Jharkhand. A.C Pandey *et al.,*(2012)[5] also observed high fluoride concentration in groundwater of Palamu district of Jharkhand. Prabhunath Singh *et al.,*(2014)[20] has reported fluoride concentration in groundwater of Ranchi city varied from 0.1 to 1.4 mg/L.

CONCLUSION

Quality and quantity of groundwater are decreasing with time in everywhere in the world and the effects for that are not only devastating to human beings, but also to all living bodyies in the world. In our present study, a review of ground water resources of Jharkhand has been carried out to define the groundwater quality system based on major ion chemistry. This will help current water resources planning of Jharkhand and provide an over all idea for contamination of ground water in Jharkhand. In general major chemical constituents are within permissible limit except fluoride, nitrate, iron, selenium, manganese, nickel and zinc contamination in some districts and arsenic contamination in Sahebganj district. Thus it is observed that the quality of groundwater in the entire state is suitable for drinking, irrigation and industrial purposes except in arsenic, fluoride and others chemical infested areas. The present review study will give an acute awareness among the people of Jharkhand about the quality of groundwater. Proper awareness program and water management plant for groundwater quality is needed in Jharkhand which can help the individual and the community to use pure drinking water and minimize water pollution.

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Conflict of interest

No potential conflict of interest was reported by the author(s).

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