

Physico-Chemical Study Arsenic Contamination of Ground water Bhojpur

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ABSTRACT

Keywords- Ground Water, Surface Water, Physico-Chemical Parameters, Arsenic, Health.

The use of ground water has increased significantly in the last decades due to its widespread occurrence and overall good quality. The present study aims at determining the suitability of ground water quality for drinking purpose at selected locations in Bhojpur. Groundwater is the main source of drinking water in Bhojpur. The Bhojpur polluted both surface and groundwater by discharging their wastes. Hence the present study has been undertaken to determine the physico-chemical characteristics of groundwater in some selected locations of Bhojpur. Various water samples were taken at three different locations. The samples are analysed for physico-chemical parameters. The results were compared with drinking water standards of Bureau of Indian Standards and World Health Organisation Standards (WHO 2011). Further the correlation studies among the different parameters of water were estimated. Geochemical characteristics and arsenic content of ground water in the Bhojpur were analyzed. Ground water is the local source of drinking water mainly used for bathing and farming purposes. The results indicate that total arsenic in ground water range between 225 to 876 and 0.3 to 656.9 µg/L, respectively. Speciation of arsenic suggests arsenite the dominant arsenic. The variations of Br/Cl and B/Cl ratio, negative ORP (Oxygen Redox Potential) and high concentrations of Cl, Na, Cs, Li, Rb, Sr, B, Br and Rb in travertine spring samples confirm deep groundwater circulation in the basement. The results of saturation indices show that groundwater samples are super saturated with respect to iron oxides, calcite, dolomite, aragonite and under saturated with respect to gypsum and halite. Dissolution of arsenic-containing sulfide minerals is not the main source of arsenic contamination in groundwater.

Introduction:

Ground water is the basic resource of drinking water. The ground water is potable when compared to surface water. The ground water is susceptible to pollution due to excessive usage of fertilizers, pesticides, increased anthropogenic activities and fast growth of industries. Thus, ground water is ultimate and most suitable fresh water resource with nearly balanced concentration of the salts for human consumption. Unfortunately, water resources are getting polluted and getting unfit for usage. Pollution of ground water aquifers has made many of the wells unfit for consumption. The availability of pure water through surface and ground water resources has become more critical day today. Only 1% is available on earth for drinking purpose, agricultural purpose, domestic purpose, power generation, industrial consumption, transportation and waste disposal. There are several states in India where more than 90% of the total populations are dependent on ground water for drinking and other purposes. The present study was taken under investigation to Analyze the impact of ground water quality of certain open wells and bore well water samples in selected locations in Bhojpur district of Bihar. Thus, in this research study an attempt has been made to assess the physico-chemical parameters of ground water for temperature (T), pH, electrical conductivity (EC) total dissolved solids (TDS), total hardness (TH), total alkalinity (TA), calcium (Ca²⁺), magnesium (Mg²⁺), chloride (Cl) and fluoride (F). The analyzed data were then compared with the standard values of (World Health Organisation) WHO. Correlation coefficients were calculated to assess the relationship between the selected parameters.

Among the widely reported inorganic pollutants in ground water, high concentration of naturally occurring arsenic (As) is a major concern all over the world. The presence of arsenic in ground water in pernicious concentrations for human health constitutes a worldwide high-priority groundwater quality problem. Long time exposure to arsenic may cause various diseases including skin disorders, circulatory system problems, cardiovascular disease, neurological complications, reproductive disorders, respiratory effects, diabetes mellitus and an increased cancer risk, especially of the skin, gallbladder, lungs and kidney. Arsenic forms both organic and inorganic compounds, and inorganic compounds are generally more toxic and mobile than organo arsenic species. Of the four oxidation states (-3, 0, +3 and +5), the trivalent arsenite compounds are considered to be more toxic, soluble, and mobile than pentavalent compounds (WHO 2001). Arsenic occurs in natural waters as oxyanions and neutral species, and undergoes important oxidation changes, which also affect its toxicity and chemical behaviors. The occurrence of arsenic in groundwater is either from anthropogenic or natural causes; however, the majority of Arsenic present in groundwater is of natural origin. For public health, contamination from natural sources is more difficult to characterize and manage, generally due to non-point sources. The most common sources of arsenic in the natural environment are geothermal and volcanic activities. Usually, the natural occurrence of arsenic in ground water is related to the presence of geothermal systems.

Materials and methods

1. Collection of water samples- Water samples were collected in 2 ½ litre water cans from bore wells at three different locations in Bhojpur district based on the area which is important for the place of city.

2. Study area- The study area Bhojpur has an area of 2,395 square kilometres, It is located at a longitude of 83° 45' to 84° 45' East and the latitude is 25° 10' to 25° 40' North and is situated at a height of 193 meters above sea level. within a semi urban area The climate in Bhojpur town is dry and hot, with northeast monsoon rainfall during the month of October to December. Temperatures during summer reach a maximum of 47°C and winter temperatures up to 5 °C. The average annual rainfall is about 126 cm. the study area Ground water in Bhojpur area is polluted due to some industrial effluents from the local industries. Industries and houses are found together very close around the selected locations. namely Garhani (S1), Jagdishpur (S2) and Piro (S3). People living in and around these areas depend on ground water and also well water. So the ground water being very vital was taken for the study. During various seasons (monsoon and post monsoon), many industries discharge their industrial effluents into the water sources without any treatment. As a result the polluted water seeps into the ground water. Due to percolation of the polluted water into the ground water the quality of ground water and around the sampling sites are affected very severely and become unfit for domestic purpose.

Physico-Chemical Analysis- Water quality parameters were analyzed using standard methods. During the sample collection temperature was note using thermometer and details of different methods relevant to parameters are shown in Table.

water quality parameters and estimated standard method.

S.No.	Parameter	Unit Test	method
1	Temp	o degree C	Thermometer
2	pH -	-	pH meter
3	EC	µS/cm	Digital conductivity meter
4	TDS	mg/L	Digital meter
5	Alkalinity	mg/L	Acid titration
6	Hardness	mg/L	EDTA titration
7	Calcium	mg/L	EDTA titration
8	Magnesium	mg/L	EDTA titration
9	Chloride	mg/L	Argentometric titration
10	Fluoride	mg/L	Selective ion electrode analysis

Results and discussion

Results of the physico-chemical parameters of water samples

Parameter	Unit	S1 Garhani	S2 Jagdishpur	S3 piro	BIS(IS10500)	WHO(2011)
Temp	o C	23	25	24	-	-
Ph	-	7.02	7.03	7.29	6.5-8.5	7.5-8.5
EC	$\mu\text{S}/\text{cm}$	870	2247	2646	-	-
TDS	mg/L	609	1673	1836	500	500
Alkalinity	mg/L	192	280	370	-	-
Hardness	mg/L	360	454	600	500	500
Calcium	mg/L	48	124	148	75	75
Magnesium	mg/L	29	39	60	30	30
Chloride	mg/L	138	580	580	250	200
Fluoride	mg/L	0.6	8	8	1-1.5	1-1

Temperature -Temperature is the most important biologically significant factor, which plays a vital role in the metabolic activities of the organism. The temperature ranges from 23°C at S1 to 24°C at S3 in the selected study areas. There is no much difference in the change of temperature at the locations.

pH (pouvoir hydrogène) - The intensity of the acid or alkaline conditions of a solution is expressed by the term pH. pH is considered as an important ecological factor and provides information on many types of geochemical equilibrium and solubility calculations. The maximum pH was recorded as 7.29 at sampling location Piro and the minimum was 7.02 at Garhani. When compared with the standard values of WHO the water samples are found to be in permissible limit at all the three locations.



RESEARCH SCHOLAR RECORDED PH VALUE IN LAB

Electrical Conductivity (EC)- Electrical conductivity (EC) is the measure of the water's ability to convey the transport of electric current. It signifies the amount of total dissolved salts and is a useful tool in evaluating the purity of water. Conductivity shows significant correlation with around ten parameters of water. In the study area the EC values were in the range of 870-2646 $\mu\text{S}/\text{cm}$. Higher EC values were observed indicating the presence of high amount of dissolved inorganic substances in ionized form.

Total Dissolved Solids (TDS) -Total dissolved solids indicate the presence of inorganic salts and small amount of organic matter in groundwater. Water with TDS greater than 500 mg/L is not desirable for drinking purpose but very rarely TDS

up 1500 mg/L is allowed, highly mineralized water may be used where better quality water is not available. TDS values in the study area varied from 609 mg/L to 1836 mg/L. Excluding TDS value at Piro (1836 mg/L) others were found within the permissible limits of WHO 1000 mg/L sample location.

Total Hardness (TH) - Hardness is the property of water, which prevents the lather formation with soap and increases the boiling points of water. Hardness of water is expressed as the sum of calcium and magnesium salts or both. The total hardness of the present study areas ranges from 360 mg/L to 600 mg/L with Piro location having the highest hardness of 600 mg/L which exceeds the WHO limit of 100 -500 mg/L.

Total alkalinity (TA)- It is the amount of alkali in the form of carbonates (CO_3^{2-}), bicarbonate (HCO_3^-) and hydroxides (OH) present in water and it also acts as a stabilizer for pH. It is the capacity of water to neutralize acids. Too high alkalinity in the study area is determined in the range of 192- 370 mg/L.



RESEARCH SCHOLAR DOING TITRATION IN LAB

Calcium (Ca^{2+}) - Calcium is naturally present in water and is directly related to hardness and is the chief cation in the water. In the study area the calcium concentration ranged between 48 mg/L to 148 mg/L and is found within the permissible limits of WHO 75- 200 mg/L.

Magnesium (Mg^{2+}) - Magnesium is responsible for water hardness. In the investigated water samples magnesium show very strong positive correlation which ranges from 29 mg/L to 60 mg/L which was found within the WHO limit.

Chloride (Cl)- The chloride content increases the electrical conductivity of water which in turn increases the corrosivity of water. People exposed to higher chloride content in water are subjected to laxative effects. In the present analysis, chloride concentration was found in the range of 138 mg/L to 580 mg/L. Most of the water samples collected from study area was above the prescribed limits 0- 200 mg/L of WHO. 580 mg/L was recorded.

Fluoride (F) - Fluoride is an ionic compound derived from fluorine and is naturally found in many rocks. Probable source of high fluoride in Indian waters seems to be that during weathering and circulation of water in rocks and soils fluorine is leached out and dissolved in ground water. The most obvious health effect of excess fluoride exposure is dental fluorosis. Fluoride at a lower concentration at an average of 1 mg/L is regarded as an important constituent of drinking water (WHO, 2011). fluoride concentration in the study area was found to be in the range of 0.6 mg/L to 8 mg/L which is considered above the WHO permissible limit of 1- 1.5 mg/L.

Conclusion

Physico-chemical analysis was carried out to assess the water quality in selected locations of Bhojpur. By observing the result, it can be concluded that the parameters which were taken for studying the water quality show that, the maximum pH of 7.29 was recorded at piro location, indicating that the water may be alkaline. Fluoride concentration was found in the range of 0.6- 8 mg/L. Most of the sample locations were found above the WHO permissible limits. High EC values were observed in almost all of the sampling points. Chloride concentration was found in the range of 138 mg/L to 580 mg/L. Positive correlated values were found between TDS and EC (0.999999), magnesium and total hardness (0.947598). Comparing the three sampling sites, S2 (jagdishpur) and S3 (piro) show high values of EC, TDS, TH, alkalinity, Ca²⁺, Mg²⁺, Cl and F because they are located close proximately to the industries and even at low intensity effluent discharge they have negative effects on ground water. In this present investigation, it was found that the most of the parameters were exceeding the permissible limit of WHO, so that the water in the study area is not suitable for drinking purposes.

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