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Monitoring of fluoride concentration in ground water of North Nanded region Maharashatra, India

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Abstract. The occurrence of dental and skeletal fluorosis among the population are the motivation to investigate occurrence of fluoride in groundwater. Groundwater quality in Marathwada region of North Nanded city has special significance and needs great attention of all concerned since it is the major alternate source of domestic, industrial and drinking water supply. Fluoride concentration as well as pH, were monitored in 2010 from 35 ground water (23 Bore well and 12 Hand pump) sample water of the North Nanded city is used unevenly by different economic sectors. However, drinking water supply remains the primary use. Fluoride determinations were made with SPANDS method by spectrophotometer at the wavelength of 570 nm nearly 35 ground water samples collected at readily accessible sites of North Nanded city. The highest fluoride concentration was 2.78 mg L^{-1} of sample side S_1 Bhawasr Chowk and the lowest was 1.34 mg L^{-1} on sample side S_{30} Lalbadi. The mean fluoride concentration ranged from premanson 2.30 mg L^{-1} and postmanson 2.59 mg L^{-1}. The results indicate that the ground water are relatively high in fluoride content and are therefore harmful in this respect for domestic and industrial uses.
Key Words: groundwater, North Nanded region, Fluoride analysis.

Introduction. Good drinking water quality is essential for the wellbeing of all people. The Fluoride ion is the ionic form of the element fluorine, which is found in abundance in nature, primarily in water and soil. Due to its extreme reactivity, fluorine is never found in nature in elemental form, only in the form of compounds known as fluoride. Fluoride pollution in the environment occurs through two channels, namely natural and anthropogenic sources (Cengeloglu et al 2002). In India, the states of Andhra Pradesh, Bihar, Chattisgarh, Haryana, Karnataka, Madhya Pradesh, Maharashtra, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal are affected by fluoride level in water. This involves about 9000 villages affecting 30 million people (Nawalakhe & Paramasivam 1993).

High fluoride levels in drinking water has become one of the most critical health hazards of this century, as it induces intense impact on human health including skeletal and dental fluorosis (Ayoob & Gupta 2006). In India, although water resources are high but there is an acute shortage of safe drinking water due to acceptable water quality. The incidence of high fluoride content in ground water (>1.5 mg L^{-1}) is not uncommon in both shallow and deeper water bearing zones (Kim et al 2006; Das et al 2000). Fluoride is a persistent and non-degradable poison that accumulates in soil, plants, wild life and in humans.

The basic potential health risks from fluoride are considered to be fluorosis or bone disease. World Health Organization (WHO) recommendation is that drinking water should not contain more than 1.5 mg L^{-1} of fluoride, through condition may require a more stringent threshold. Since drinking high fluoride groundwater is the major reason for endemic fluorosis and has considerable impact on human health, many efforts have been

made in recent years to study the hydrochemistry and the genesis of high fluoride groundwater as well as alternative technologies of defluoridation (Al-Salamah et al 2009; Essadki et al 2009). While on a local scale anthropogenic activities, such as the application of phosphate-containing fertilizers or aluminum smelting, may introduce considerable amounts of fluoride into the environment (Saxena & Ahmed 2005), this is associated with rocks with low calcium content, or high pH conditions where sodium bicarbonate dominates the groundwater composition. Apart from the groundwater chemistry, hydrological properties (e.g., residence time) as well as climatic conditions (e.g., evapotranspiration, precipitation etc) and soil conditions (e.g., pH, soil type) have an influence on fluoride concentration. Hence, the spatial and temporal heterogeneities of fluoride concentrations in groundwater are particularly large (Hudak 1999; Valenzuela-Vasquez et al 2006).

Study Area. Nanded is a second largest city in Marathwada region. It is easternmost district of Marathwada region of Maharashatra. It lies between Latitude N $18^0$16′ and $19^0$55′ and Longitude $76^0$55′ and $78^0$20′E.

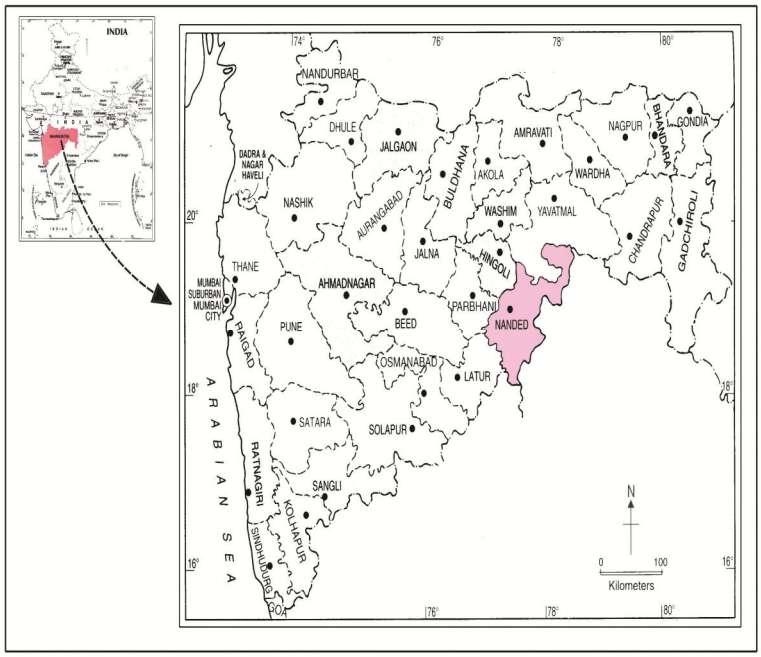

Figure 1. Location of Maharashtra state in India.

Material and Method. Water sample. Thirty-five individual Ground water samples were collected from Bore Well and Hand Pump in the South area of Nanded city (23 Bore Wells and 12 Hand pump) from pre monsoon and post monsoon. Water sample were taken directly from Bore well, Hand pump and filled into 500 ml polyethylene bottles, which were previously acid-washed and rinsed with portions of distilled water and water sample, fitted with tight lids. The water samples were filtered immediately using filter paper and filtrates acidification to pH 2 in order to keep the fluoride in solution. All samples were kept in a dark and cool place. The water samples were analysed in the department of School of Earth Sciences, Visnupure, Nanded.

Measurement and Analysis. The Fluoride analysis was performed according to standard method (APHA), and using U.V. Double Beem Spectroscopy. All solution were prepare with deionized water. Stock solutions of the Fluoride, containing 1000 mg were used form the preparation of the standards for the calibration curve. The pH was measured by pH meter was calibrated for 4.0 and 9.2 buffer solution (University of S. R. T. M. U. Nanded).

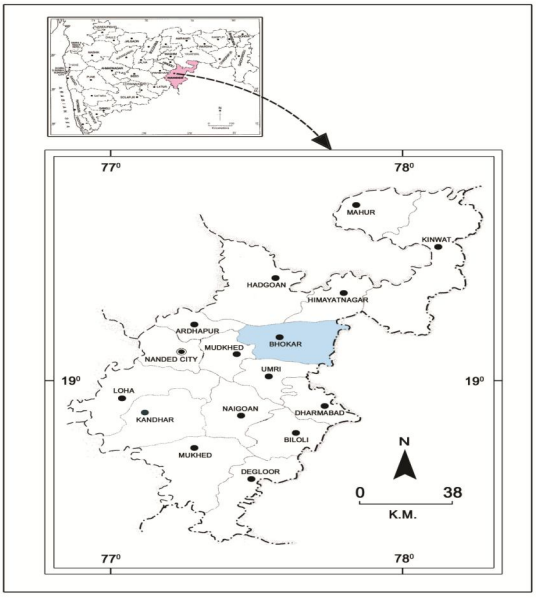

Figure 2. Location of Nanded city in Nanded District in Maharashtra state.

Results and Discussion. Fluoride in ground water has drawn world wide attention due to its considerable impact on human physiology. In this view, fluoride contamination study of along with other physical parameter like pH as well as depths of bore well and hand pump has been carried out to determine the status of drinking water from South Nanded Maharashatra state. The total samples where collected in North Nanded city nearly 35 samples are collected and 23 are bore wells and 12 are hand pump. The results revealed that the pH ranged from 6.8 to 8.3. Minimum pH 6.8 was observed in pre-mansoon sample number S_{30} Lalwadi area and maximum pH 8.2 is observed post-manson in sample number S_7 and the area is Bhagya Nagar. The value of pH showed the positive correlation with most of the fluoride. Focusing on the average values of pre monsoon and post-monsoon are pH 7.38, 7.45 and fluoride concentration were 2.19 mg L^{-1} and 2.59 mg L^{-1}.

Maximum fluoride concentrations 2.58 mg L^{-1} in sample number S_{17} and 2.90 mg L^{-1} in S_5 during pre and post-monsoon respectively. Also we found minimum fluoride 1.26 mg L^{-1} in S_{24} and 2.26 mg L^{-1} in S_{30} during pre and post monsoon. The graphical representation of pH and fluoride concentration is as below (Table 1). If we see the graphical representation the different kinds of variations found its means Bhayga Nagar water samples S_7 and Anand Nagar water samples S_8 are high pH and fluoride concentration because of the the domestic waste waters, drainage lines are not properly sealed in that area from pre to post-mansoon season.

The study on groundwater quality of Malegaon region of Nanded of Maharashatra was made during June 2004 to May 2005. During the study were found fluoride concentration in the range of 0.2 - 0.57 mg L^{-1}, with mean values of 0.41 mg L^{-1}, 0.38 mg L^{-1} and 0.28 mg L^{-1} in monsoon, winter and summer respectively (Wavde & Bhosle 2010).

The analysed groundwater samples of Orathupalyam village, Erode district, Tamil Nadu; were observed fluoride level as minimum 0.4 mg L^{-1}. In ground waters, natural concentration of fluoride depends on geological, chemical and physical character of aquifer, porosity of soil and rock, temperature of action of other chemical and depth of wells (Kirubavathy 2010).

The studied fluoride content in ground water, in Salem district; the noted maximum and minimum of the fluoride ion concentration were 1.78 and 0.58 mg L^{-1} respectively (Isalash et al 2003). He observed the fluoride values varied from 0.0 to 1.0 mg L^{-1} which were within the prescribed limit of WHO i.e. 1.0 - 1.5 mg L^{-1}. Were studied the

groundwater quality at rural areas of Sheopurkalan, Madhya Pradesh during 1998-1999 (Prajapatp & Mathur 2005).

Table 1

Variation of Fluoride and pH in pre and post monzón samples (during period of time)

Sample Number	Area	Sources	Depth of BW/HP	pH		Concentration of Fluoride (mg L-1)	
				Pre monsoon	Post monsoon	Pre monsoon	Post monsoon
S_1	Bhawsar Chowk	BW	300	7.6	7.8	2.38	2.78
S_2	Vaman nagar	BW	345	7.4	7.5	2.47	2.69
S_3	Taroda naka	BW	290	7.4	7.7	1.34	2.39
S_4	Chaitanya nagar	BW	380	7.3	7.5	2.45	2.71
S_5	Workshop road	BW	210	7.4	7.7	2.44	2.90
S_6	Peerbhuran nagar	BW	70	7.3	7.4	1.43	2.42
S_7	Bhayga nagar	BW	270	8.1	8.3	2.22	2.55
S_8	Anand nagar	BW	300	7.6	7.9	2.37	2.69
S_9	Shoba nagar	BW	270	7.3	7.7	2.23	2.54
S_{10}	Hingoli naka	BW	210	7.2	7.9	2.38	2.69
S_{11}	Datt nagar	BW	400	7.7	8.1	2.50	2.73
S_{12}	Hingoli gate	BW	360	7.5	7.8	2.50	2.71
S_{13}	New mondha	BW	120	7.3	7.6	2.24	2.58
S_{14}	Mastan pura	HP	75	7.5	7.8	2.29	2.58
S_{15}	Gokul nagar	BW	250	7.9	8.2	2.22	2.75
S_{16}	Baba nagar	BW	340	7.3	7.7	2.49	2.54
S_{17}	Kailas nagar	HP	76	7.4	7.6	2.58	2.61
S_{18}	Sham nagar	BW	300	7.1	7.5	2.25	2.44
S_{19}	Shree nagar	HP	270	7.1	7.7	2.39	2.58
S_{20}	Jangmwadi	BW	290	7.4	7.8	2.40	2.57
S_{21}	Prabhat Nagar	HP	75	7.1	7.4	2.13	2.38
S_{22}	Vivek Nagar	BW	310	7.5	7.9	2.09	2.53
S_{23}	Police colony	HP	75	7.9	8.1	2.11	2.70
S_{24}	Sneha nagar	BW	300	7.3	7.4	1.26	2.64
S_{25}	Rest House	BW	350	7.4	7.7	1.46	2.71
S_{26}	Labour colony	BW	270	7.4	7.5	2.23	2.50
S_{27}	ITI	BW	290	7.3	7.6	2.20	2.49
S_{28}	Shivaji nagar	HP	75	7.1	7.4	2.29	2.82
S_{29}	New abadi	HP	75	7.2	7.5	2.25	2.49
S_{30}	Lalyadi	HP	75	6.8	7.1	1.34	2.26
S_{31}	Naryan nagar	HP	75	7.3	7.5	2.18	2.50
S_{32}	Ambedkar Nagar	HP	75	7.2	7.5	2.26	2.43
S_{33}	Jaibheem nagar	HP	75	7.4	7.7	2.26	2.77
S_{34}	Janta colony	HP	75	7.3	7.5	2.23	2.69
S_{35}	Ganesh nagar	BW	360	7.3	7.5	2.25	2.58

All the values are presented in mg L^{-1} in table, except pH and temperature; BW: Borewell HP, Hand Pump.

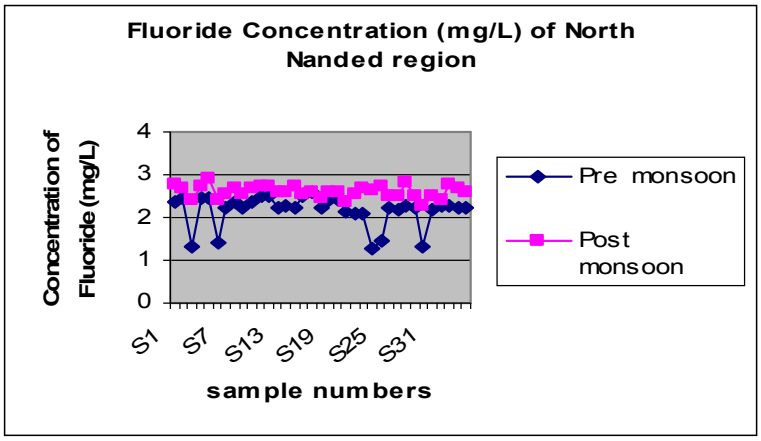

Figure 3. Fluoride variations on water from the selected sites.

The investigated ground water quality of Davanagere Taluka in Karnataka; Manjappa et al (2003) were noted that fluoride content was ranging 0.19-2.06 mg L^{-1}.

The studied fluoride level in ground water of Hiriyar Taluka, Karnataka. Anand & Garg (2000) observed fluoride level minimum below 1 mg L^{-1} to 4.2 mg L^{-1} from different selected ground water samples.

The recorded fluoride concentration ranged from 0.30 mg L^{-1} to 3.89 mg L^{-1}. For their study, Ramachandramoorthy et al (2004) selected different groundwater samples from Tiruchirappalli Ta, Tamil Nadu. Were detected the fluoride levels in an average 0.3 mg L^{-1} which is within desirable limit of Bureau of Indian standards. They studied water quality status of Murda village in Ramtek Tehsil (Ramachandramoorthy et al 2004).

The investigated water quality from different region of Mahendergarh, Haryana. During study they recorded fluoride concentration ranged between 0.238 to 1.995 mg L^{-1}. In some villages high fluoride content water cause serious health hazards to people (Ramachandramoorthy et al 2004).

The recorded mean value of fluoride, 1.41 mg L^{-1}, from groundwater samples, Singh et al (2005). They studied seasonal variation in groundwater quality of Agra city during March 1997 – Feb 1998. The ground water Pollution due to industrial effluents of Kothur industrial area, Maheboobnager, Andhra Pradesh during 1999 were recorded fluoride ion content ranged between 0.40- 1.80 mg L^{-1} (Srinivas et al 2002).

The estimated fluoride in drinking water of rural areas of Salem district. The maximum fluoride ion concentration found to be in N. Metur, 170 mg L^{-1} and maximum in Aerikadu 1.21 mg L^{-1} (Venkatachalam et al 2004).

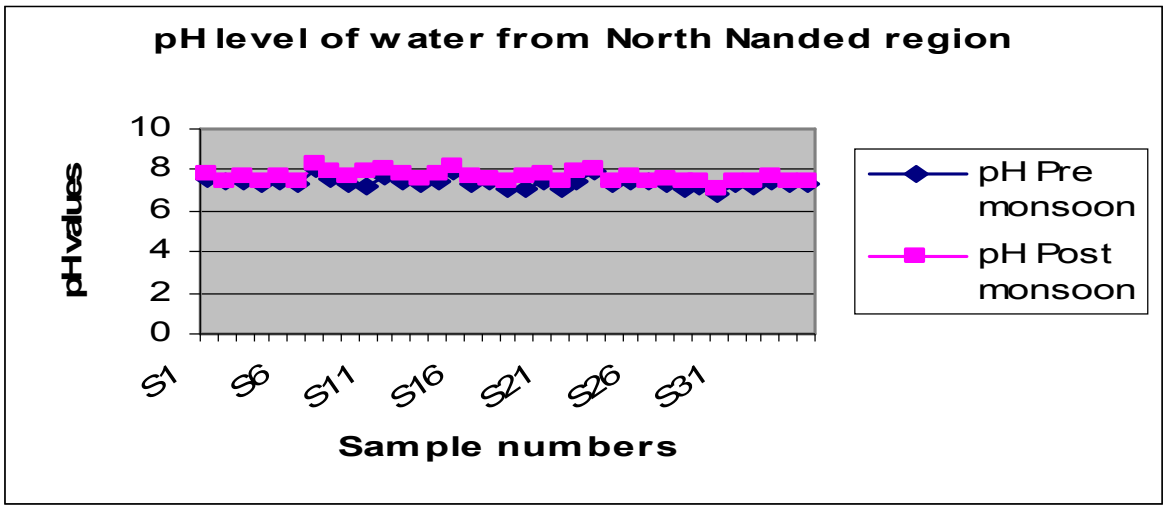

Figure 4. The pH variations from the selected stations.

Conclusions. The important role of drinking water in the incidence of fluorosis is obvious. It is therefore, essential that the North Nanded region partly affected by fluoride levels in the water supply with safe drinking water less than 1 mg L^{-1} fluoride, either by changing the water source to safe one or by adapting suitable treatment technique to remove excess fluoride from the existing sources. Since grains, vegetables and milk are also significant sources of fluoride to man, their fluoride content could be taken into account while fixing the safe level of fluoride in drinking water.

The investigated Fluoride concentration in the drinking water samples from this groundwater in the North Nanded region of Marathwada region was slightly more as compared to the guidelines for drinking waters given by the WHO (Guideline for Drinking Water, World Health Organisation 1993). However, there is the need for routine check and treatment of water to avoid waterborne diseases and its harmful effects to the human beings and all the societies.

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