

Distribution of Fluoride Content in the Water System around Haldiati-Doboka Areas, Assam

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Abstract: *The severity of the impending crisis of potable fresh water and contamination to this life sustaining process by fluoride and arsenic is now a critical concern for the NE-India. Both skeletal and dental fluorosis is reported from the Karbi Anglong and Nowgaon districts of Assam with area and population are 10,526km² and 700,000 respectively. Considering all these an attempt has been made to understand the distribution pattern of fluoride content in the water resources of Karbi Anglong and adjoining Naogaon districts of Assam. The fluoride content in the water samples of the Haldiati-Doboka areas of the Karbi Anglong district, Assam, varies from 0.05mg/L to 3.52mg/L with an average of 1.89mg/L. The study has attributed enough evidence that the water system of the area is not environmentally safe with reference to fluoride content. The arsenic content varies from 3.20-10.60µg/L (permissible limit of arsenic is 10µg/L; WHO, 1984). Therefore, it can clearly be attributed that the area needs an in-depth investigation in view of the environmental aspects towards improving the quality of life forms around. It is believed that the generated environmental knowledgebase with precision and accuracy will fill up a critical domain in improving the quality of life and people around.*

Keywords: Fluoride, Water, Haldiati-Doboka, Karbi Anglong, Assam

1. Introduction

Impending crisis of potable fresh water and contamination to this life sustaining attributes is a threat to entire life forms on this mother earth. At least, 170 million people in different urban areas of the world still lack a source of portable water near their homes, and in rural areas, although access has increased rapidly in the past decade, more than 855 million people are still without safe drinking water (Barrot, 1998). Many of the states of Indian union already have alarming quantities of arsenic and fluoride in their water resources above their permissible limit to human beings (Susheela, 2007). Within the limitation of available studies so far conducted have shown enough evidences that the environmental segments in North Eastern region of India specifically Assam with respect to water quality of the region is not at all satisfactory (RGNDWM, 1993; Paul, 2000; Chakravarty et al., 2000). The severity of the problem with respect to fluoride and arsenic is now a critical concern. Both skeletal and dental fluorosis is reported from the Karbi Anglong and Nowgaon districts of Assam with area and population are 10,526km² and 700,000 respectively. Available evidence has revealed that one tenth of total population is suffering from fluorosis, which finally leads to paralysis (Kotoky et al., 2008). A group of workers reported presence of fluoride up to 6.88 ppm in drinking water samples of various parts of Guwahati and suburbs (Das, 2000; Das et al., 2003).

Considering all these an attempt has been made to understand the distribution pattern of fluoride content in the water resources of Karbi Anglong and adjoining Naogaon districts of Assam. It is believed that the environmental knowledgebase with precision and accuracy is a critical domain in improving the quality of life and people around.

2. Methodology

Thirty four number of water samples from tube well (TW), deep tube well (DTW) and surface water (pond) were collected from Haldiati-Doboka area, Karbi Anglong and adjoining Naogaon Districts, Assam (Figure 1) and analyzed for associated fluoride content utilizing Fluoride Ion Meter. A few representative samples were also utilized for determination of trace element concentrations in them through atomic absorption spectrophotometer (AAS). For both the approaches established standard methodology (APHA, 1995) have been followed to generate precision based knowledgebase and utilized for interpretative use of the present study.

3. Results and Discussion

The fluoride content in the studied samples varies from 0.05mg/L to 3.52mg/L with an average of 1.89mg/L (Table 1). The study has attributed enough evidence that the deep tube well samples contain comparatively more fluoride content than the hand tube wells. However, the surface water samples have shown less fluoride content below the tolerance limit (WHO, 1984; IS, 1983). Water with high fluoride content, being highly electronegative is preferentially attracted to Ca⁺⁺ ions, rich in bones and teeth and is thus deposited as calcium fluoroapatite crystals. However in general fluoride ions from the minerals (fluorospars, fluoroapatite, and cryolite) leach into the ground water and contribute to high fluoride concentrations. Mica group of minerals also occasionally contribute to water fluoride content. The minerals usually fluorospars occurs in structurally weak planes like shear fractures, joints and at the contact of host rock and vein minerals such as vein quartz. They weather and form calcium and magnesium carbonates which act as sink of high fluoride ions. It is the

leachable state of fluoride ions that determine the water fluoride levels. However, the leachability is governed by 1)

pH of the draining solution and 2) by the amount of dissolved carbon dioxide in the rock-soil system.

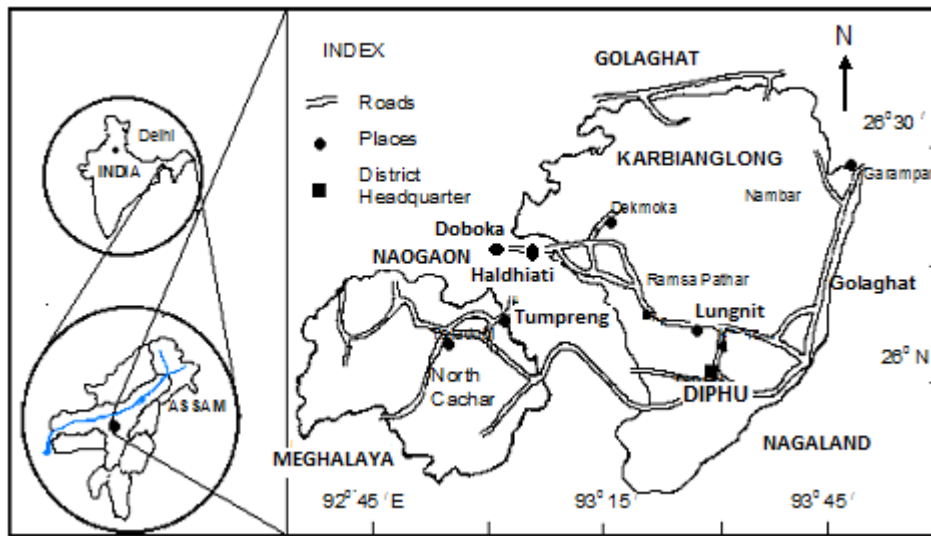


Figure 1: Location map of the study area

Geologically, Karbi Anglong area is highly enriched with mineral matter like limestone and coal. The present observation on the trace element distribution and fluoride content has given strong evidence on the relationship of the fluoride with Ca^{2+} and Na^{+} contents. The limestone of the region contains the equivalent of 31 to 52% CaO and 0.06 to 0.28% of Na. The strong affinity of F^{-} with Ca^{2+} and Na^{+} has shown enough evidence towards its association with them and can be considered very well that the existing litho-geological environment has played a major role in distribution of fluoride content in the associated water system. Since the area is free from all types of industrial activities, natural incorporation of fluoride into the water sources is the most plausible explanation for the elevated level of fluoride in them.

Table 1: Concentration of fluoride in water samples around

S. No	Locations	Source	Fluoride (mg/L)
1	Howraghat (Near Jamuna Nadi Bridge)	DTW	0.26
2	Howraghat(Near Netaji welfare Society)	DTW	0.28
3	Debasthan	DTW	0.32
4	Nazrana Hotel	HTW	0.41
5	Nilbagan Tinali	DTW	0.49
6	Udhaganga	Surface Water	0.07
7	Ardangengti Gaon	HTW	0.05
8	Haldhiati Gaon	DTW	1.50
9	Akashiganga(Near No2 Haldhiati Gaon)	DTW	2.90
10	Mahamaya Hotel	DTW	0.27
11	Matikhola	HTW	3.27
12	Nilbagan L.P. School(Two Nos)	HTW	2.17
13	Nilbagan Kabarsthan	HTW	2.65
14	Nilbagan Bazar	HTW	2.67

15	Nilbagan Play Field	HTW	2.35
16	Nilbagan M.V. School	HTW	1.65
17	Dakhin Nilbagan	HTW	2.65
18	Jayanti L.P. School	HTW	2.75
19	H. S. School, Doboka	HTW	0.87
20	Namghar, Doboka	HTW	1.16
21	Nizparakhowa	DTW	3.21
22	Udhab Gaon	HTW	3.12
23	Haldhiati (Near L.P.School)	HTW	3.48
24	Pub Nilbagan	HTW	1.75
25	Akashiganga L.P.School	HTW	1.68
26	Engtigaon	DTW	2.19
27	Udhaganga	HTW	1.64
28	Near Jamiuna Nadi	HTW	2.71
29	Haldhiati Tinali	HTW	3.52
30	Haldhiati (NO.2)	HTW	3.36
31	Doboka	DTW	3.36
32	Doboka H.S. School	HTW	1.25
33	Ragibis House, Doboka	HTW	2.63
34	M.V.School, Nizparakhowa	HTW	1.69

(DTW=Deep Tube Well; HTW=Hand Tube Well; RW=Ring Well)

Haldhiati-Doboka, Kari Anglong-Nowgaon Districts, Assam

The arsenic content varies from 3.20-10.60 μ g/L (Table 2). Permissible limit of arsenic is 10 μ g/L (WHO, 1984). Therefore, it can clearly be attributed that the area needs an in-depth investigation in view of the environmental aspects. The arsenic concentration has shown significant correlation with the iron content. It is believed that the distribution of arsenic is basically related with the associated iron content in them. The higher incorporation of iron to the water system from the associated lithology of the region might have played a role in its distribution and association of arsenic above the permissible limit (10 μ g/L).

Table 2: Elemental Concentration of the water samples (As *µg/L and others are in mg/L) in and around Hadiati-Doboka area, Karbi Anglong District, Assam

Sl. No.	F	Mg	Zn	Na	K	Ca	Pb	Fe	Mn	Ni	Cd	Cr	Co	Cu	As*
1	0.26	61.5	0.14	171	46.9	45.2	BDL	1.49	0.16	BDL	0.04	BDL	BDL	BDL	4.3
2	0.26	46.7	0.46	201	16.9	48.7	BDL	2.12	0.22	BDL	0.06	BDL	BDL	0.09	7.8
3	0.31	65.8	0.09	214	15.1	55.0	BDL	0.38	BDL	BDL	BDL	BDL	BDL	BDL	3.9
4	0.41	54.6	0.14	310	24.6	51.9	BDL	2.52	BDL	BDL	0.08	BDL	BDL	BDL	10.2
5	0.49	30.7	0.13	420	22.5	63.4	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	4.1
6	0.07	5.9	0.17	186	15.7	32.6	BDL	0.53	0.27	BDL	0.03	BDL	BDL	BDL	3.2
8	0.05	12.3	0.11	253	37.9	34.5	BDL	BDL	0.13	BDL	BDL	BDL	BDL	BDL	BDL
9	1.47	25.4	0.25	790	19.9	81.5	BDL	1.84	0.47	BDL	BDL	BDL	BDL	BDL	9.5
10	2.89	20	0.4	853	24.6	87.0	BDL	2.96	0.05	BDL	0.04	BDL	BDL	BDL	10.6
11	0.27	2.6	0.11	183	46.1	19.8	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL

The scenario as evidenced from the study along with the available literature is alarming enough and a concerted effort combining all the related aspects towards understanding the root cause of the problem is an utmost requirement (Tamuli, 2010; Kotoky et al., 2010). It can very well be attributed from the study that the area is not evenly affected by the fluoride content in the water system. The areas having more than 1.5mg/L of fluoride concentration needs specific attention to undertake detail investigation combining human health and societal implications. The part played by the local geology of the areas around needs in-depth investigation with detail identification/transformation/dissolution/leaching mechanism of fluoride containing minerals in them. The fluoride content as evidenced from the study is increasing with the increase in deepness of bore well. Therefore, as an alternative source, development of system for water supply from natural sources like river (as is presently carried out by Gujarat Government) can be a most effective solution. As it is generally seen that complaints of skeletal joint pain and dental fluorosis is increasing rapidly with urbanization of human society all water supply system should invariably be monitored and studied before it reaches hands of common people.

4. Conclusion

The fluoride content in the water samples of the Hadiati-Doboka areas of the Karbi Anglong district, Assam, varies from 0.05mg/L to 3.52mg/L with an average of 1.89mg/L. The study has attributed enough evidence that the water system of the area is not environmentally safe with reference to fluoride content. The deep tube well samples contain comparatively more fluoride content than the hand tube wells and surface water source is comparatively free. Moreover, analysis of trace element concentration has attributed a notable observation that the water system of the area is not only contaminated by fluoride content but also associated with arsenic content above the prescribed tolerance limit. The arsenic content varies from 3.20-10.60µg/L (permissible limit of arsenic is 10µg/L; WHO, 1984). Therefore, it can clearly be attributed that the area needs an in-depth investigation in view of the environmental aspects towards improving the quality of life forms around.

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