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Physico-chemical Analysis of Bore-well Water of Malda District

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ABSTRACT

The main source of drinking water in India is groundwater. Groundwater is also used enormously for domestic purposes, agricultural practice and industrial sectors. The composition of groundwater varies from place to place depending on the nature of soils through which it flows. However, the groundwater becomes contaminated due to human activities. In this paper, we studied the composition of bore well water collected from different places of nine blocks of Malda district, West Bengal, India. We also analyzed the deviation of composition of bore well water from WHO standard.

1. Introduction

Groundwater is the most reliable source of drinking water in India [1]. But now-a-days, this natural source is becoming a scarce commodity due to over utilization by human being for domestic as well as agricultural and industrial sector. Increase in population and rapid urbanization has enhanced the demand of groundwater tremendously.

The main source of drinking water in the developing countries like India is bore-well water. In this system a borehole is drilled into the aquifer level for withdrawing water by hand pump or by using machine. The quality or composition of bore-well water varies from place to place depending to the nature of soils, rocks and surfaces through which the water flows [2]. However, the quality of bore-well water becoming unsafe for drinking due to human activities like disposal of chemicals and microbial matters on the land surface.

In the present work, we examine the quality of bore-well water collected from nine different places of Malda District in West Bengal, India and investigated the physicochemical properties such as pH, total hardness, chloride, nitrate, sulphate, calcium, magnesium, total dissolved solids, iron, fluoride, alkalinity etc following standard methodologies. We also made a comparative study of our findings with WHO standardized data to assess the quality of water.

2. Materials and Methods

2.1 Study area

Malda district is situated at the middle of West Bengal between North latitude $24^0$40'20" N to $25^0$32'08" N and East longitude $87^0$45'50" E to $88^0$28'10" E and is surrounded by Uttar Dinajpur district on the north, Murshidabad district on the south, Bangladesh on the east and Behar and Jharkhand on the west (**Figure 1**). Few rivers such as the Ganga, Mahananda, Fulahar and Kalindri flow through this district. The total area of the district is 3,733.66 square kilometers. The district has fifteen blocks namely Bamangola, Chanchal I, Chanchal II, English Bazar, Gazole, Habibpur, Harishchandrapur I, Harishchandrapur II, Kaliachak I, Kaliachak II, Kaliachak III, Manikchak, Old Malda, Ratua I, Ratua II under two subdivisions. But in our present study we did not consider the Kaliachak I, Kaliachak II, Kaliachak III, Manikchak, Ratua I, Ratua II blocks because these blocks are arsenic prone areas. However, we will work very soon with these arsenic affected blocks with some others physicochemical parameters.

Figure 1: Map of our study area

2.2 Geomorphology

Physiographically Malda district can be separated into regions namely Tal, Diara and Barind. The western and eastern side of Mahananda River is Tal and Barind region respectively. The Mahananda river has flown in the midway of Malda District along north-south direction. The Diara region is the southern side of river Kalindri and south-west part of the district. The Barind region comprises with Old Malda, Gajol, Bamangola and Habibpur blocks which is made up with older alluvium soil. Scarcity of drinking water is found in this region during summer. The Tal region consisting of recent alluvium soil with sandy clay, sand and fine slit. The blocks present in Tal region are Ratua, Chanchal and Harishchandrapur. The soil of Diara region is also recent alluvial with sand and clay. The blocks such as English Bazar, Baishnab Nagar, Kaliachak and Manikchak fall under Diara region. The average elevation of the district is 30 mts above sea level.

2.3 Bore-well water Collection

The plastic bottles used for sample collection were cleaned with mineral acid and washed thoroughly several times to avoid any kind of contamination during the collection of samples. Then the bottles were rinsed with de-ionised water. About 2 litre of each sample was collected in the bottle after pumping out sufficient water from the bore-well. The blocks of Malda district from where the samples were collected are shown in **Table 1**.

Table 1: Sample No collected from different blocks of district Malda, West Bengal

Sample no	Location (blocks)
M1	Bamangola
M2	Chanchal I
M3	Chanchal II
M4	English Bazar
M5	Gazole
M6	Habibpur
M7	Harishchandrapur I
M8	Harishchandrapur II
M9	Old Malda

3. Results and Discussions

Physico-chemical parameters of bore-well water collected from nine different places of Malda District were determined following standard methodologies [3, 4]. The parameters such as pH, total dissolved solids and Electrical conductivity, total hardness, iron, fluoride, chloride and alkalinity were analyzed thoroughly and shown in **Table-2**. We also mention the permissible limits of different parameters given by WHO in **Table 3**.

Table 2

Physicochemical Analysis of Bore-well Water of various blocks of district Malda, West Bengal

Sample no	pH	EC µs/c m	TDS ppm	TH mg/l	Cl mg/l	TA mg/l	F mg/l	Fe mg/l
M1	6.98	676	546	275	88.54	377	0.67	0.46
M2	6.72	705	642	368	99.40	373	0.64	0.57
M3	6.83	745	665	397	110.46	387	0.60	0.58
M4	6.86	689	679	361	94.44	320	0.70	0.53
M5	7.04	823	517	285	85.77	372	0.65	0.45
M6	7.09	869	521	262	86.67	359	0.67	0.41
M7	6.91	769	658	384	93.45	370	0.64	0.55
M8	6.93	841	636	381	89.06	386	0.71	0.52
M9	7.08	693	611	357	92.28	366	0.64	0.58

Table 3: WHO Standards for drinking water

Parameter	WHO Standard
pH	7.0-8.0
EC µs/c m	1000
TH mg/L	100
Cl^- mg/L	250
TDS ppm	1000
Fe mg/L	0.1
F mg/L	1,0
TA mg/L	600 (BIS)

pH : An important physical characteristic for analyzing the quality of bore-well water is the determination of pH which may be defined as the minus logarithm of hydrogen ion concentration. It indicates whether any aqueous sample is acidic or basic in nature. The permissible limit of pH for drinking water is 7.0-8.0 given by WHO. The pH values of our studied areas vary from **6.83 – 7.07.**

Electrical Conductivity (EC): Another important parameter to assess the quality of water is Electrical conductivity which is considered the ability to conduct electric current through the samples under investigation [5]. Electrical Conductivity of an aqueous solution at certain temperature depends upon the presence of free ions which originate from dissolved minerals [6]. Higher the Conductivity, higher is the mineral content dissolved in water. The Conductivity of the groundwater of our studied areas ranges from 676-869 μs/cm whereas the permissible limit for drinking water is 1400 μs/cm given by WHO.

Total dissolved solids (TDS): The amount inorganic solid in mg dissolved in 1 litre of water is termed total dissolved solids (TDS) permissible limit of which is 1000 mg/l as per WHO [7]. The TDS values of our studied areas vary from 517-679 mg/L which is quite less than the WHO standard. We obtain some ideas such as hardness, ground water pollution, taste etc. from TDS value [8]. It is observed that the TDS values of Tal and Diara regions are comparatively higher than the Barind region.

Total Alkalinity (TA):

The presence of ionic species such as bicarbonates, carbonates, hydroxides, phosphates cause total Alkalinity of groundwater [9, 10]. The dissolution of minerals from soil into water causes alkalinity of bore-well water. The release of waste waters into the soil also leads to the increase in alkalinity of ground water. The desirable limit of total alkalinity of ground water is 120-600 mg/L as prescribed by WHO. The alkalinity of the bore-well water of our studied places ranges from 320-587 mg/L.

Total Hardness (TH):

The hardness of water arises due to the presence of Ca & Mg salts as carbonates, fluorides and sulphates [11]. The undesirable effects of hard water are consumption of extra soap in laundry works, formation of stains on clothes, sticking of precipitation of hard water on the surface of boilers, utensils, tubs and sinks etc. Total hardness in the areas of our investigation ranges between 262 ppm to 384 ppm. The permissible limit is 600 ppm as per WHO. It is noticed that the Total hardness value in Tal region is comparatively higher than Barind and Diara regions.

Chloride: The permissible limit of Chloride in ground water samples recommended by WHO is 250 mg/l. The porosity and permeability of soil play a vital role for high chloride content of ground water [12]. The ranges of chloride in bore-well water of our studied areas vary from 85.77-110.46 mg/L.

Fluoride: Fluoride is poisonous ion which causes dental and skeletal damages. The presence of fluoride depends on the fluoride content of soils or rocks through which water flows [13]. The fluoride content of various blocks ranges from 0.60-0.71 mg/l whereas the permissible limit is 1 mg/l as per WHO guidelines.

Figure 2

Variation of pH of different blocks of district Malda, West Bengal

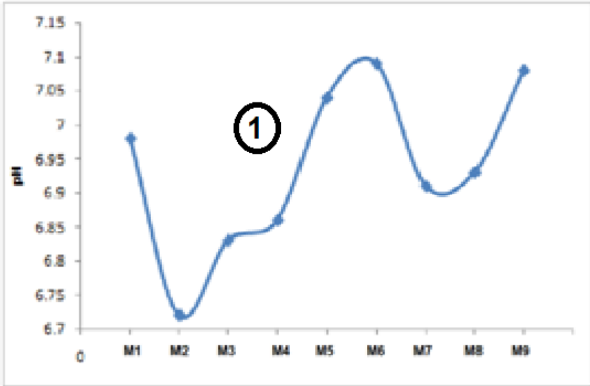


Figure 3

Variation of TDS of different blocks of district Malda, West Bengal

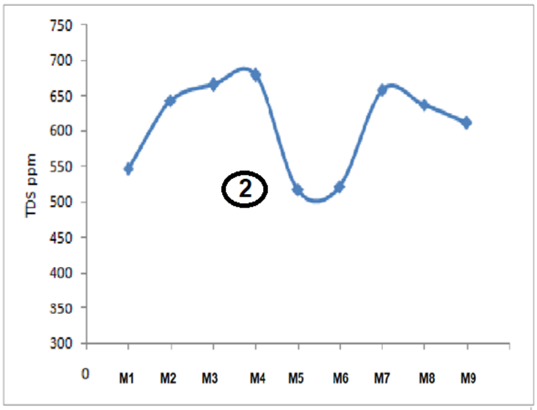


Figure 4

Variation of TH of different blocks of district Malda, West Bengal

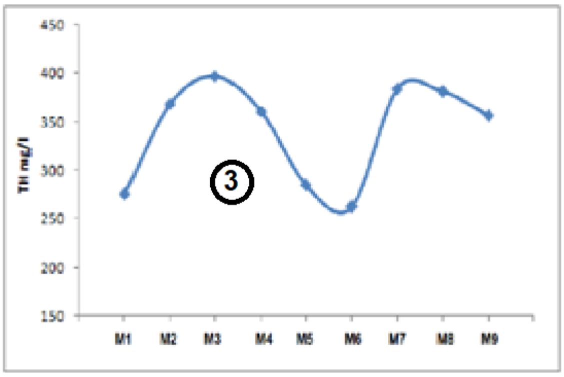
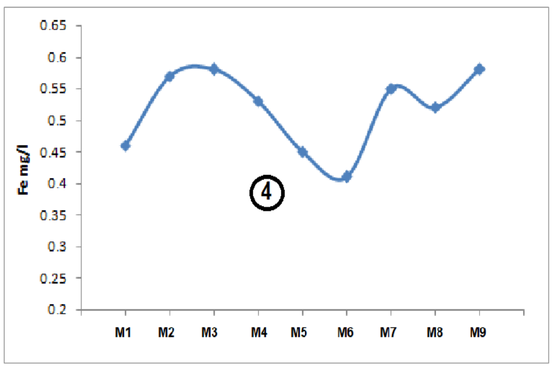


Figure 5

Variation iron content of different blocks of district Malda, West Bengal



Iron: Iron causes undesirable taste to drinking water. It can stain clothes thereby affecting the laundry works. Ferrous salts present is ground water precipitate as brown ferric hydroxide which is insoluble in water. Formation of thin layer inside the pipeline is caused due to the deposition of ferric hydroxide [14]. The permissible limit of iron in drinking water is 1.0 mg/L as per WHO. The iron content of various blocks of our studied areas ranges from 0.41-0.58 mg/L. The Variation of pH, TDS, TH and iron content of different blocks are shown in **Figure 2**.

4. Conclusions

The careful analysis of various water quality parameters of bore-well water by physicochemical analysis from nine different blocks of Malda district in West Bengal reveals that pH, total hardness, chloride, nitrate, sulphate, calcium, magnesium, total dissolved solids, iron, fluoride, alkalinity etc are quite well within the desirable limits prescribed by WHO. The TDS, TH, Iron and TA contents of Tal and Diara regions are little bit higher than Barind region which may be regarded due to nature of recent alluvium soil of Tal and Diara regions. Considerably low chloride and fluoride contents reveal that there is no reasonable contamination of groundwater from polluted surface water. The bore-well water of the studied areas is suitable for drinking and household purposes if proper treatment is carried out to minimise the contaminations.

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