CONTAMINATIONS OF FLUORIDE AND NITRATE IN THE GROUNDWATER OF HARIHARA TALUK, KARNATAKA, INDIA

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Annotation

In the present study the Physico-chemical analysis of ground water aquifers in Harihara taluk was performed to have a clear picture of water quality. So that remedial measures could be worked for. Fluoride higher than 1.5 ppm may cause osteoporosis and fluorosis. High nitrate is alarming as it indicates possibility of seepage from sewage. Most samples had fluoride concentration within the maximum permissible limits recommended by ICMR and 1.5 mg/L (BIS) yet water is not portable due to high nitrate and fluoride.

Key Words: Fluoride, Nitrate, Groundwater, Harihara.

Introduction. Water is critical for substantial development and is indispensable for human health and well being. The USA has proclaimed the years of 2005-2015 as the international decade for action on "water for life" (UN 2004). Although India has substantial fresh water resources there is an acute shortage of safe drinking water of acceptable qualities especially, in rural areas (Akhalesh Kumar et al 2019). To provide safe drinking water especially to rural population, groundwater has been sought as the source in many countries. India has increasing incidences of fluorosis, both dental and skeletal, with around 66 million people being at risk (Sinha & Musturia 2020).

Harihara taluk has maximum number of habitations affected by excess fluoride in groundwater. 18 villages of Harihara taluk have fluoride in much greater amounts than the permissible limits (Sinha et al 1979). In this state 60% of the irrigation and 90% of the drinking water supply source is groundwater (Rathore 2015). South region of Harihara town and

Bevinahalli has high nitrate and fluoride concentrations in groundwater respectively, making it unsuitable for drinking purposes.

EPA has set an enforceable drinking water standard for fluoride of 4 mg/L. Some people who drink water containing fluoride in excess of this level over many years could get bone disease, including pain and tenderness of the bones. EPA has also set a secondary fluoride standard of 2 mg/L to protect against dental fluorosis. Dental fluorosis, in its moderate or severe forms, may result in a brown staining and/or pitting of the permanent teeth. This problem occurs only in developing teeth, before they erupt from the gums due to its strong electro negativity, fluoride is attracted by positively charged calcium in teeth and bones (Susheela et al 2009). Children under nine should not drink water that has more than 1.5 mg/L of fluoride. Millions of people are suffering from dental and skeletal fluorosis due to fluoride contaminated water (Madhavan & Subramanian 2016). According to Goel & Sharma 1996, in view of the above observations, Indian Council of Medical Research (1975) has suggested 1.0 mg/L and 1.5 mg/L as the highest desirable and the maximum permissible limits for fluoride in drinking water.

High nitrate may cause methemoglobinemia, gastric cancer and birth defects (Mirvish 2017). In an effort to prevent the diseases I.C.M.R. has recommended the concentration of 20mg/L nitrate in water to be used for infant feeding, while more than 50mg/L was not recommended for human consumption Wakida F. T. & Lerner D. N. (2009). To make the water potable these two ions have to be treated upon to reduce their concentration. The research work is being persuaded to analyze ground water quality and to find out chemical and bio-chemical remediation of problematic ions. In this context, the work published here provides insight into the problems faced by the people of Harihara Taluk.

Material and Method. Sampling location in Harihara and some-selected villages of the Taluk has been selected-using random grid method on the basis of geographical ground map of the Taluk. A total of 50 water samples from 50 different localities were collected. Temperature and pH were measured during the sampling procedure itself.

Nitrate and fluoride concentrations were assessed by ion meter using ion selective electrodes.

Geology. The geological location of Harihara Taluk located in the Northern plains of Karnataka state, India (Fig 4) covers an area of 984.50 square km and lies in between 14° 25’ latitude and 75° 30’ longitude. As a whole, the region has rocky areas and dry land with an average elevation of 700 m above average sea level. It comprises 2 hoblies and 84 villages.

Table 1.Samples collected at various sites of Harihara Taluk

Sl. No.	Sample number	Name of the site/village	Sl. No.	Sample number	Name of the site/village
1	S_1	Kondajji	26	S_{26}	Vasana
2	S_2	Kenchanahalli	27	S_{27}	Mallahalli
3	S_3	Saarathi	28	S_{28}	Nandigudi
4	S_4	Chikkabidare	29	S_{29}	Govinahalu
5	S_5	Deetoor	30	S_{30}	Komaranahalli
6	S_6	Ganganarasi	31	S_{31}	Dibbadahalli
7	S_7	Guttur	32	S_{32}	Koppa
8	S_8	Harihara (Kirloskar)	33	S_{33}	Kumbaluru
9	S_9	Harihara (Birla)	34	S_{34}	Nittoor
10	S_{10}	Halasabalu	35	S_{35}	Mitlakatte
11	S_{11}	Thimmalapura	36	S_{36}	Boodihalu
12	S_{12}	Hosahalli	37	S_{37}	Devarabelakere
13	S_{13}	Bhanuvalli	38	S_{38}	Bannikodu

14	S_{14}	Yekkegondi	39	S_{39}	Harihara town (centre)
15	S_{15}	Bellodi	40	S_{40}	Harihara town (North)
16	S_{16}	Haraganahalli	41	S_{41}	Harihara town (south)
17	S_{17}	Hanagavadi	42	S_{42}	K.Bevinahalli
19	$S1_{9}$	Dhoolhole	44	S_{44}	Saalakatte
20	S_{20}	Yelavatti	45	S_{45}	Yelehole
21	S_{21}	Gigali	46	S_{46}	Palya
22	S_{22}	Malebennur	47	S_{47}	Doggahalli
23	S_{23}	Hallihalu	48	S_{48}	Kunabelakere
24	S_{24}	Kokkanur	49	S_{49}	Haralahalli
25	S_{25}	Kadaranayakanahalli	50	S_{50}	Nanditavare

Summary and Conclusions. Ground water from Harihara Taluk has been generally observed to be little brackish to saline. During the field visit, People in the villages complained about diseases of gastro-intestinal tract and bladder with symptoms of diarrhea and diuresis which may be caused by high fluoride and nitrate levels in the region.

Indian Council of Medical Research (1975) bas recommended 20mg/L and 50 mg/L as desirable and maximum permissible limits for nitrate, and in view to prevent the diseases caused by high concentration of fluoride, I.C.M.R. has suggested 1.0 mg /L as acceptable limit and the maximum permissible limit of 1.5 mg/L in drinking water.

The results from the analysis are given in figures 1 and 2 values have been compared with maximum permissible limits for drinking water recommended by I.C.M.R and BIS (1992). Though fluoride in most of the samples is within permissible limit, yet water is rendered non-portable because in some of the samples, nitrate is much above the standard permissible limit.

Mallahalli, Kumbalur, Bevinahalli and Palya regions are having fluoride concentration more than 4 mg/L limit while other locations have fluoride lesser than even 1 mg/L. This low fluoride water may be used safely as the fluoride traces are useful for healthy growth of teeth and bones. A concentration less than 0.8 mg/L results in "dental caries". Other samples have fluoride well within the lower and upper limits recommended and therefore portable.

Groundwater at Harihara south and Bevinahalli has nitrate values more than 100 mg/L. Minimum value of nitrate concentration in ground water found 1.2 mg/L, at Thimmalapura. High nitrate concentration may be considered as warning that aquifers should be tested for harmful bacteria because it indicates seepage from sewage near the sampling locations. Legume cropping in study area cause nitrate enrichment of groundwater as legumes takes nitrogen from atmosphere and fixes it in soil as nitrate. The nitrates, thus formed are usually in excess of the plants needs, which is transferred to groundwater regime subsequent to leaching. High nitrates can also be caused by artificial fertilizers used for healthy growth of plants since the farmers may be ignorant about right amount to be supplemented to the crops.

Further research work in the study area is going on, to assess the ground water quality in the region and to find out remedial measures, so that the water can be made suitable for drinking purposes.

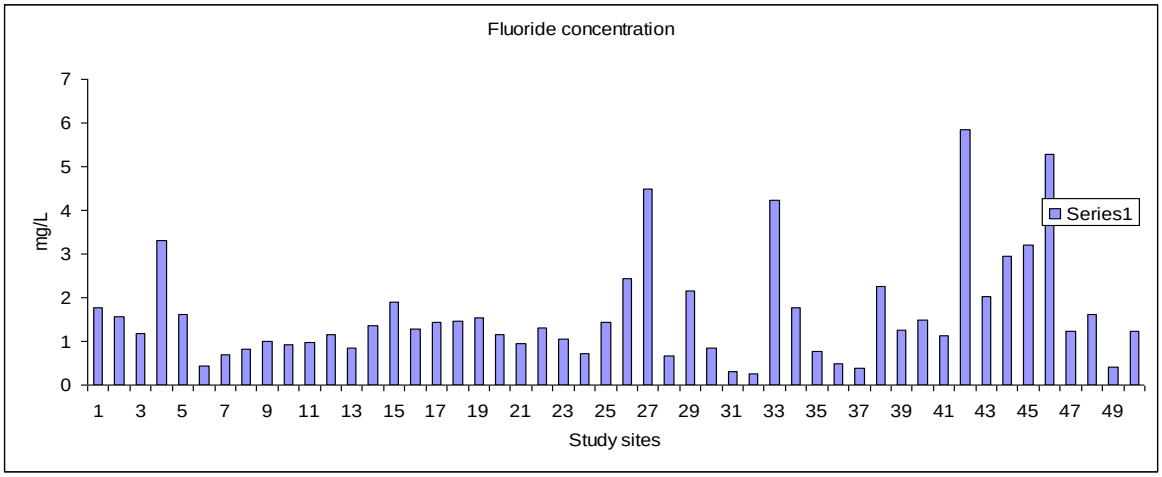


Figure 1. Fluoride concentrations in ground water of Harihara Taluk region

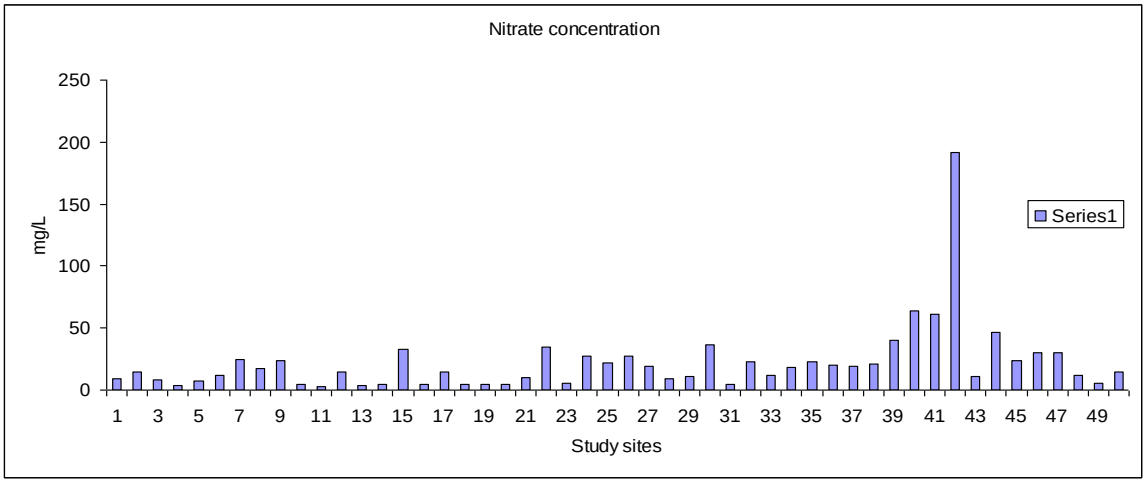


Figure 2. Nitrate concentrations in ground water of Harihara Taluk region

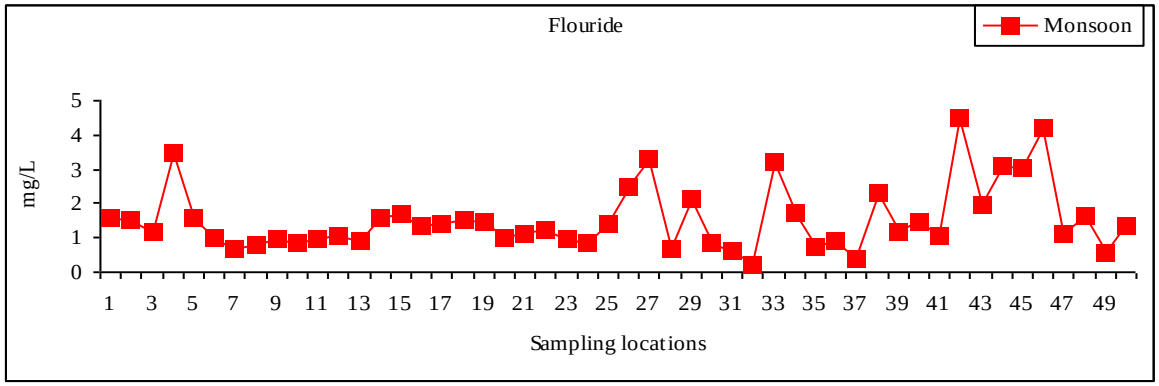


Figure 3. Fluoride values recorded among the study sites

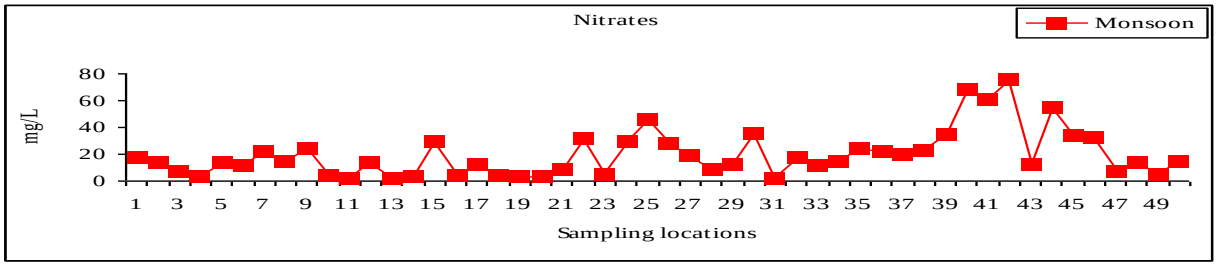


Figure 4: Nitrate values recorded among the study sites the Study sites of Harihara Taluk

References

1. APHA, 1998 Standard Methods for the examination of water and wastewater, 18th ed.
2. Washington, DC: American Public Health Association.

3. Akhalesh Kumar, Gita Seth & Mahesh K. Sharma, 2019 Geochemical studies of fluoride in ground water of Rajasthan. Indian Journal of Chemistry, **2**(6):191-193.

4. BIS,1992 Bureau of Indian Standards. ISO: 10500, New Delhi, India.

5. Mivrish S. S., 1985 Gastric cancer and salivary nitrate and nitrite. Nature, **315**:461-462.

6. Muralidharan, D. Nair, Anitha P. and Sathynarayana U., 20 Fluoride in shallow acquifers in Rajgarh tensil of Churu dist., Rajasthan, an arid environment. Current Science, **83**(6):699-702.

7. Sinha A. K. & Yashoda Musturia, 2004 High fluoride ground water in Chaksu Tehsil, Jaipur, Rajasthan, Indian Journal of Environmental Sciences, **8**(2):103-107.

8. Susheela A. K., Kumar A., Bhatnagar M., and Bahadur M., 2009 Prevalence of endemic fluorosis with gastro-intestinal manifestations in people living in some North-Indian villages. Fluoride, **26**:97–104.