

	<p>Journal Homepage: -www.journalijar.com</p> <p>INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)</p> <p>Article DOI:10.21474/IJAR01/13494 DOI URL: http://dx.doi.org/10.21474/IJAR01/13494</p>	
---	--	---

RESEARCH ARTICLE

CONCENTRATION OF IRON AND MAGNESIUM IN GROUND WATER AT NORTH BELA OF DARBHANGA DISTRICT (BIHAR)

Dr. Ravindra Kumar

P.G. Department Botany, I.N.M.U. Darbhanga.

Manuscript Info

Manuscript History

Received: 30 July 2021

Final Accepted: 31 August 2021

Published: September 2021

Key words:-

TDS, Concentration, Sediment,
Statistical, Analysis, Iron, Magnesium,
TDS, North Bela, Darbhanga

Abstract

Excessive levels of Fe, Mg and TDS are the main factors affecting groundwater quality at North Bela, Darbhanga. However, there are few studies on the source and effect of Fe, Mg and TDS concentration in the groundwater. This study takes at North Bela of Darbhanga city in Bihar state as an example, where the source and effect of Fe, Mg and TDS concentration in groundwater in the study area were analyzed. The results show that the source of Fe and Mg in the groundwater of the platform is the iron and Magnesium nodules in the soil layer. The TDS, fluctuation in groundwater levels are the important factors affecting the content of Fe and Mg in groundwater. This study provides a basis for the rational utilization of groundwater and protection of people's health in these areas with high iron, magnesium and TDS concentrations.

Copy Right, IJAR, 2021,. All rights reserved.

Introduction:-

North Bela is one of the important developing areas in Darbhanga city. Because it is located in a humid subtropical climate region, it has enough surface water. Groundwater sediments is the main source of drinking water for local residents. However, excessive levels of Fe, Mg and TDS are the main factors affecting groundwater quality behind R. B. Jalan College Bela, Darbhanga. Groundwater used as a source of drinking water containing excessive levels of Iron, Magnesium and TDS affects only certain area of North Bela, Darbhanga but not any other points. Iron and Magnesium ions can cause staining of laundry clothes, dirty stained patches on wall & plumbing fixtures and lead to the accumulation of sediment in the water delivery system. They can also raise the color, TDS and turbidity of the groundwater. The deleterious effect of Fe and Mg on health is known to include chronic intoxication, lung embolism, bronchitis, impotence, nerve damage and parkinsonism [1]. The national standard for drinking water qualities in India are 0.3 mg/L, 30 mg/L and 500 mg/L for Fe, Mg and TDS. The WHO recommends a health-based value of 30 mg/L for Mg and 500 mg/L for TDS. Iron and Magnesium are widely found in soils and aquifers, which have similar geochemical behavior. To investigate the influence of Fe, Mg and TDS. Studies show that high Iron, Magnesium and TDS water is distributed mostly in the environment.[2]

The North Bela, located in Darbhanga city of Bihar, is a typical area with high Iron and Magnesium content in groundwater. Though some domestic studies focus on the treatment of Iron and Magnesium groundwater. Above all, This study systematically investigated the hydrogeochemical characteristics of groundwater with high Iron, Magnesium and TDS in Bela, Darbhanga city. The relationship between Iron, Magnesium and TDS and their source were investigated. The relationship between the concentration of Iron and Magnesium in groundwater and the character of the aquifer (thickness of clay and groundwater level fluctuation) and TDS is discussed quantitatively. In addition, a good correlation between the concentration of Fe/Mg was found in the study area. This study provides a

Corresponding Author:- Ravindra Kumar

Address:- P. G. Department Botany, I.N.M.U. Darbhanga.

basis for the rational utilization of groundwater and protection of local people's health.



Figure1 (A):-Map of India Showing Bihar. (B) Map Of Bihar Showing Darbhanga City.

Materials And Methods:-

2.1. According to the standard for drinking water quality in India, approx. 90.5% of all the water samples have Fe in excess, followed by 21.5% with excessive Mg and 58.60% with excessive TDS.

2.2. Field Work, Sample Collection and Analysis According to the variation in groundwater level in Bela of Darbhanga city, a groundwater level survey point was conducted in the rainy season, the winter season and the dry season of 2020 respectively. A total of 04 boreholes were collected from Bela to District Level Water Testing Laboratory, Darbhanga. A total of 12 hydrochemical samples from different borewells were collected during rainy season in 2020. The groundwater level in the observation borewell was collected. The annual hydrochemical data of the observations were collected in May, July and November of 2020. Plastic bottles were used for collection of the water sample. At each location, the bottle was rinsed with the water to be sampled before the water was collected. Sampling was done following the National Environmental Protection Standard (2010), where twelve water samples from each of these 04 borewells were carefully collected and packaged, labeled and transported in November 2020.



Figure 1:- (A). Map Of India Showing Bihar Location. (B).Map Of Bihar Showing Darbhanga Location.



Figure 1:- (C). Location And Geology Map Of The Study Area Showing Sample Locations.

SAMPLING STATIONS	IRON	MAGNESIUM	ARSENIC	TDS	TURBIDITY	NITRATE	CONDUCTIVITY	pH
INFRONT OF R. B. JALAN COLLEGE	0.17	112.32	BDL	285	1	NIL	398	8.45
AT MOHINI NIWAS	1.26	42.24	BDL	642	2	NIL	941	8.64
NEAR B.P.SINHA HOUSE	1.42	48.15	BDL	685	2	NIL	984	8.72

Table 1:- Flactuation of various parameters at different stations.

2.3. Analysis Correlation and factor analysis were carried out between Fe, Mg, TDS, and some related physical and chemical parameters. Factor analysis is a widely used tabulated method, which compresses the total information content of the multivariate data in terms of a few factors. Then, through the geological interpretation of these factors, the main processes affecting hydrogeochemistry can be found [3]. The influencing factors of Fe, Mg and TDS in groundwater were determined by correlation analysis and factor analysis. Data analysis involved all 04 borewells. Fe, Mg, TDS and others concentration were depicted in table. The average Fe and Mg in soil types and resource calculation districts are calculated. Mean values of Fe and Mg concentration in groundwater samples from resource and soil type districts were calculated.

Results:-

Physico-Chemical Parameters

A summary of the values obtained from laboratory and fieldwork are presented in Table 1. Fe, Mg and TDS in the groundwater seriously exceed the standard in the study area. The pH of groundwater is neutral-to-weak alkaline, the anion is mainly bicarbonate, and the TDS is high.

The parameters analysis for the platform shows that three parameters account for the variation in the data (Table-1). Fe accounts for 26.44% of the variation. This factor shows the inorganic sources of Iron in groundwater. pH explains 18.85% of the variation. This factor indicates the effect of fluctuations in groundwater level. This suggests that changes in pH and redox state caused by seasonal groundwater level fluctuations dissolve Mg complexes and release TDS adsorbed on them into groundwater [4]. TDS, which accounts for 40.60% of the variation, is the positive loading of borewell depth and turbidity. This factor is related to geology.

Discussion:-

Source of Fe and Mg

Several main factors affect the content of Iron and Magnesium groundwater at Bela in Darbhanga city is Fe and Mg substances and organic matter deposited. It has been observed in field investigation that once colorless groundwater is extracted from borewells, it will appear red or yellow after a short time of contact with air. This indicates that the groundwater is in a reduced state [5]. A microbially mediated redox process, controlled by organic matter, can lead to the mobilization of Fe and Mg into groundwater [6]. This reduction environment is fostered by the combination of fine-grained sediments and organic matter [7]. Iron and Magnesium from soil will be released into groundwater under these conditions [8]. The lithology of platforms at North Bela in Darbhanga city is Quaternary deposits.

The oxidation of organic matter causes iron and manganese minerals to dissolve in ground water. Thus, the source of Fe and Mg in groundwater is not only clay, but the other. There are also soil sources of Fe and Mg in the groundwater. This area has a history of rice cultivation along with deposition of garbage outside the fields. Paddy soils are widely distributed in rice-growing areas. Under the condition of artificial periodic submerging and draining, paddy soil was kept in the process of redox alternation for a long time, and underwent a series of unique biochemical changes [9]. Long-term submerged conditions are favorable for soil organic matter deposition. The input of inorganic and organic fertilizers continuously increases the organic content of soil. The iron and Magnesium oxides in the ploughing layer were reduced to low valence iron and Magnesium compounds under submerging conditions and entered the groundwater with the water under the action of gravity [10].

Effect of Groundwater Level Fluctuation on Fe and Mg

At present, it is generally accepted that there are four ways for oxygen to enter shallow groundwater: vertical infiltration of oxygen-containing precipitation, infiltration of oxygen-containing surface water, diffusion of air in the vadose zone, and gas capture caused by fluctuation of groundwater level caused by intermittent operation of exploitation borewells [11]. The dynamic of groundwater in the study area is mainly influenced by precipitation and human activities (mostly irrigation and exploitation). Different groundwater dynamic types represent different ways in which oxygen enters shallow groundwater.

According to the formation mechanism, the groundwater dynamics in the study area can be divided into four types, that is, the upland field without irrigation, the upland field irrigated by groundwater, the paddy field irrigated by surface water and the paddy field irrigated by groundwater. However, the lower plain is irrigated by groundwater and the groundwater table depth is deeper (usually 4–8 m).

Effect of TDS on Fe and Mg

The TDS in the study area was high, with an average of 585 mg/L. Under the influence of pH effect, the increase in TDS leads to an increase in ionic strength and a decrease in activity coefficient, which will dissolve more Fe and Mg in groundwater. Fe and Mg ions can also form inorganic complexes with anions in water (such as Cl^- , SO_4^{2-}). The hydro-chemistry data of water samples with TDS close to the mean value were selected for calculation, and the results showed that $\text{Fe}^{2+}/\text{TFe}^{2+}$. This indicates that the concentration of Fe and Mg can be significantly increased under the effect of inorganic complexes.

Conclusions:-

In this study, the source and mobilization mechanisms of Fe, Mg and TDS in groundwater at Bela in Darbhanga city were determined by different methods and spatial analysis. The main conclusions are as follows:

firstly, the Fe and Mg in the groundwater comes from the soil and whole borewells, while the source of Fe and Mg in the groundwater of the platform is the Iron and Magnesium nodules in the soil layer. Secondly, according to different formation mechanisms, groundwater dynamic types in the study area were discerned. The annual and seasonal changes in Iron in dynamic types and their influencing factors were determined. Thirdly, the increase in TDS leads to a decrease in the activity coefficient; in addition, Iron and Magnesium ions can form inorganic complexes with anions in water. Together, they promote the dissolution of Iron and Magnesium in water. Fourthly, the TDS level is too much high due to deposition of garbage and other human exploitation, the pH and redox state changes caused by the fluctuations in water level dissolve the iron–Magnesium nodules. Finally, this paper provides the basis for groundwater development in high Iron, Magnesium and TDS concentrations.

References:-

1. Pezzetta, E.; Lutman, A.; Martinuzzi, I. Viola, C.; Bernardis, G.; Fuccaro, V. (2011): Iron concentrations in selected groundwater samples from the lower Friulian Plain, North-East Italy: Importance of salinity. *Environ. Earth Sci.*, 62, 377–391.
2. Carretero, S.; Kruse, E. (2015): Iron and manganese content in groundwater on the North-Eastern coast of the Buenos Aires Province, Argentina. *Environ. Earth Sci.* 73, 1983–1995.
3. Ravenscroft, P.; Burgess, W.G.; Ahmed, K.M.; Burren, M.; Perrin, J. (2005): Arsenic in groundwater of the Bengal Basin, Bangladesh: Distribution, field relations, and hydrogeological setting. *Hydrogeol. J.* 13, 727–751.
4. Pawar, M. J., Gawande, S. (2015): Groundwater pollution & its consequence. *International journal of engineering research and general science*. 3(4): 773–776.
5. Luzati, S.; Beqiraj, A.; Beqiraj Goga, E.; Jaupaj, O. (2016): Iron and Manganese in Groundwater of Rogozhina Aquifer, Western Albania. *J. Environ. Sci. Eng. B*, 5, 276–28
6. Brown, C.J.; Coates, J.D.; Schoonen, M.A.A. (1999): Localized sulfate-reducing zones in a coastal plain aquifer. *Ground Water*, 37, 505–516.
7. Neidhardt, H.; Berner, Z.A.; Freikowski, D.; Biswas, A.; Majumder, S.; Winter, J.; Gallert, C.; Chatterjee, D.; Norra, S. (2014): Organic carbon induced mobilization of iron and manganese in a West Bengal aquifer and the muted response of groundwater arsenic concentrations. *Chem. Geol.*, 367, 51–62.

8.Kshetrimayum, K.S.; Hegeu, H.(2016): The state of toxicity and cause of elevated Iron and Manganese concentrations in surface water and groundwater around Naga Thrust of Assam-Arakan basin, Northeastern India. *Environ. Earth Sci.*, 75, 1–14.

9.Champ,D.R.;Gulens,J.;Jackson,R.E.(1979):Oxidation–reduction sequences in groundwater flow systems. *Can.J.EarthSci.*, 16, 12–23.

10.Brown, C.J.; Walter, D.A.; Colabufo, S. (1999):Iron in the Aquifer System of Suffolk County, New York, 1990–1998; Water Science Center U.S. Geological Survey: New York, NY, USA,.

11.Kohfahl, C.; Massmann, G.; Pekdeger, A.(2009): Sources of oxygen flux in groundwater during induced bank filtration at a site in Berlin, Germany. *Hydrogeol. J.*, 17, 571–578.