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SEASONAL VARIATION OF DRINKING WATER QUALITY WITH RESPECT TO FLUORIDE AND NITRATE IN DHAKUAKHANA SUB-DIVISION OF LAKHIMPUR DISTRICT OF ASSAM

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ABSTRACT

The present investigation has been undertaken to determine the seasonal variation of the quality of drinking water of the study area Thirty water samples were analysed during May-June 2008 for pH, total hardness, fluoride and nitrate contents by adopting standard methods (APHA-AWWA-WPCF, 1995) and another thirty water samples were analysed during Nov-Dec. 2008 for the same contents. The data obtained were within the standard, permissible limits of WHO. The variations of the pH values were not vary large but an increase was noticeable during winter and a lowering during the post monsoon period. All the water samples were found either soft or moderately hard. The total hardness values were comparatively higher in the water samples collected during the dry season. Fluoride and nitrate contents were found slightly higher during post-monsoon period.

Key words : pH, Hardness, Fluoride, Nitrate

INTRODUCTION

The environment for any living organism has never been constant or static. Comprising over 71% earth's surface, water is unquestionably the most precious natural resource that exists on our planet[1]. Although water is very abundant on this earth, yet it is very precious. Out of the total water reserves of the world, about 97% is salty water (Marine) and only 3% is freshwater. Even this small fraction of freshwater is not available to us as most of it is located up in polar ice caps and just 0.003% is readily available to us

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in the form of ground water and surface water. Over use of ground water for drinking, irrigation and domestic purposes has resulted in rapid depletion of ground water in various regions leading to lowering of water table and drying of wells. Pollution of many of the ground water aquifers has made many of these wells unfit for consumption. Fluoride pollution is significant global problem and WHO (1999) that that over 60 million people are affected by fluorosis in India and China and that the total global population affected as being 70 million nitrate is also of concern. Although their remains uncertainty about the scale of adverse health effects from nitrates as few countries include methemoglobinaemia as a noticeable disease (Saywell, 1999). Raised nitrate is, however, identified as a potential public health problems in countries, where concentrations in ground water reach extremely high values (Melian et al. 1997). Water provided for direct consumption and ingestion via food should be of a quality that does not represent a significant risk to human health. Water pollution studies in India have received tremendous momentum in recent times. Most of the studies are, however, related to rivers. Chemical quality of drinking water in the tea garden belt of Lakhimpur district, Assam was studied by Bhuyan *et al*. (2006). Sarma and Bhattacharya[2] studied the quality of drinking water in Darrang district of Assam with respect to fluoride and nitrate content in some locations. Drinking water quality in various locality of Dhemaji district of Assam with respect to fluoride, nitrate, arsenic and iron content was studied by Buragohain et al.[3,4]. There is no earlier data available for seasonal variation of various water quality parameters in Dhakuakhana sub-division of Lakhimpur district, Assam. The present research is undertaken with a specific view to strengthen the national and local water quality database.

Study area

The study area Dhakuakhana (Fig. 1) is one of the two sub-divisions of Lakhimpur District, which is situated in the eastern parts of India on the North-East corner of Assam located between the latitudes of 27º00’ (N) and 27º18’ (N) and the longitude of 94º13’ (E) and 94º32’ (E).

Selection of sampling seasons

The district is malorius from April to May and very hot during June to August, the air temperature ranging from 20 to 33^{o}C. In July and August, the moist heat is very oppressive. On the basis of the average rainfall and other climatic conditions, two sampling seasons were selected for this work and these are as follows –

Winter and pre-monsoon season (November to April)

Monsoon and post-monsoon season (May to October)

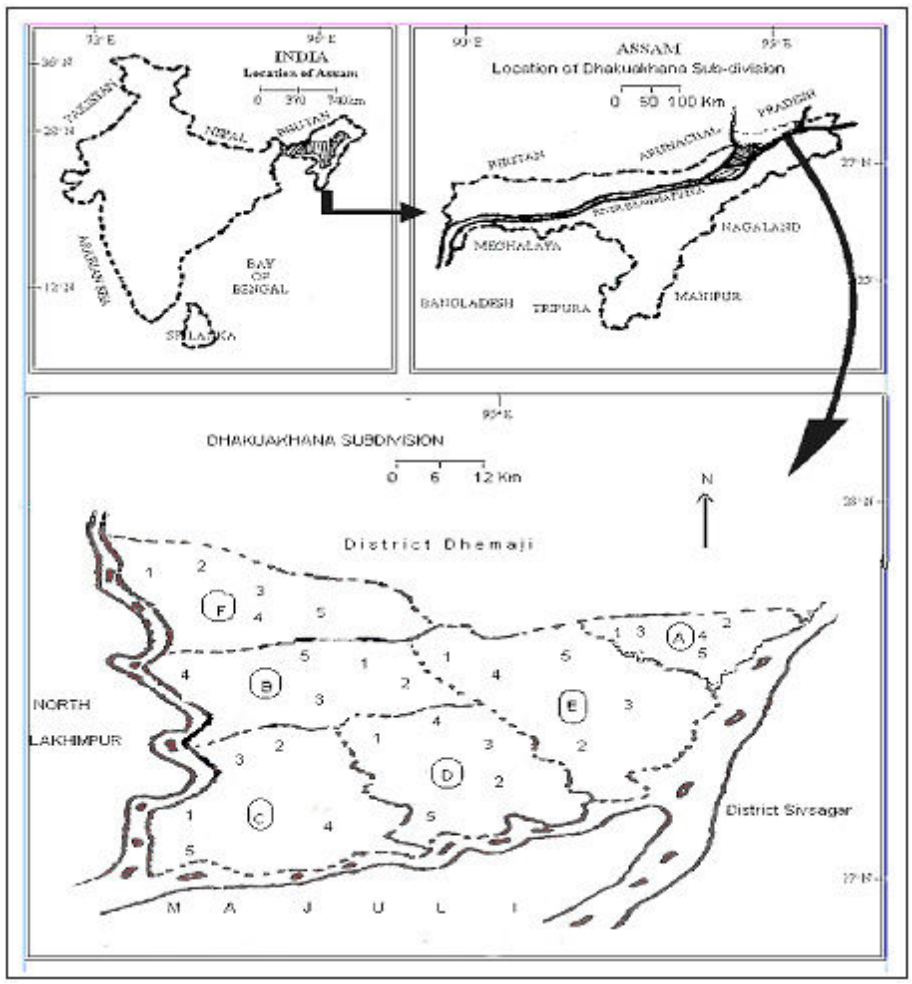

Fig. 1: Location of sampling stations in Dhakuakhana sub-division

EXPERIMENTAL

Materials and methodology

The need for careful sampling techniques varies according to the constituent being tested. Separate water samples were selected by random selection and compiled together in plastic bottles to set a representative sample. Samples were protected from direct sun light during transportation. Standard methods (APHA-AWWA-WPCF, 1995)[5] were followed during the analysis of pH, total hardness, fluoride and nitrate contents in water in

both A and B seasons. The results were evaluated in accordance with the WHO standards[6].

RESULTS AND DISCUSSION

Table 1 : Water sampling locations

Name of the gaon panchayat	Sample No.	Total number of samples	
		Season A	Season B
Harhi	A1 - A5	05	05
Dhakuakhana	B1 - B5	05	05
Subansiri	C1 - C5	05	05
Deolia	D1 - D5	05	05
Ghilamara	E1 - E5	05	05
Bordoibam	F1 - F5	05	05

Table 2 : Water test values in Harhi gaon panchayat

Sample No.	pH		Total hardness (mg/L)		Fluoride (mg/L)		Nitrate (mg/L)	
	Season		Season		Season		Season	
	A	B	A	B	A	B	A	B
A-1	6.5	6.3	65.0	55.0	0.15	0.20	01.04	01.59
A-2	6.3	6.3	69.0	60.0	0.25	0.28	00.04	00.14
A-3	6.7	6.5	94.0	74.0	0.18	0.22	00.76	00.30
A-4	6.6	6.4	34.0	28.0	0.12	0.15	03.30	03.50
A-5	6.6	6.6	77.0	72.0	0.13	0.12	02.50	03.00

(**Locations** : A-1 : Laokuth, A-2 : Gobinpur, A-3 : Modarguri, A-4 : Deoliagaon, A-5 : Panigaon)

Table 3 : Water test values in Dhakuakhana gaon panchayat

Sample No.	pH		Total hardness (mg/L)		Fluoride (mg/L)		Nitrate (mg/L)	
	Season		Season		Season		Season	
	A	B	A	B	A	B	A	B
B-1	6.7	6.5	73.0	60.0	0.17	0.20	11.30	11.60
B-2	6.4	6.4	76.0	64.0	0.19	0.25	03.20	03.50
B-3	6.6	6.4	55.0	50.0	0.14	0.14	07.10	07.50
B-4	6.3	6.3	67.0	60.0	0.12	0.18	06.50	06.00
B-5	6.8	6.6	65.0	64.0	0.13	0.14	01.10	01.70

(**Locations** : B-1 : Dhakuakhana Chariali, B-2 : Baligaon, B-3 : Brahmin gaon, B-4 : No. 1-Bantow, B -5 : Bagisa gaon)

Table 4 : Water test values in Subansiri gaon panchayat

Sample No.	pH		Total hardness (mg/L)		Fluoride (mg/L)		Nitrate (mg/L)	
	Season		Season		Season		Season	
	A	B	A	B	A	B	A	B
C-1	7.0	6.6	77.0	70.0	0.14	0.17	06.90	07.30
C-2	6.6	6.5	79.0	64.0	0.17	0.20	09.70	11.00
C-3	6.4	6.4	39.0	31.0	0.16	0.18	06.50	06.50
C-4	6.5	6.3	64.0	60.0	0.19	0.20	06.50	07.00
C-5	6.4	6.4	28.0	28.0	0.13	0.17	12.30	12.60

(**Locations** : C-1 : Kath gaon, C-2 : Sunari Sapari, C-3 : Kekuri, C-4 : Bahpara, C-5 : Mor-Noi)

Table 5 : Water test values in deolia gaon panchayat

Sample No.	pH		Total hardness (mg/L)		Fluoride (mg/L)		Nitrate (mg/L)	
	Season		Season		Season		Season	
	A	B	A	B	A	B	A	B
D-1	6.8	6.6	68.0	56.0	0.17	0.19	07.10	09.00
D-2	6.6	6.5	71.0	65.0	0.12	0.14	11.20	11.00
D-3	6.4	6.4	65.0	60.0	0.12	0.17	07.10	09.30
D-4	6.4	6.3	37.0	28.0	0.14	0.19	06.10	06.50
D-5	6.7	6.5	40.0	30.0	0.21	0.22	07.10	07.50

(**Locations** : D-1 : Phukan-gaon, D-2 : Bhakat-gaon, D-3 : Lamu-gaon, D-4 : Sakuli,
D-5 : Tamuli gaon)

Table 6 : Water test values in Ghilamara gaon panchayat

Sample No.	pH		Total hardness (mg/L)		Fluoride (mg/L)		Nitrate (mg/L)	
	Season		Season		Season		Season	
	A	B	A	B	A	B	A	B
E-1	6.6	6.4	51.0	50.0	0.22	0.25	01.02	01.55
E-2	6.8	6.4	55.0	50.0	0.20	0.20	09.20	10.00
E-3	6.5	6.6	62.0	55.0	0.16	0.17	08.10	09.00
E-4	6.8	6.5	72.0	60.0	0.17	0.19	11.20	12.00
E-5	6.7	6.5	69.0	65.0	0.20	0.25	07.20	09.00

(**Locations** : E-1 : Ghilamara Tiniali, E-2 : Kalita gaon, E-3 : Raidangia gaon, E-4 : Ghahi gaon, E-5 : Milan Nagar)

Table 7 : Water test values in Bordoibam Gaon Panchayat

Sample No.	pH		Total hardness (mg/L)		Fluoride (mg/L)		Nitrate (mg/L)	
	Season		Season		Season		Season	
	A	B	A	B	A	B	A	B
F-1	6.4	6.3	35.0	30.0	0.21	0.21	10.20	11.00
F-2	6.3	6.3	64.0	55.0	0.20	0.25	12.40	12.60
F-3	6.4	6.0	71.0	69.0	0.21	0.22	12.10	12.00
F-4	6.3	6.1	79.0	65.0	0.21	0.20	11.20	12.00
F-5	6.5	6.4	71.0	64.0	0.16	0.19	11.20	11.50

(**Locations** : F-1 : Chinai gaon, F-2 : Gohain gaon, F-3 : Baliyani gaon, F-4 : Mohbal gaon, F-5 : Dighali gaon)

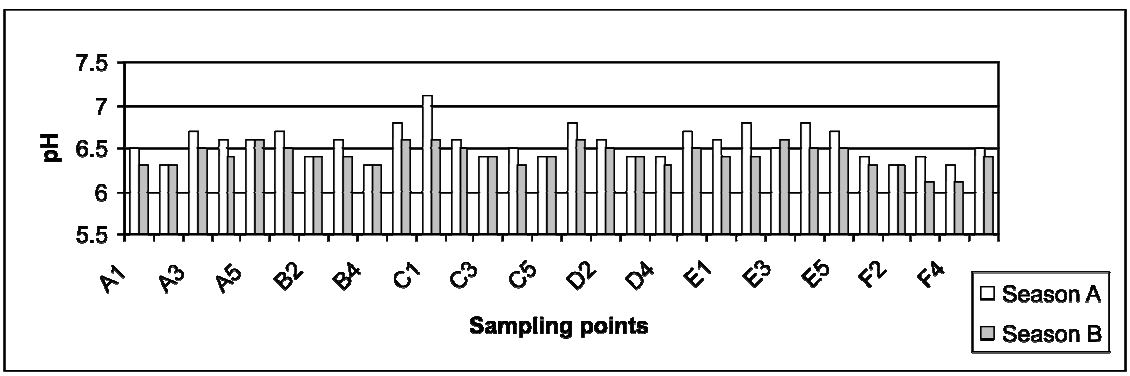

Fig. 2 : Seasonal variation of pH

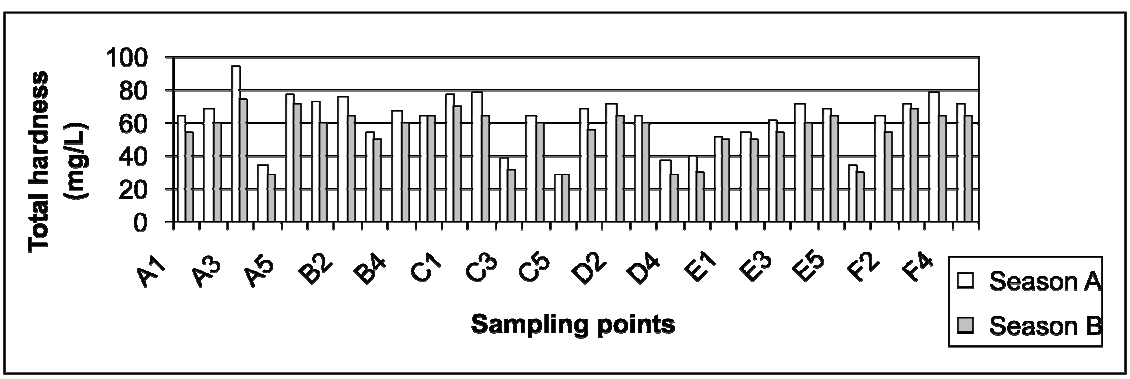

Fig. 3 : Seasonal variation of total hardness

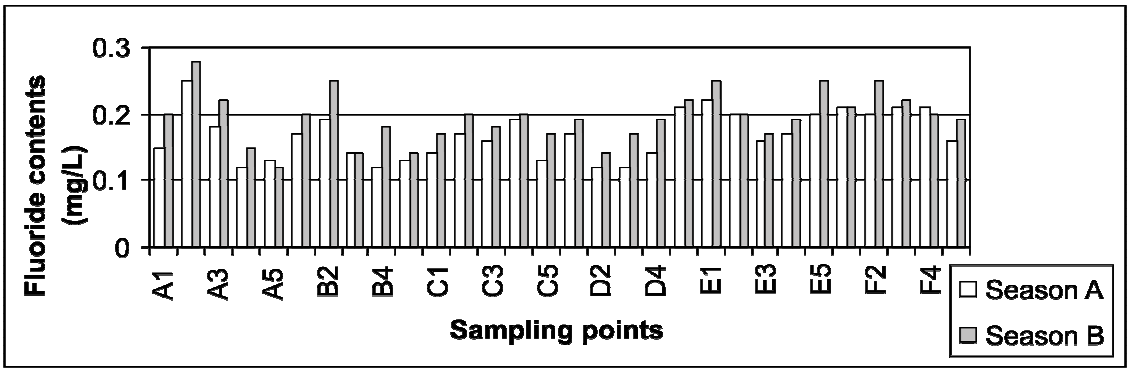

Fig. 4 : Seasonal variation of fluoride

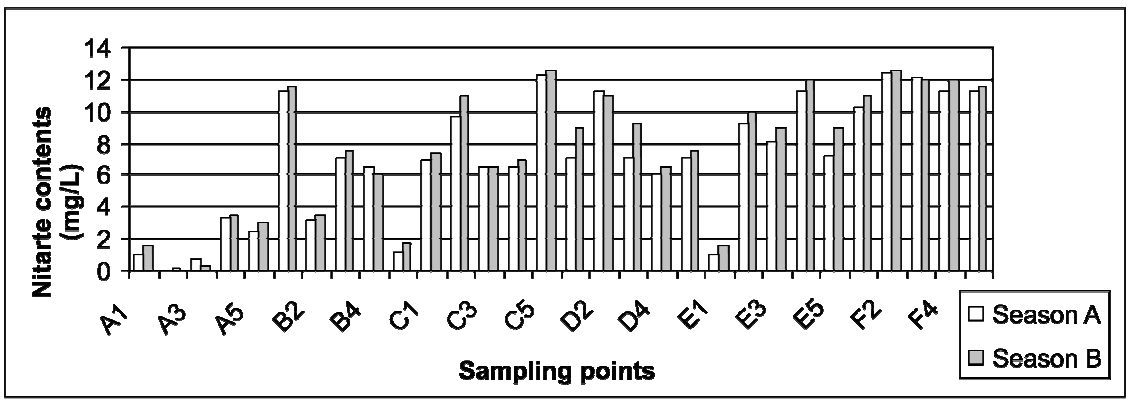

Fig. 5 : Seasonal variation of nitrate

The pH is an important water quality parameter measuring the acid-base equilibrium of the dissolved components. In natural waters, the pH is controlled by the carbon dioxide- bicarbonate – carbonate equilibrium and generally, the values lie in the range 6.5 to 8.5.Low pH causes corrosion in the distribution system and increases the metal contamination of drinking water. A typical seasonal variation of pH values is shown in Fig. 1.The variations of the pH values were not vary large but an increase was noticeable during winter and a lowering during the post-monsoon period. During post-monsoon, the photosynthetic activity gets reduced due to high temperature resulting in a slight build up of CO_2 concentration in the atmosphere and more CO_2 gets into solution in water with a subsequent decrease in pH. So far as pH values are concerned, no serious problems are likely to be encountered by using water from the different sources of Dhakuakhana Sub-division.

Hardness is the property of water, which prevents lather formation with soap and

increases the boiling point of water. It has no known adverse effect on health. However some evidence has been given to indicate its role in heart diseases. The degree of hardness of drinking water has been classified in terms of its equivalent $CaCO_3$ concentration in the following way:

(i) Soft : 0 – 60 mg/L

(ii) Moderately hard : 60 – 120 mg/L

(iii) Hard : 120 – 180 mg/L

(iv) Very hard : > 180 mg/L

In the present study, all the water samples were found either soft or moderately hard. Fig. 2 shows the typical seasonal variation in the hardness values for different sampling points. The values were comparatively higher in the water samples collected during the dry season. Because there is no rainfall of this time, the water bodies tend to accumulate the contaminants.

The presence of fluoride in ground water is attributed to the geological deposits, geo-chemistry of the location and the application of fertilizer like rock phosphate. The use of rock phosphate or fluoroappetite fertilizer can also generate fluoride ions on dissolution. Fluoride is beneficial to certain extent, when present in concentration of 0.8 to 1.0 mg/L for calcification of dental enamel especially for the children below eight years of age. But it causes dental fluorosis, if present in excess of 1.5 mg/L and skeletal fluorosis beyond 3 mg/L, if such water is consumed for about 8 to 10 years. WHO guideline for drinking water quality and water technology mission of the Government of India has specified the permissible limit for fluoride in drinking water as 1.0 mg/L. It can be extended to 1.5 mg/L if there is no alternative source in the villages. The highest desirable and maximum permissible limits for fluoride content given by ISI for fluoride in drinking water is 0.6 to 1.2 mg/L. In the present investigation, the fluoride concentrations were found to be within the permissible limit of WHO, but in some locations, where the fluoride concentration in water is less than 0.7 mg/L, it may cause dental carries. A typical seasonal variation of fluoride in the water samples are shown in Fig. 3. It was found slightly higher during post-monsoon period.

Nitrates can be found in soil, water and plants. Organic nitrogen compounds (e. g. proteins, amino acids etc.) are oxidized to nitrates by bacteria present in soil and water, when sufficient oxygen is present. Oxides of nitrogen formed in the atmosphere are also brought to water bodies as nitrates by the rains. Other sources of nitrates in water are

fertilizer use, decayed vegetables and animal matter, domestic effluent, sewage sludge, industrial discharge, refuge dump leachates etc. Normally the nitrate level is below 5 mg/L in most waters with the level being higher in ground water than in surface water, where aquatic plants decrease the level. The level tends to go up after heavy rainfall following severe drought. Higher concentration of nitrates enhances the growth of algae and other aquatic plants leading to eutrophic conditions. All the water sources have nitrate contents within permissible limit, but it was found higher during post-monsoon period. It may be due to the rainwater, which carry nitrate rich water to the ground water.

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