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HYDROLOGICAL STUDIES OF GANGA DIARA LAND WATER OF PATNA, BIHAR WITH SPECIAL REFERENCE TO WATER QUALITY

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ABSTRACT:

The hydrological studies of Ganga diara land water of Patna district, including the the term "Diara" meaning is 'earthen lamp' which means land like a bowl shape on the side of a river bank (Anonymous 1974). The definition of Diara land explains as land lying capture by perennial river and matter to diluvium action of river. The Diara land is also known as for their many names such as Mara land, Chara land, Kachhar land etc. The hydrological parameters are to be accessed for water quality, especially drinking purposes, domestic use and for agricultural production. There are fifteen parameter examined for water quality assessment and study, all these 15 parameters are for water quality studies including as follows - pH, TDS, Turbidity, EC, Iron, Calcium, Magnesium, colour, Alkalinity, B.O.D, C.O.D, Sodium chloride, Total hardness, Sulphate, MPN, Nitrate. The entire sample collected in pre monsoon and post monsoon season. Total five samples collected from five different Ganga Diara land area of Patna, Bihar.

KEY WORDS: Diara, Diara water, Parameter, Geo-chemical data.

INTRODUCTION:

On the surface of earth, about 70% of earth is covered by water, in which 1.7% is groundwater .Water play an important role in human beings day to day life. In humans body also 70% parts are filled with water. The entire flora and fauna are also survive on it by intake of water. Diara is the piece of land that has got created in the middle of the river Ganges as a result of deposition of sands over the decades. Actually, the term may be defined as land lying capture by perennial river and matter to diluvium action of river. Diara land is also known as for their many names such as Mara land, Chara land, Kachhar land etc.

The Diara land classified as follows:-

1. Diara land of lower region

The Diara lands of lower region are present in main river beds of fine grain sand to coarse and they are deposited in the surface.

2. Diara land of middle region

The middle region Diara land present in bank of the river. These lands are considerably and frequently filled with water during rainy season.

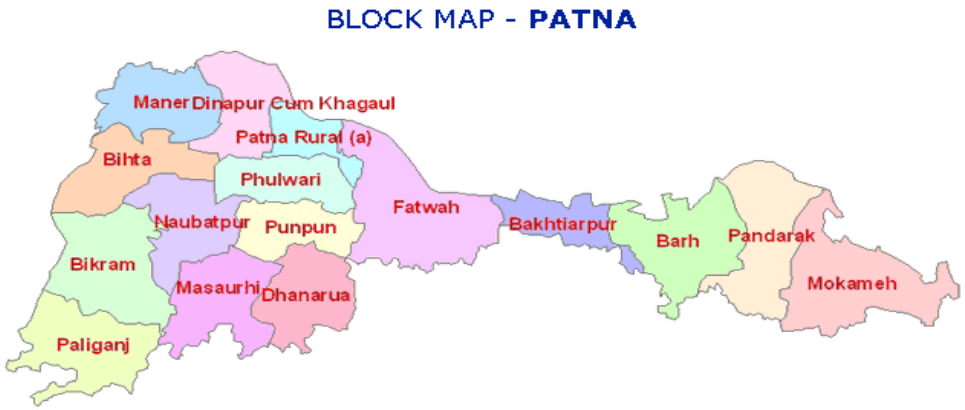
3. Diara land of upper region

The upper region Diara land are continuous deposition during coarse of frequently flooded compared with middle Diara land.

STUDY AREA:

The study area is located in and around the state capital of Bihar which is situated in the southern side of holy river Ganga. Patna (25.5941^0N, 85.1376^0E) is the capital city of Bihar, it lies between 25°21′45.83″N. 85°42′19.54″ E and 25°21′22.78″ N. 83°51′51.40″E, Patna town is situated between the bank of river Ganga in south and also straddles by Punpun, Son and Gandak river. Patna town covers an area of about 250 squares kilometres i.e. (97 sq m). It is situated 53 meter (174 feet) above sea level and 110 km long from East to West and 10 km North to South. The city average temperature is about 25.5º C / 78 º F. The literature survey presents that a very few studies done in context of Ganga Diara land of Patna. The study shall enable an assessment of water quality of subsurface water which is situated along the Ganga river, Patna, Bihar.

In the study of Diara land water, the samples are collected from areas near Bansghat Diara, Naktaghat Diara, Ganga jal tola Diara, Kanganaghat Diara and Rashtampur Diara areas have been taken for studies of its water quality which includes in two seasons, the first samples are from pre-monsoon and another is post-monsoon. It is found that, in a year, the area is full of water for 3 to 4 months. The middle areas of Diara are by and large partially or covered with water. In this study, the results are examined for water quality which represents the idea about the elements present in water and show the drinking point of view that it is safe or not for consumption for human beings.



MATERIAL AND METHOD:

The water samples of Diara land areas have collected in tight sealed good quality 1 litre bottle and two extra small bottles of 200 ml and 250 ml were used for examining iron and arsenic content in water. Water was collected in 200 ml bottle and 0.5 ml nitric acid was also added for its preservation for water collected and same condition was for Arsenic examination in which 250 ml bottle was used and 0.5 ml HCl was added for its preservation. All the bottles were rinsed with distilled water before taking samples. After collection of water samples, the entire bottles were transferred to PHED department, Govt. of Bihar for examination of various parameters for water.

RESULTS AND DISCUSSION:

Ground water is the main source in Diara land. There are many wells and hand pumps found during the course of survey. There are not enough data available, it was documented the relevant details suitably to facilitate and enable physical verification. The value of study based on available information observations during physical survey and analysed. Water sample of five places were collected randomly for knowing the values of pH, Total dissolved Solid (TDS), Calcium (Ca), Magnesium (Mg), Chloride (Cl), Bicarbonate (HCO_3), Iron (Fe), Nitrate (NO_3), Sulphate (SO_4), Fluoride (F), Sodium (Na), Potassium (K), Phosphate

(PO_4), Arsenic (As) and Coliforms organisms during pre monsoon and post monsoon through chemical analysed.

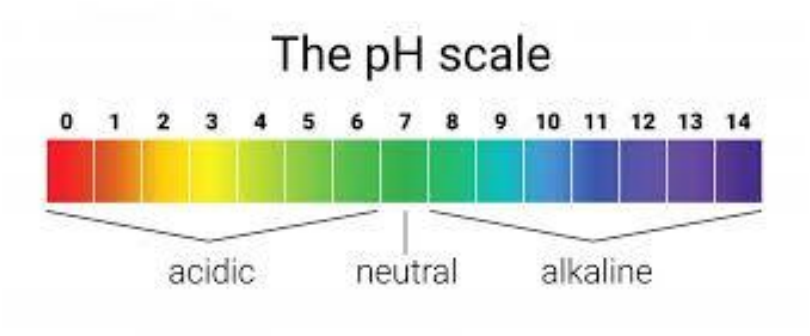
Data were plotted in the graph showing mean and standard deviation of pH Value, Total dissolved Solid(TDS), Calcium (Ca), Magnesium (Mg), Chloride (Cl), Bicarbonate (HCO_3), Iron (Fe), Nitrate (NO_3), Sulphate (SO_4), Fluoride (F),Sodium (Na), Potassium (K), Phosphate (PO_4), Arsenic (As) with their measurements. This data were analysed to know the correlation between the pre and post monsoon water samples of different places.

1. Electrical Conductivity Value

The conductivity is used to measure the capability of water to flow electrical charges through them. It is directly related from ions concentrations of the water. All sample of Diara area, pre and post monsoon shows normal result of electrical conductivity of water. Its value range is about 155 to 720 micro/mho cm.

2. P^H Value

The meaning of pH stand for potential of hydrogen, for that pH is directly used to measure the hydrogen concentration of water in the substance. All samples of pre-monsoon and post- monsoon show normal value of pH in water .The pH value is measured about 7 or above means towards alkaline. The post-monsoon reading shows the more alkalinities in composition with respect to pre-monsoon. The mean P^H Value was found larger in post-monsoon than the pre-monsoon and r- value found highly significant. The pre monsoon pH mean 7.31 and post monsoon mean 7.57. The pre and post pH average mean 7.44. According to PHED the pH permissible limit is in between 6.5 to 8.50. So, the water quality is fine in this parameter. The Pre monsoon pH mean is less than the post monsoon pH mean may be due to the dilution of monsoon water in the course of Ganga river water.



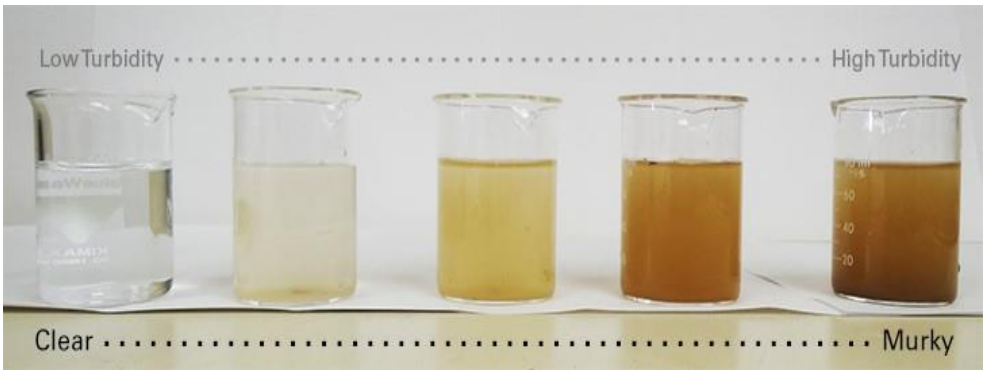
3. TDS (Total Dissolved Solid) Value

The terminology of TDS stand for total dissolved solid that is explained about inorganic salt and small quantity of organic matter available in water solution. TDS mean S D (966.544) of post-monsoon was found larger than TDS mean ± S D (900.2) of the pre-monsoon. The r- value found highly significant. It means after the monsoon period extra total dissolved solid were added to the river course. According to PHED the permissible limit in absence of alternative source is 2000. So, the water quality is fine in this parameter.

TDS Count	Water Quality
0 to 150	Unacceptable, because of too less minerals
150 to 300	Excellent
300 to 500	Good
600 to 900	Fair
900 to 1200	Poor
Above 1200	Unacceptable, because of too much impurities and Minerals

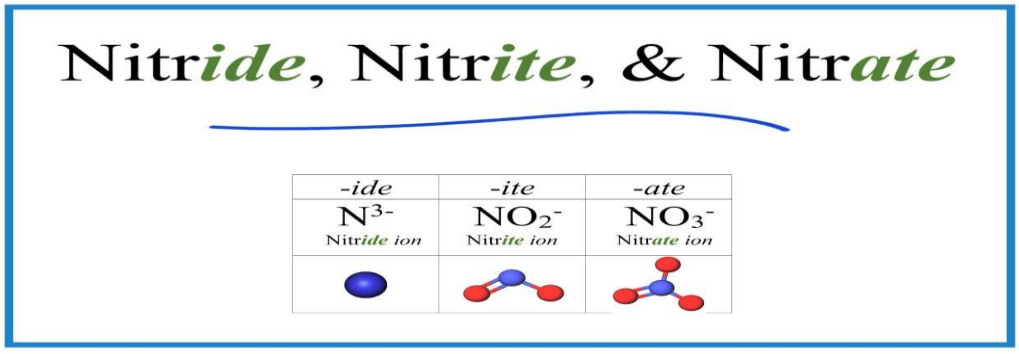
4. Turbidity Value

The meaning of Turbidity shows the amount of cloudiness in water means relative clarity of a liquid. The turbidity of water varies from a river in which fully silt and mud present in water to which it is impossible to see clear water, where as a spring show clear turbidity. It is an optical characteristic of water and is a measurement of the amount of light that is scattered by material in the water when a light is shined through the water sample. The higher the intensity of scattered light is the higher the turbidity. All samples of Diara water shows normal value of turbidity, but post monsoon water sample of Bansghat diara and Hagjiganj diara show elevated result of Turbidity. Its desirable limit is about 1.0.



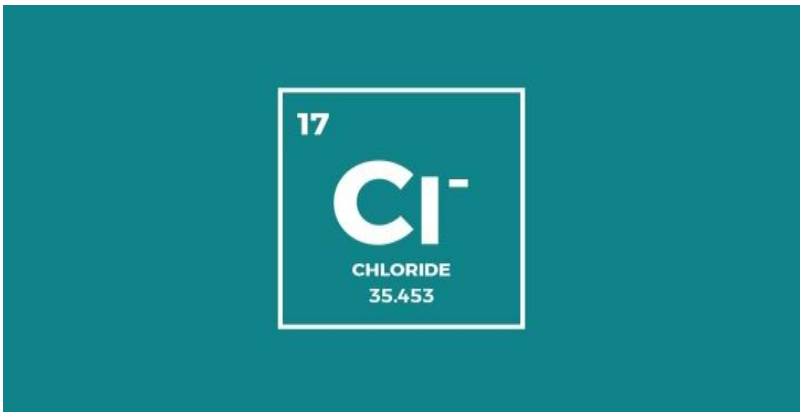
5. Nitrite Value

The Nitrate is a compound which is obtained naturally when nitrogen reacts with ozone or oxygen. It is essential for all living beings and high level of nitrate is may be dangerous to health, especially for infants and pregnant women. All water samples show normal values of nitrate in water. As per PHED department the desirable limit of nitrite is about 45 mg/l. The average value of pre monsoon is found 0.88 while the post monsoon value is 3.76. So, average value is 2.324.



6. Chloride Value

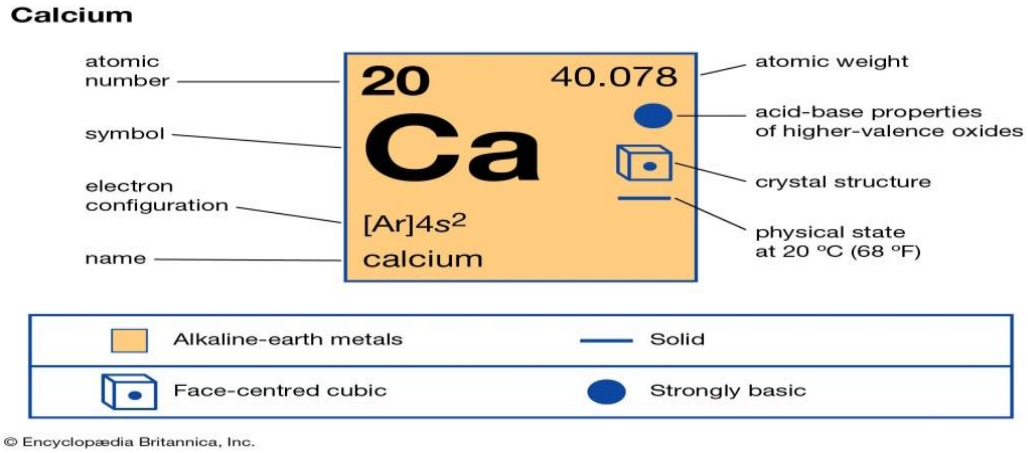
The chloride is the element and it occurs naturally. Most of natural water contains chloride in it. It is mostly present as component of salt and in some condition it occurs with combination with calcium or potassium. All water samples shows normal value of chloride in water. Its desirable limit is about 250 mg/l.



Chloride mean ± S D (166.71) of post monsoon were found larger than chloride mean ± S D (139.63) of the pre monsoon. The average mean were (153.17). The r- value found highly significant. According to PHED the permissible limit is 250 and the permissible limit in absence of alternative source is 1000. Results are within desirable limit. So, the water quality is fine in this parameter. Chloride is a type of electrolyte. It works with other electrolytes such as potassium, sodium, and carbon dioxide (CO_2). These substances help keep the proper balance of body fluids and maintain the body's acid-base balance. Chloride is the major anion in the extra cellular fluid (ECF).

7. Calcium Value

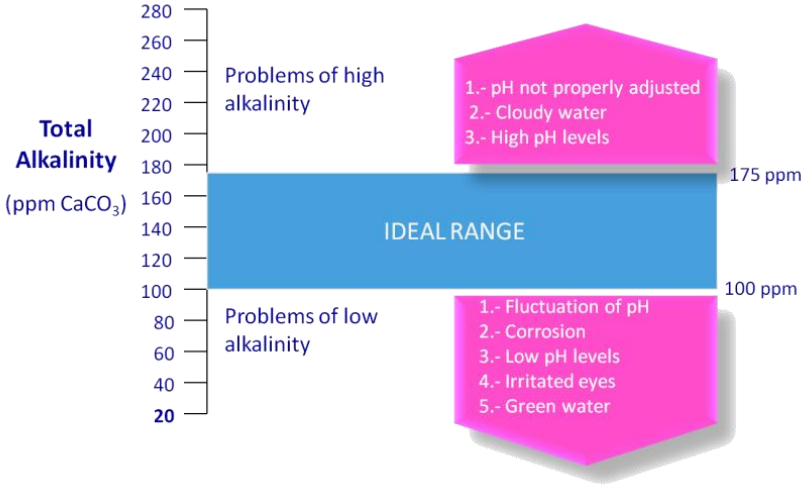
The important source of calcium in groundwater is due to pyroxene and feldspar found in rock and sand particles. Dependence of calcium solubility in calcium carbonate, sulphide and chloride are rarely. The pre monsoon sample shows normal value of calcium but post monsoon sample of Rustampur, Bansghat and Nakta Diara shows elevated level of calcium. Its desirable range is between 75 mg/l. Calcium mean ± S D of (134.02) of pre monsoon were found larger than calcium mean ± S D (62.34) of the post monsoon. The average mean of calcium is 98.18. The r- value found significant. According to PHED the permissible limit is 200. Results are within desirable limit. So, the water quality is fine in this parameter.

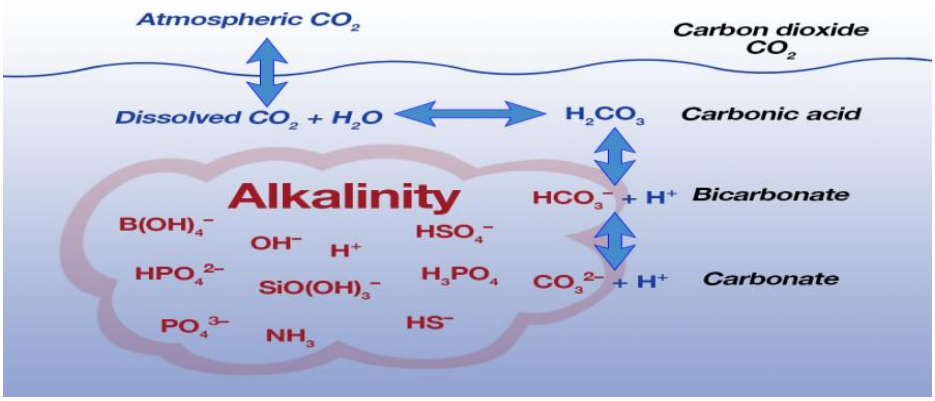


Calcium is a mineral associated with healthy bones and teeth because it helps in development and also it involve in important role for making blood clotting, muscles contraction, and regulating normal heart rhythms and nerve system.

8. Alkalinity Value

The Alkalinity shows the present acid neutralizing value in the water, i.e. used for total measure of solubility of substances. The rock contains carbonate (Co_3), Bicarbonates (Hco_3), Hydroxide (OH), Silicate compound (SiO_4) and Phosphates (Po_4) are the important sources of alkalinity. All water samples of Diara area shows elevated level of Alkalinity in water in both pre monsoon and post monsoon. Its desirable limit is about 200 mg/l. Alkalinity mean ± S D of (479.20) of pre monsoon were found larger than Alkalinity mean ± S D (311.96) of the post monsoon. The average mean of Alkalinity is 395.58. The r- value found significant. Alkalinity is the capacity of water to resist acidification. There can be long term changes in the alkalinity of river in response to human disturbances such as acid rain etc.





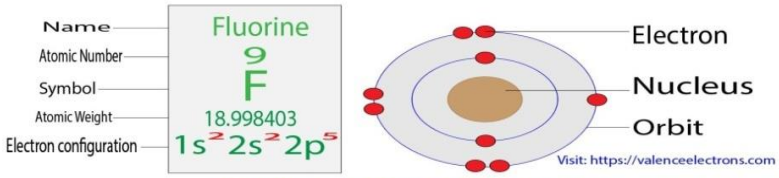
The average mean of Alkalinity is 395.58. The r- value found significant. Alkalinity is the capacity of water to resist acidification. There can be long term changes in the alkalinity of river in response to human disturbances such as acid rain etc. The factors of salts of weak organic acids which undergo hydrolysis and consume H^+ ions of water. As a result, concentration of OH^+ ions increases in water and water becomes alkaline. The presence of HCO_3^-, $HSiO_3^-$ and $SiO3^{-2}$ ions in water which makes alkaline because they have tendency to take up H^+ ions from water. Hence, the concentration of OH ion increases in water and water becomes alkaline. High alkaline water have high carbonates and bicarbonates has pH value may be 7 or above. While, the high pH does not mean have high alkalinity.

9. Coli form organism Value

The Bacteria that is present in the facial material of warm blooded humans and animals and also present in the environment. The availability of the coli form organism can used serious damage to humans' beings. They are disease causing organism. All water samples shows normal value of coli form organism. Its unit is MPN/100ml. Total coliform consists of several genera of bacteria of fecal and non-fecal origin. Pre monsoon and the post monsoon coli forms organisms are not detected or very less in amount (< 1.1), throughout the year, 95% of the samples not contain coli forms organisms in 100ml. No sample should contain more than 10 coli forms organisms per 100ml.

10. Fluoride Value

The fluorides naturally occur in water, and it is derived by the fluorine, that is a element found in earth crust. Fluoride is well known for the help in preventing and even reversing early stages of tooth decay. All water samples show normal values of fluoride present in water. Its desirable range is about 1.00 mg/l.

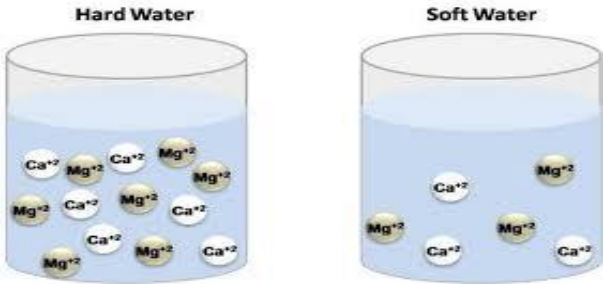


Fluorine Electron Configuration

The fluoride mean ± S D (0.30 ± 0.2) of pre monsoon were found larger than the fluoride mean ± S D (0.34 ± 0. 2) of the post monsoon. The average value is 0.32. The r- value found highly significant. According to PHED the permissible limit is 1.0 and the permissible limit in absence of alternative source is 1.5. The result is within permissible limit.

11. Total Hardness Value

The total hardness is defined as the sum of magnesium and calcium concentrations present in water. All the water samples show normal value of total hardness. Its desirable range is about 200 mg/l. It expressed as calcium carbonate in milligrams per litre (mg/L).

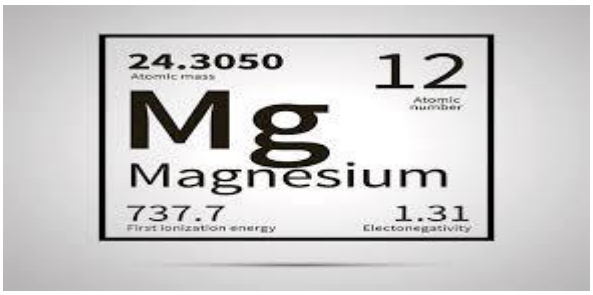


$CaCO_3$ content	Total water hardness
50 ppm	Soft
50–100 ppm	Moderately soft
100–150 ppm	Slightly hard
150–250 ppm	Moderately hard
250–350 ppm	Hard
>350 ppm	Very hard

12. Magnesium Value

The magnesium is found in the earth's crust and it is eight abundant elements present in the earth's crust, as value of 2.5 %. It occurs in minerals like Talc, Serpentine, olivine etc. Magnesium is responsible for hardness of water. All samples show normal value of magnesium in water. Its permissible limit is about 100.00 mg/l.

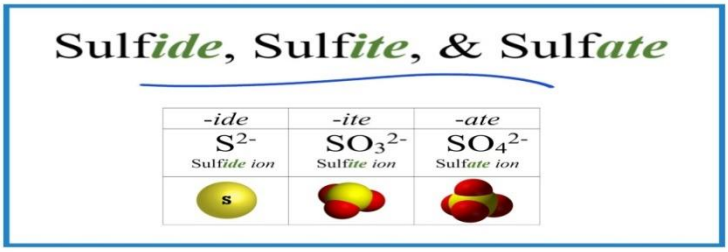
Magnesium is a co-factor in more than 300 enzyme systems that regulate diverse biochemical reactions in the body, including protein synthesis, muscle and nerve function, blood glucose control, and blood pressure regulation. Magnesium deficiency causes muscle spasms, muscle cramps, muscle pain, fatigue, high blood pressure, anxiety, insomnia, headache, fatigue, abnormal heart rhythms etc. Magnesium is required for energy production, oxidative phosphorylation, and glycolysis. Mg is the eighth most abundant element in the earth crust, eleventh most abundant element in human body and second most abundant metal in sea water.



Magnesium mean ± S D (39. 37 ± 3) of pre monsoon were found lesser than magnesium mean ± S D (44. 12 ± 4) of the post monsoon. The average mean of Magnesium is 83. 49. The result value found highly significant. According to PHED the permissible limit is 100. Results are within desirable limit. So, the water quality is alright in this parameter.

13. Sulphate

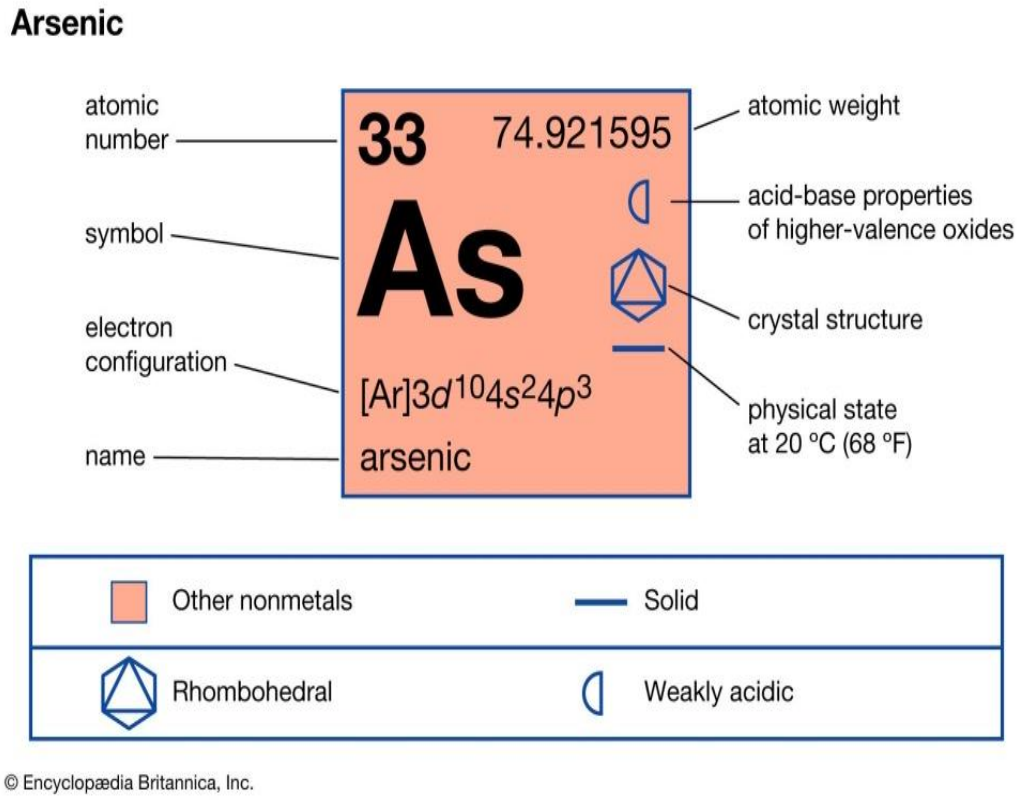
The sulphate is present in all natural water body. Sulphate is basically a chemical compound that is composed of sulphur and oxygen atoms. Sulphate forms salts with a variety of elements including potassium, sodium, calcium, magnesium and barium. By the oxidation of sulphate areas, sulphate is originated from it. The sulphate is present in industrial waste or shale. In rain water sulphate is the major component. All Diara water show normal values of sulphate. Its desirable range is about 200mg/l.



The sulphate mean ± S D (56.8) of pre monsoon were found larger than the sulphate mean ± S D (33.4) of the post monsoon. The average value of sulphate is 41.1. The result value found highly significant. According to PHED the permissible limit is 200.0 and the permissible limit in absence of alternative source is 400.

14. Arsenic

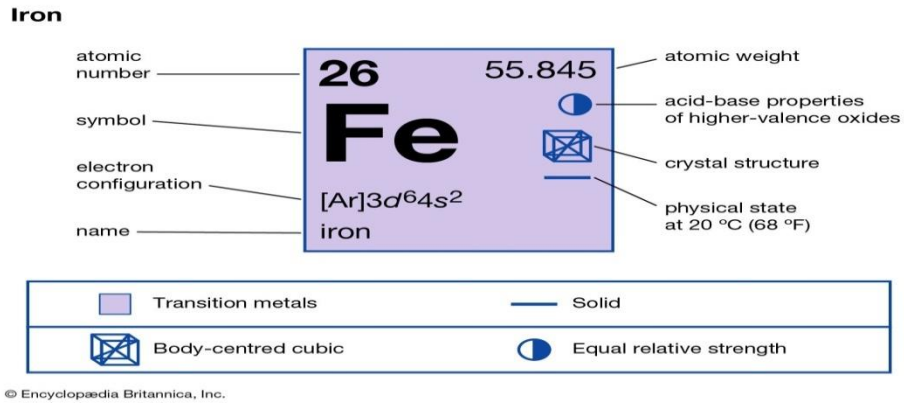
Arsenic is a natural element that can be found in rocks and soil, water, air, and in plants and animals. People can also be exposed to arsenic in the environment from some agricultural and industrial sources. By the food chain it comes to the human body. The vegetables, non-veg meals and it become deadly element to the life. In the Diara area water examination, few areas being have little quantity of arsenic; the range is under desirable limit is about 0.01 mg/l.



The Pre and post monsoon arsenic contamination values are found below detection limit. It means that water of study areas are arsenic free. According to PHED the permissible limit is 0.01 and the permissible limit in absence of alternative source is 0.05. So, the water is drinkable.

15. Iron

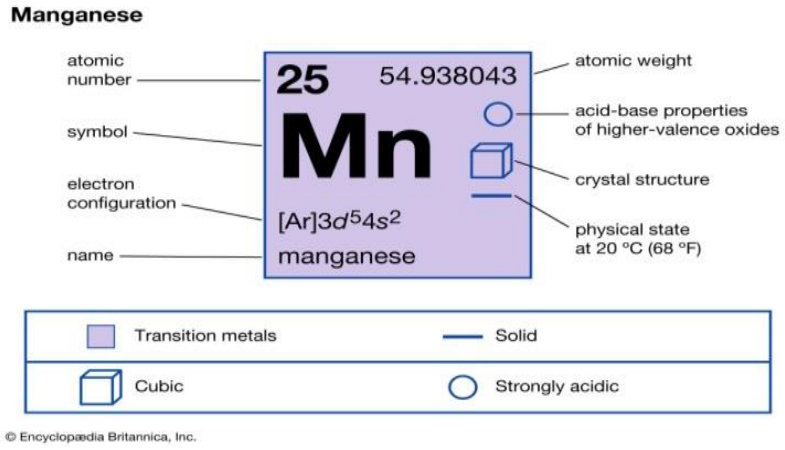
The earth's crust consists of 5% iron in it. In the natural water its range is increase by 10 mg/l. It is available in two forms (i) Ferric ion (insoluble), (ii) Ferrous ion (soluble). All Diara water show little elevated value of iron. Its desirable range is about 1.0 mg/l.



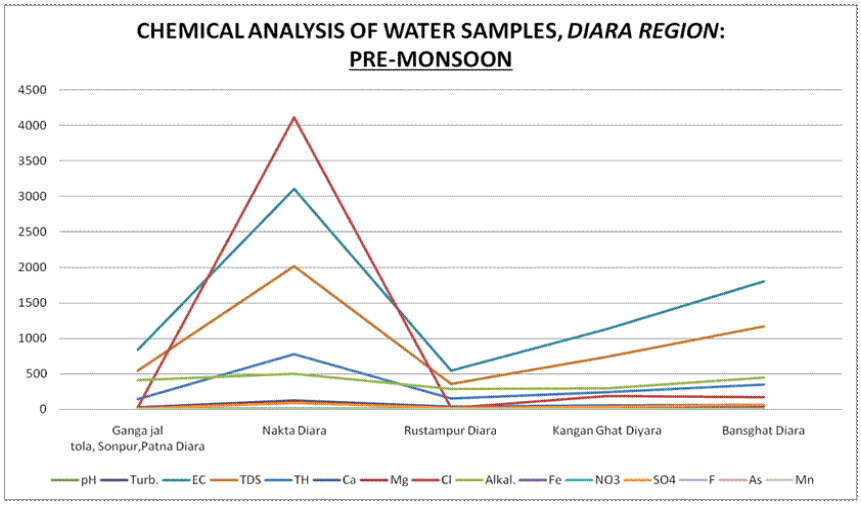
The iron mean ± S D (0.92) of pre monsoon were found larger than the iron mean ± S D (0.0, N.D, i.e. no detectable) of the post monsoon. The result value found significant. According to PHED the permissible limit is 0. 3 and the permissible limit in absence of alternative source is 1.0.

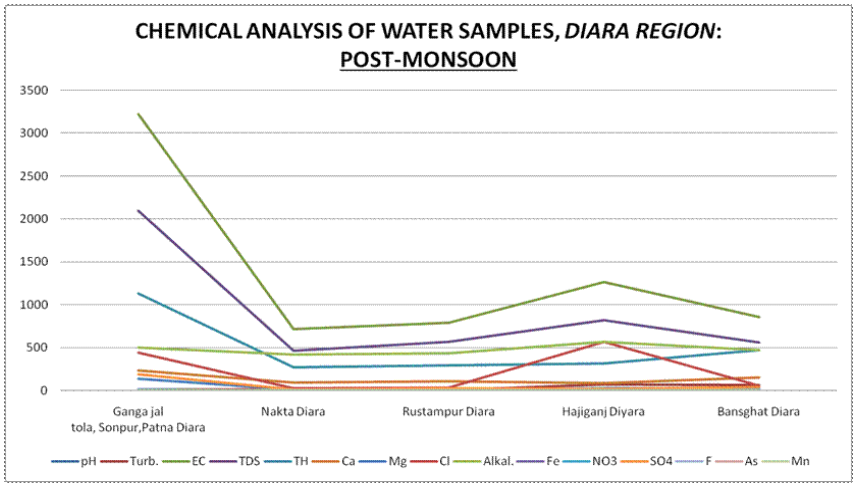
16. Manganese

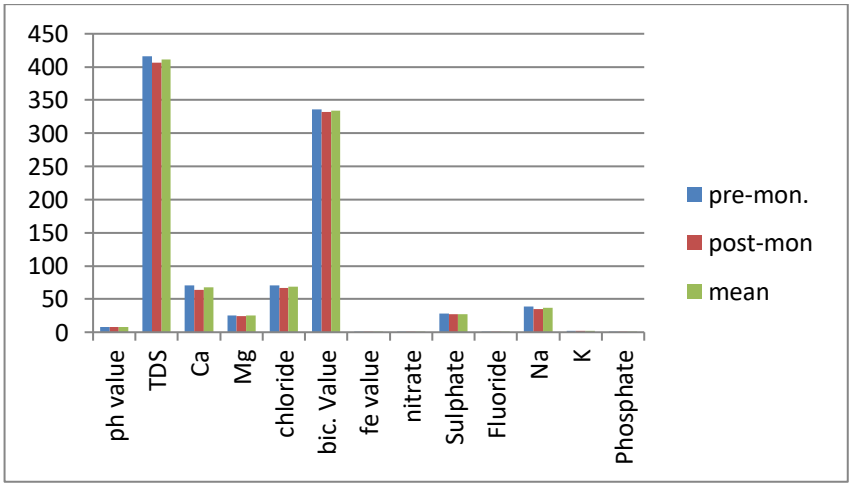
The Manganese of pre monsoon and post monsoon were not found in measurable amout and the result is negligible, so, the water is drinkable for safe.



Statistical Diagram:







CONCLUSION

The samples of sub - surface water was taken from the selected area of diara region in Patna district were analyzed and the conclusion found under permissible limit. The examination reveals that the selected diara region of Patna district has a huge load of water loading problems during the rainy seasons. And after the rainy season elements carried by the river, mixed with ground water and increase the unsuitability of water for drinking purpose, and this cause serious illness towards the people living in this areas. Therefore, it is important to protect diara region water for the people who reside in this region.

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