International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2020; 8(1): 231-233

Received: 04-11-2019
Accepted: 06-12-2019

Basavaraja D
Department of Environmental Science, College of Agriculture, Bheemarayanagudi, University of Agricultural Sciences Raichur, Karnataka, India

MA Bellakki
Department of Soil Science and Agricultural Chemistry, College of Agriculture, Kalaburagi, University of Agricultural Sciences Raichur, Karnataka, India

SL Arunkumar
Department of Geology, GM Institute of Technology, Davanagere, Karnataka, India

Corresponding Author:
Basavaraja D
Department of Environmental Science, College of Agriculture, Bheemarayanagudi, University of Agricultural Sciences Raichur, Karnataka, India

Assessment of groundwater fluoride using GIS in Shahapur Taluk, Hyderabad-Karnataka region, India

Basavaraja D, MA Bellakki and SL Arunkumar

Abstract
This study aims to identify high fluoride concentration in ground water of Shahapur taluk, Yadgir district of Karnataka (India). For this purposes sixty five ground water samples were collected during the pre and post monsoon season. The fluoride concentration in ground water samples was determined as per the standard methods for the examination of water and wastewater. The concentration of fluoride in the groundwater samples varies from 0.25 to 4.85 mg/L. Among the sixty five samples analyzed, 26.14% and 6.15% of the samples exceeded the maximum permissible limits of fluoride during pre and post monsoon season respectively. A fluoride zonation map has been prepared using ArchGIS software. The areas below 1.5 mg/L of fluoride have been labeled as safe zones and the areas above 1.5 mg/L as risk zones.

Keywords: Groundwater fluoride, GIS mapping, Shahapur, Karnataka

Introduction
Fluoride, the ionic form of fluorine is widely distributed in nature. It has been estimated that the element fluorine in the form of fluoride constituents 0.32% of the earth's crust. Naturally, the fluoride occurs in the combined form because of its high reactiveness. Fluorspar, Cryolite and Fluoroapatite are the parent form taking berth in the surface water, groundwater and sea water. The agricultural inputs such as application of fertilizer coupled with pesticides also contribute the fluoride to the groundwater (Girja and Singh, 2010) [1]. Fluoride has been considered as both an essential element and potent environmental pollutant. Up to a small level (1-1.5mg/L) this strengthens the enamel (Mohapatra *et al*., 2009) [2]. An excess fluoride in drinking water causes harmful effects such as dental fluorosis and skeletal fluorosis among the consumers (Chidambaram *et al*., 2003) [3]. According to World Health Organization norms, the upper limit of fluoride concentration in drinking water is 1.5 mg/L. India is among 23 nations in the world, where fluoride contaminated ground water is creating problems. Sixty-two million people including 6 million children in the country in 17 states are affected with dental, skeletal and non-skeletal fluorosis (Janardhana *et al*, 2009) [4]. Yadgir is one of the fluoride affected district of northern part of Karnataka state where, groundwater is the main drinking water source. The prolonged use of fluoride rich water, people are suffering from both dental and skeletal fluorosis irrespective of their age. An identification of geographical location of high fluoride exposed area is useful to undertake remedial measures and to create awareness about fluorosis to the villagers residing in the particular area. With this background, the present work was carried out to identify the high fluoride zones using geographical information system.

Materials and Methods
The study area Shahapur taluk located in Yadgir district, Karnataka (India) and lies between latitudes 16°22.30' N to 16°53.15 N and longitudes of 77°15.25 E to 77° 37.30 E (Figure 1). The study area experiences a temperature ranging from 12°C to 42°C with an average annual rainfall of 640 mm.The geology of the study area is dominated by grey/pink granites and gneiss followed by shale. The area is characterized mixed soil, black and red soil. The main sources of drinking water are bore wells, hand pumps, lakes and river. The depth of underground water level varies between 3.20-9.95 m in premonsoon and 2.50-7.95 m in postmonsoon.

Groundwater samples were collected from 65 bore wells in Shahapur taluk both in pre-monsoon and post-monsoon season during the year 2013 and transported to laboratory as per the standard methods. The concentration of groundwater fluoride was determined using Ion analyzer (*Elico* make) as per the standard procedures of APHA (1998) [5] and BIS (1991). Based on the results of the fluoride levels of the ground water, a fluoride isopleth map of the region prepared using ArchGIS software. The high fluoride zones were identified and distinguished by different shades depicting the fluoride levels.

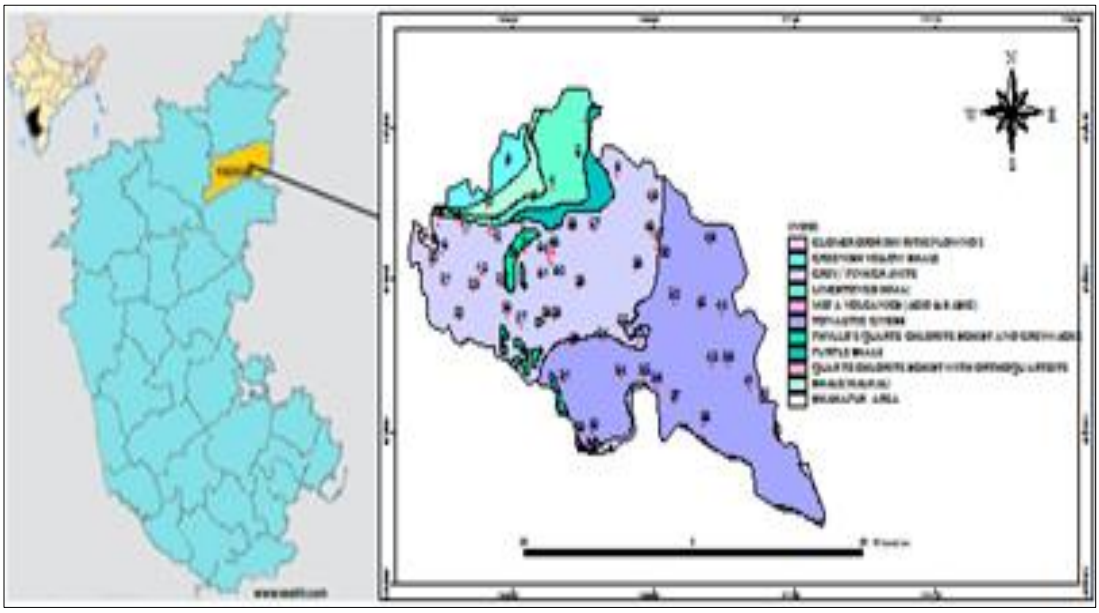

Fig 1: Geology and Sampling locations of the study area

Results and Discussion

The analytical data in the study area reveals that fluoride concentration was recorded in the range of 0.25-4.85 mg/L and 0.00-2.93 mg/L with an average of 1.36±0.86 mg/L and 0.38 ± 0.52 mg/L during pre and post monsoon respectively. According to the World Health Organization (WHO) the maximum acceptable concentration of fluoride in drinking water lies below 1.5 mg/L(S. Ayoob, A.K. Gupta, 2006; Kotoky *et al*, 2010) [7, 8]. Nearly 26.14% and 6.15% of the total samples exceeded the maximum permissible limits of fluoride during pre and post monsoon season respectively depicted in table 1 & 2. Based on the spatial distribution of fluoride concentration in groundwater during the pre-monsoon and post-monsoon season, isopleth map was prepared (Figure 2 & 3). The area above 1.5 mg/L of fluoride has been labeled as risk zones (represented with purple color in map) and the area below 1.5 mg/L as safe zones (green and pink color). The high fluoride in the ground water was identified in these villages viz Bheemarayanagudi, Diggi, Singanahalli, Gogipeta, Rabbanalli, Kadamgere, Saidapur, Naganatagi, Dariyapur, Sahura, Habsihal, Shivanura, Karanagi, Krakunda, Hanchinal, Kaynakolluru and Halisagara. The high fluoride in these areas may be due to the presence of grey/pink granites and gneiss.

Conclusion

The analytical data on groundwater fluoride reveals that in some areas fluoride level during summer season was very high and exceeded the drinking water permissible limit. Therefore, an attention is essential to educate the people on the causes of fluorosis, encouraging rain-water harvesting and providing fluoride-free drinking water in these villages.

Acknowledgements

Authors would like to thank the Directorate of Research, University of Agricultural Sciences, Raichur for financial support under Demand Driven Research Project Scheme and Dr. R S Giraddi, Former Dean (Agri.), College of Agriculture, Bheemarayanagudi for his support during research work

Table 1: Concentration of Fluoride in drinking water

Parameter	Fluoride concentration (mg/L)	Effect on human health	Representing Samples	
			Pre monsoon	Post monsoon
Fluoride	<0.5	Dental carries	GW 5, 28, 33, 46, 47 (7.69%)	GW 3-7, 9-11, 13-14, 16, 18-23, 27, 29-32, 34-39, 42-44, 46-47, 49-58, 60-65 (75.38%)
	0.5-1.5	Prevention of tooth decay	GW 3-4, 6-9, 12-16, 18-19, 21-23, 27, 29-30, 32, 34-38, 41-45, 49-51, 54-58, 60-65 (66.15%)	GW 2, 8, 12, 15, 17, 24, 26, 28, 33, 41, 45, 48 (18.46%)
	1.5-4.0	Mottling and pitting of teeth (Dental fluorosis)	GW1-2, 10-11, 17, 20, 24-26, 31, 39-40, 48, 52-53, 63 (24.61%)	GW 1, 25, 40, 59 (6.15%)
	>4.0	Pain in neck bones and back(Skeletal fluorosis) and Crippling fluorosis	GW 59 (1.53%)	-

Note: GW- Groundwater

Table 2: Concentration of Fluoride of Shahapur taluk comparison with WHO standards

Parameter	WHO standards		Percentage of samples exceeded maximum permissible limit	
			Pre monsoon	Post monsoon
Fluoride	Highest desirable limit	Maximum permissible limit	26.13%	6.15%
	0.5 mg/L	1.5 mg/L		

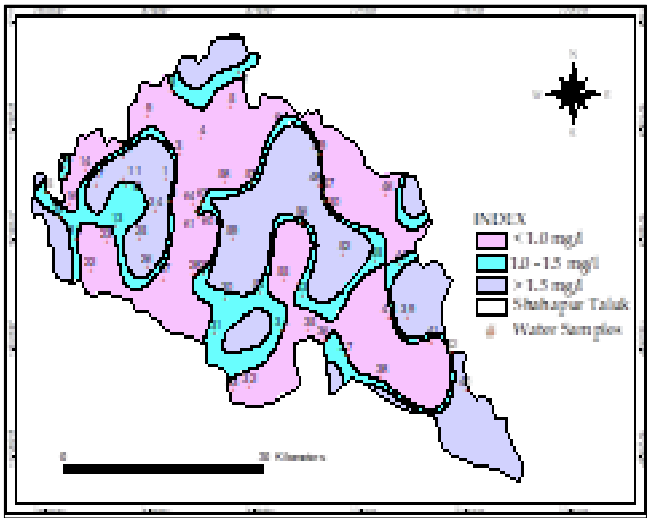

Fig 2: Fluoride mapping of groundwater in pre- monsoon season

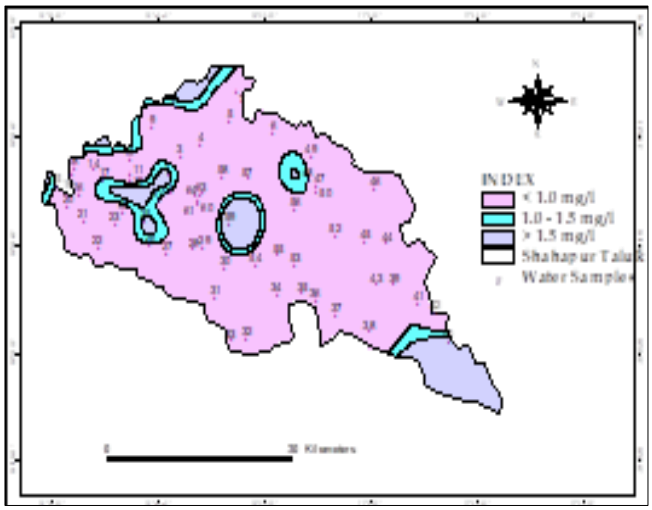

Fig 3: Fluoride mapping of groundwater in post- monsoon season

References

1. Girja Shanker Tailor, Singh Chandel CP. To Assess the Quality of Ground water in Malpura Tehsil (Tonk, Rajasthan, India) with emphasis to Fluoride Concentration, Nature and Science. 2010; 8(11):20-26.
2. Mohapatra M, Anand S, Mishra BK, Giles DE, Singh P. Review of fluoride removal from drinking water. J Environ Manage. 2009; 91(1):67-77.
3. Chidambaram S, Ramanathan AL, Vasudevan S. Fluoride removal studies in water using natural materials. Water SA. 2003; 29:339-344.
4. Janardhana Raju N, Sangita Dey, Kaushik Das. Fluoride contamination in ground waters of Sonbhadra District, Uttar Pradesh, India. Current Science. 2009; 96(7):979-985.
5. APHA. Standard methods for the examination of water and wastewater. American Public Health Association APHA, AWWA and WPCF, Washington, D.C. 20thEdition, 1998.
6. BIS. Specification for drinking water, Bureau of Indian standard, New Delhi, 1998, 171-178.
7. Ayoob S, Gupta AK. Fluoride in drinking water: a review on the status and stress effects, Crit. Rev. Environ. Sci. Technol. 2006; 36:433-487.
8. Kotoky P, Tamuli U, Borah GC, Baruah MK, Sarmah BK, Paul AB *et al*. A fluoride zonation map of the Karbianglong district, Assam, India. Fluoride. 2010; 43(2):157-159.