Asian Journal of Water, Environment and Pollution, Vol. 10, No. 2 (2013), pp. 87–90.

Short Note

Distribution of Fluoride in the Environment of Balasore District, Odisha, India

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Received September 4, 2012; revised and accepted March 12, 2013

Abstract: Fluoride pollution in the Balasore district of Odisha has become a challenging issue before the scientists and administrators as well. The problem is wide-spread in most of the areas of the district and fluorosis has been revealed in most of areas where people are using fluoride-contaminated drinking water. The in situ fluoridization of water has caused contamination in static water quality, ground water, soil, water hyacinth, grass and drumstick plants as well. A detailed investigation has revealed that fluoride content varies in the range of 0.6 ppm to 400 ppm.

Key words: Fluoride, fluorosis, water hyacinth, drumstick, WHO, groundwater.

Introduction

There is a definite pathway through which pollutants pass from the source to the living world. In situ fluoride, which arises due to the deep well boring process has been found to be the most contaminating factor that pollutes the groundwater level (Girhe, 1996; Mukhopadhyay, 1996; Rao et al., 1993; Rajiv Gandhi Mission, 1986, 1993; Sarolkar, 1993). When the water reaches the surface, it contaminates the soil as well as static water medium. The plants developed in the static water medium as well as surface soil get extensively contaminated. Due to this contamination the plants and living organisms which absorb this water get contaminated with fluoride toxicity (Singh, 1996; Navabharat Times, 2001; Times of India, 1999; WHO, 1994). In the present study an attempt has been made to monitor the fluoride intake of different biotic species and environmental sources such as water hyacinth, grass and drumstick plant and static water, ground water and soil respectively. The data obtained have been correlated and the impact of fluoride on different medium has been evaluated exhaustively.

Area of Study

Balasore district is one of the coastal district of Odisha, situated with a longitude 21°3″ to 21°59″ north and a longitude of 86°20′ to 87°29′ east with a geographical area of 3634 sq km. The district can be divided into three geographical regions, namely, the coastal belt, the inner alluvial plain and the north-western hills.In this study, 20 sampling sites have been selected in a radius of 3500 m, 7000 m, 15,000 m, and 30,000 m. Sample collection was done in all four seasons of the year. The periods of collection was from 5 am to 11 am morning hours and samples were stored for analysis. The concentration of fluoride in water has been analyzed by ion-analyzer. For studying the effect on vegetation, samples have been taken from different places with reference to the major polluted sites. The results obtained have been incorporated in tabular as well as graphical form. The schematic representation of fluoride contamination has been represented in the study.

Result and Discussion

The concentration of fluoride present in soil samples collected from 20 different sites has been represented in Table 1. The result revealed that in specific areas like Hatigada, Bhogarai, Baliapal, Chandbali, Kuanarpur, Nilagiri etc. fluoride concentration are found to be very high (Figure 1) as compared to the WHO guidelines. The static water medium shows maximum concentration of

Table 1: Concentration of fluoride in soil samples

Sl. No.	*Sampling site*	*Sampling Station Code*	*% Fluoride*
1	Hatigada	S_1	245 mg/ltr
2	Jaleswar	S_2	332 mg/ltr
3	Kamarda	S_3	267 mg/ltr
4	Bhogarai	S_4	389 mg/ltr
5	Baliapal	S_5	241 mg/ltr
6	Basta	S_6	455 mg/ltr
7	Rupsa	S_7	361 mg/ltr
8	Chandbali	S_8	220 mg/ltr
9	Remuna	S_9	405 mg/ltr
10	Nilagiri	S_{10}	345 mg/ltr
11	Khantapada	S_{11}	303 mg/ltr
12	Bahanaga	S_{12}	324 mg/ltr
13	Anantapur	S_{13}	411 mg/ltr
14	Simulia	S_{14}	645 mg/ltr
15	Khaira	S_{15}	445 mg/ltr
16	Kasa	S_{16}	265 mg/ltr
17	Markona	S_{17}	287 mg/ltr
18	Kunarpur	S_{18}	232 mg/ltr
19	Darakholi	S_{19}	405 mg/ltr
20	Kupari	S_{20}	200 mg/ltr

fluoride followed by that found in surface water level. The ground water is found to be highly contaminated with fluoride concentration almost 10 times more than WHO standard.

The study has revealed that in the sampling sites S_1, S_4, S_5, S_8, S_9, S_{17}, S_{18}, S_{19} and S_{20} fluoride concentration is high in all sources taken under observation as represented in Figure 2. The surface water is found to be highly contaminated with fluoride like ground water in sites such as sampling stations S_8, S_9, S_{15}, S_{17} and S_{18}. In other sampling stations i.e.S_1, S_4, S_5, S_{19}, S_{20}, it has been found that the fluoride concentration of surface water is high in comparison to the ground water which may be attributed to the fact that surface water might have become more concentrated due to the nearby stations from which fluoride must have reached through various pathways while ground water, being exposed to these sources, must be less contaminated. The same trend is observed in case of vegetations and soil samples as well. As the fluoride contamination in Balasore district is not due to any industrial activity, necessary measures are to be taken to get rid of this pollutant. In some specific sample sites such as S_4, S_5, S_6, S_7, S_{11}, S_{12}, S_{13}, S_{14}, S_{19} and S_{20} the surface soil is much highly contaminated as compared to the soil from 25 cm depth which revealed that in these sites fluoride contamination is arising due to other surface sources and then its inserting to the ground to cause contamination.

Taking into consideration the water quality, it has been observed that in most of the sites the static water fluoride content is less than the groundwater contamination with a deviation at site number S_5 and S_6, which may be attributed to the surface contamination of the static water quality.In case of vegetation, it has been observed that, as the water hyacinth is growing on static water, maximum amount of fluoride is getting accumulated on these plants followed by the drumsticks as given in Figure 3. The concentration of fluoride is found to be least in the grass samples, which indicates that the fluoride samples found in these areas are getting generated from the ground level sources.

Depending upon the quality of fluoride in various experimental samples, the concentration has been classified into four different categories such as normal zone, average zone, semi-polluted and highly polluted zone as mentioned in Figure 4.

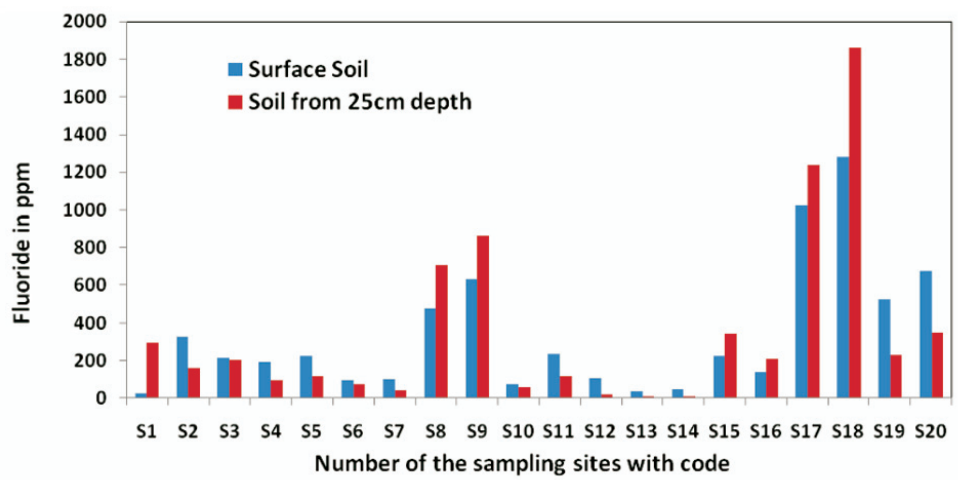

Figure 1: The comparative chart for fluoride in surface soil and soil in 25 cm depth.

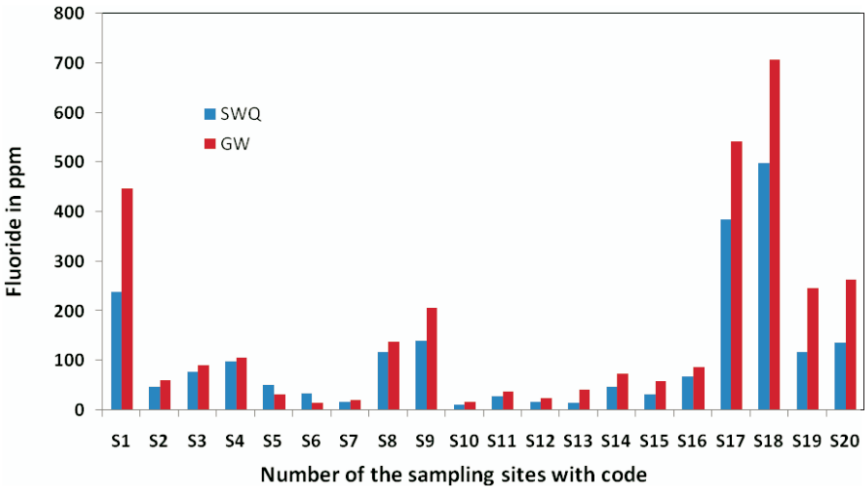

Figure 2: Fluoride contamination in static water quality (SWQ) and ground water (GW).

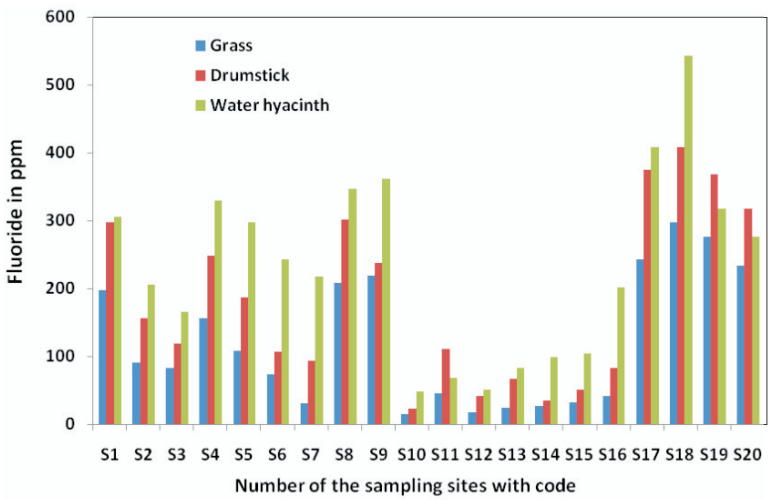

Figure 3: Fluoride contamination in grass, drumstick and water hyacinth.

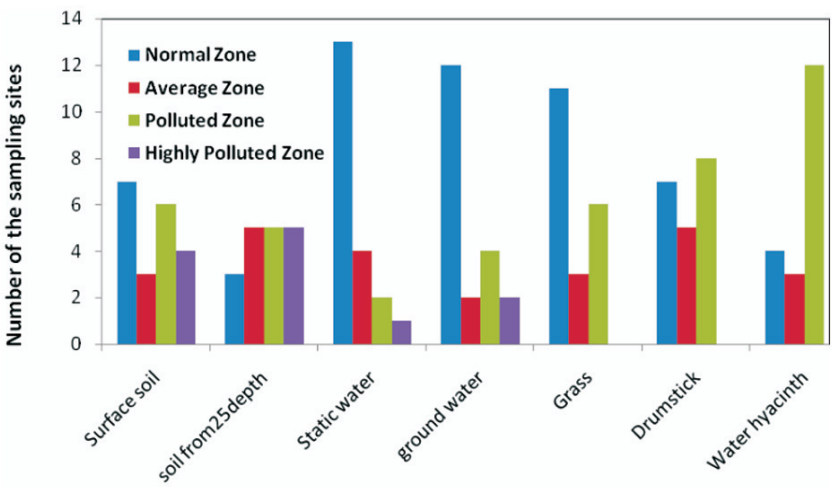

Figure 4: Fluoride contamination in different sources at various levels. (Normal zone = 0 to 100 ppm, Average zone = 100 – 200 ppm, Polluted zone = 200 – 500 ppm, Highly polluted zone= 500 –2000 ppm)

Conclusion

Though fluoride intake within the limitation of 1.5 mg/litre is required for human teeth purpose, increase in fluoride concentration has led to serious problems like fluorosis. With reference to this study, preventive measures are to be taken to get rid of this silent killer.

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