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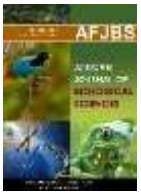

Fluoride water contamination in Arasikere Taluk, Hassan District, Karnataka, India

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ABSTRACT

Water, which occurs below the water table, is referred to as groundwater. Ground water is usually cool, colourless and free from turbidity. Ground water is used for agricultural, industrial, household, recreational and environmental activities all over the world. In the last few decades, there has been tremendous increase in the demand for fresh water due to rapid growth of population and accelerated pace of industrialization which has resulted in the deterioration of quality of groundwater. Since the quality of public health depends to a greater extent on the quality of drinking water, it is incumbent that detailed information about the quality of water be systematically collected and monitored regularly through research and scientific way for sustainable development. Fluoride is widely dispersed in nature and a common constituent of most soils, rocks, plants and animals. Fluorine is a common element representing about 0.38 g/kg of the earth's crust (WHO 2008), which exists in the form of fluoride in a number of minerals. In addition to the anthropogenic activities, the availability of potable water resources is being deteriorated by agricultural activities and over exploitation. Hence, it needs the study on the status of ground water quality in Arsikere taluk of Hassan district.

Keywords: Agricultural soil , Tooth decay , Ground water, Physico-chemical parameters,

Introduction:

Water is one of the most important and basic natural resources. Among all natural resources, water is the most precious one and life is not possible without water. It is one of the basic needs of the mankind and is vital to all forms of life, which exist in lentic and lotic habitats. It is considered as the universal solvent having many chemical constituents dissolved in it, utilizing these in various metabolic activities the aquatic organisms bring about changes in chemical composition of water.

Water is not only one of the most essential commodities for our day to day life but this natural resource also plays a crucial role in our economic and social development process. However, during these days the water resources are becoming dumping places for all the waste material generated by increasing human activities thereby deteriorating the quality of water. Hence, water quality monitoring has gained importance in recent years due to the increasing stress on the available water resources. The aim of water quality monitoring is to characterize existing problems, monitor the temporal variation in water quality characteristics and identify potential problems. While the total amount of water in the world is constant and is said to be adequate to meet all the demands of mankind. It is therefore, imperative for man to use and manage this scarce commodity as rationally and efficiently as possible. In order to implement this task, accurate and adequate information must be available about the behavior of environment under constantly changing human pressure and natural forces. (Mohammad Zakir Hossain 2015) .

Water is one of the abundant and available substances in nature. Man has exploited more than any other resources for the sustenance of life. Water of good quality is necessary and required for living organisms. Due to the rapid development in industrial growth, urbanization and consequence of pollution made the fresh water systems as challenges for the fragile fresh water ecosystems (Tripathi and Panday, 1990). The ability of waterbodies to clean themselves has been affected by the sheer quantity of waste generated by ever increasing population (Ghosh, 1992; Zaheeruddin and Shadad Khusheed, 1998). The anthropogenic activities such as disposal of sewage and industrial effluent, recreational activities, excess fertilization of land and the use of pesticides have threatened environmental health of surface water. Deterioration of water quality and the fast depletion of water resources is the main challenge which needs an immediate solution.

Fluorine is a salt which is formed by combining with other elements. Its concentration in ground water differs from region to region. Fluorine is a highly relative element, with readily forms the bond with other elements. (Stefanie Dehnen. Et.al, 2021)

Fluorides are used in the production of aluminum, bricks, tiles, ceramics, phosphate fertilizers and toothpaste. The high concentration of fluoride causes mottling of teeth, skeletal fluorosis, bending of vertebral column, deformation of knee joints and other bones of the body and even causes paralysis. (Mohammed Naji Taresh Ali.et.al).

When fluoride enters the body, they become most exclusive bone seeking element, owing to its affinity for calcium phosphate when the fluoride is more than 1.5mg/L (BIS 2012), which accumulate in body, its exhibit mainly dental fluorosis and other nerve related diseases.

Fluoride is widely dispersed in nature and a common constituent of most soils, rocks, plants and animals. Due to its high electro-negativity, it forms only fluorides and no other oxidation states are found. Fluorine is a common element representing about 0.38 g/kg of the earth's crust (WHO 2008), which exists in the form of fluoride in a number of minerals. Fluorides are used in the production of aluminum, bricks, tiles, ceramics, phosphate fertilizers and toothpaste. The high concentration of fluoride causes mottling of teeth, skeletal fluorosis, bending of vertebral column, deformation of knee joints and other bones of the body and even causes paralysis. (Mohammed Naji Taresh Ali.et.al).

Industries like oil refinery, plastic, pharmacy, cosmetics, glass, refrigeration and automobile use fluoride containing salts as raw material or produce fluoride in any form which emits exhaust gas, dust or fumes rich in fluoride as by-product. (Beck et.al)

Fluoride enters environment through natural as well as anthropogenic sources. The chief sources of fluoride are minerals viz., fluorite, fluorospar, fluorapatite, crylolite, micaand hornblende; rocks and sediments. Fluoride bearing minerals occur in all geological rocks such as sedimentary, metamorphic and igneous deposits. The ordinary soil that contains clay minerals may be the main source of fluoride. Natural concentration of fluoride in groundwater depends on the availability of fluoride in rocks and minerals encountered by the water as it moves along the flow path. The distribution of fluoride in groundwater depends on a number of factors, such as amount of soluble and insoluble fluorine in source rocks, rainfall, vegetation, redox potential, pH and ion exchange process.Fluorides are more common in groundwater than surface water. (Sunil Kumar Jha. et.al) ·These contain fluoride as an impurity and lead to high fluoride accumulation in soil. Fluoride enters human beings through drinking water, food, air, industrial exposure, drugs, cosmetics, tooth paste and mouth rinses etc. (V. Saxena.et.al).

Naturally, fluorides occurring in groundwater are a result of the dissolution of fluoride containing rock minerals by water while artificially high soil fluoride levels can occur through contamination by application of phosphate fertilizers, sewage sludge or pesticides.

Material and methods

Arsikere is one of the talukas of Hassan district, in Karnataka state situated at $13^0$18'50" N and $76^0$15'22" E about 48 km from Hassan city. The groundwater quality of Arsikere region is being over stressed in order to fulfill the heavy demand for fresh water. Even though the Hemavathi and the Yagachi flow through the district, it is deprived of potable drinking water and the water table has decreased due to successive years of drought. The ground water quality of this region is being over stressed in order to meet the heavy demand for water because of pollution of surface water bodies, inadequate sanitary and drainage systems, septic tanks, disposal of municipal and domestic sewage without treatment, disposal of solid wastes and improper management etc. This may lead to depletion and water quality deterioration. (Yogananda.et.al , 2016).

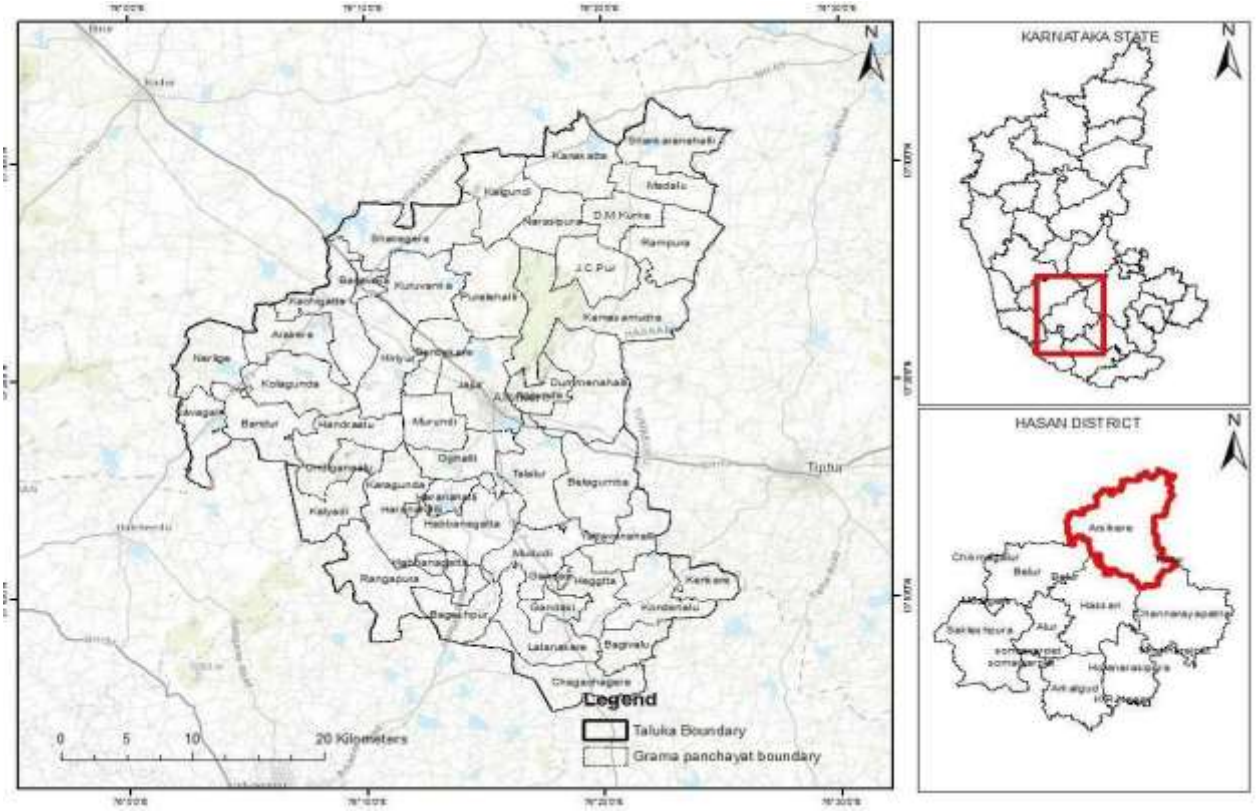
Spectrophotometric methods

In this method, a compound of a metal such as aluminium, iron, thorium, zirconium, lanthanum or cerium reacts with an indicator dye to form a complex of low dissociation constant. This complex reacts with fluoride to give a new complex (Jacobsonet al. 1977). Due to the change in the structure of the complex, the absorption spectrum also shifts relative to the spectrum for the fluoride-free reagent solutions. This change canbe detected by using a spectrophotometer. One of the important dyes used is trisodium 2 -(parasulfophenylazo)-1,8-dihydroxy-3,6- napthalene disulfonate, commonly known as SPADNS. Erichrome Cyanine R is another commonly used dye. The dye reacts with metal ions to give a coloured complex. In the SPADNS method, zirconium reacts with SPADNS to form a red coloured complex. Fluoride bleaches the red colour of the complex and hence the change in absorbance can be measured using a spectrophotometer.

STUDY AREA:

Arasikere Taluk Hassan District, Karnataka in the state of Karnataka, India. It is a major railway junction on the South Western Railway and a central place of visit to places of tourist interest like Belur (40km), Halebidu (25km) and Shravanabelagola (80km). it is known for its coconut production and Malekall Tirupathi hill. Hosadurga town with an area of 8.0sq.kms sits at the foot Tirupathi hills and is surrounded by many other smaller hills which rise to 797mm above mean sea level. I have been selected 10 study sites around Arasikere Taluk.

F**ig No. 1:** Map showing the fluoride content in villages of Arasikere Taluk.



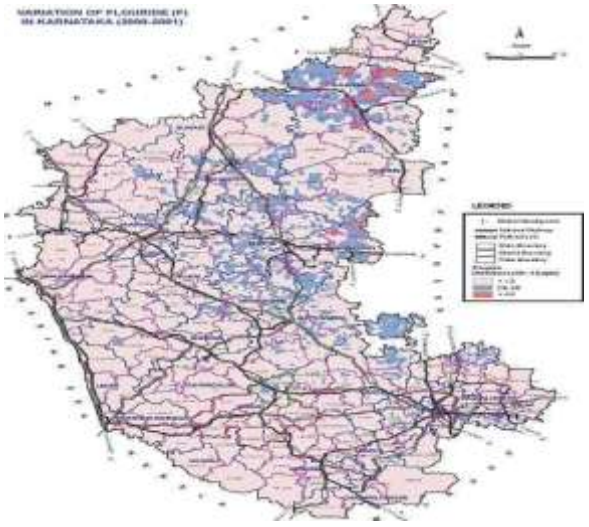
Sampling Location:

Sampling locations in and around villages of Arsikere taluk have been selected using random grid or spatial network method based on geographical ground map of Arsikere (Figure 1) shows the different sampling stations, which have been selected from 10 different localities. Water samples from different location were collected as per the guidelines of random sampling techniques; collected ground water samples were transferred into pre-acid washed transparent 1 or 2 Liter plastic can. The samples from 10 sampling sites were collected and analyzed during pre-monsoon, monsoon and post monsoon seas during 2022 to 2023 to determine the fluoride content in the study area (Table 1) . The water samples were collected from bore wells. analyzed in departmental laboratory for fluoride concentration .

Table 1: Sampling sites in Arasikere taluk of Hassan district

S.No	Sampling Station	Locations
1.	S1	Arasikere
2.	S2	Haranahalli
3.	S3	Shankaranahalli
4.	S4	D.M.Kurke
5.	S5	Shanegere
6.	S6	Arakere
7.	S7	Kallusadaralli
8.	S8	Bendekere
9.	S9	MaruthiNagara
10.	S10	Lakshmipura

Fig No 2 : Fluoride Affected Areas in Karnataka:



RESULTS AND DISCUSSION:

The study was conducted to analyses the concentration of fluoride in ground water in the study area in all the seasons. The fluoride concentration in ground water samples was determined in 10 villages of Arasikere Taluk, Hassan District, Karnataka. since in most of the villages it is the only source of drinking water. The fluoride concentrations in these villages varied from 0.7 to 5.8mg/L with highest fluoride level at different villages. There was found a positive correlation of pH with fluoride and a negative relationship of fluoride with bicarbonate which is generally observed in deep ground water.

Fluoride above permissible levels (i.e 1ppm) in drinking water causes Dental and Skeletal fluorosis in humans. This kind of a contamination is present in more than 60 countries around the world and in more than 15 Indian states including Karnataka. Hence, villages of Arasikere Taluk, Hassan District, Karnataka was taken as a pilot area to study and analyze the scenario of fluoride contamination in drinking water bore wells in the State of Karnataka. The study was conducted in 10 villages, where every village, public bore water samples was analyzed for fluoride contamination. Out of the 10 villages, 6 villages showed fluoride above permissible levels (i.e. above 1ppm) in which 4 villages were in a critical level (i.e. More than 3ppm). All the data collected were plotted in a map.

The Fluoride content in the groundwater samples in various locations of the study area has been shown in Table 2 .From the results, The fluoride concentrations varied from a minimum of 0.7 mg/L to maximum 5.8 mg/L in the study sites samples have the value of minimum 0.5mg/l in Mansoon seasons in all the study sites in pre-mansoon seasons the fluoride level is slightly shows high and in post mansoon seasons the fluoride content cross the excessive limit. the highest fluoride content is recorded in village is around Shanegere 5.8 mg/l in Post monsoon season and lowest is in Kallusadaralli and Bendekere village is around 1.5mg/l.

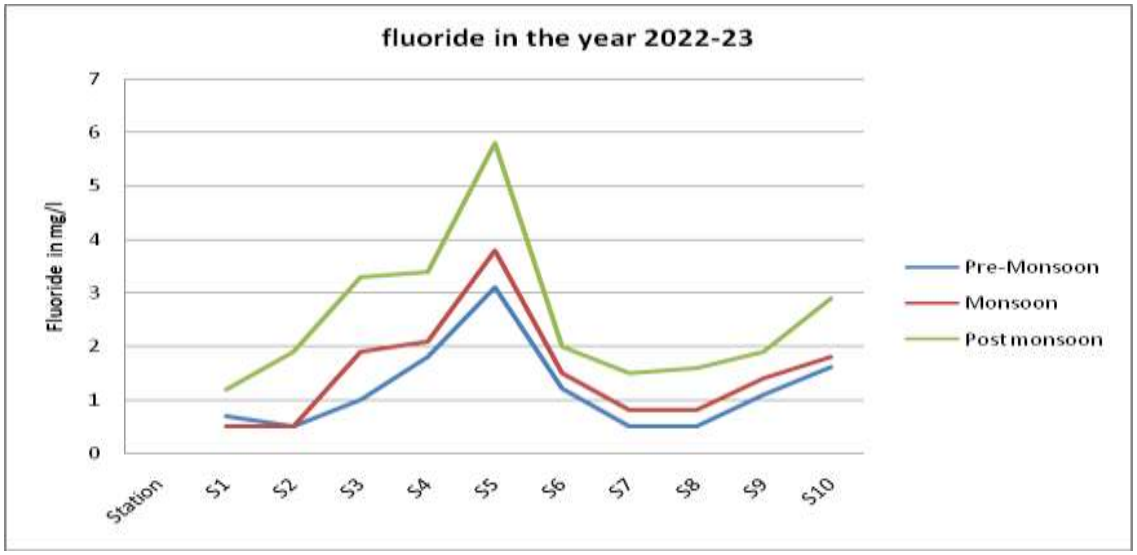
In the current study, all the samples of all the three seasons of the study period were having fluoride content high in some places and also less than the permissible limits of BIS for drinking water standards. The BIS permissible limits for drinking water sample is 1.5 mg/L.(BIS 2012).

Table No : 2 The observed values of fluoride in ground water in pre-monsoon, monsoon and post monsoon seasons during 2022 -2023

S.No	Sampling Station	Locations	Pre-Monsoon	Monsoon	Post monsoon
1.	S1	Arsikere	0.7	0.5	1.2
2.	S2	Haranahalli	0.5	0.5	1.9
3.	S3	Shankaranahalli	1.0	1.9	3.3
4.	S4	D.M.Kurke	1.8	2.1	3.4
5.	S5	Shanegere	3.1	3.8	5.8
6.	S6	Arakere	1.2	1.5	2.0
7.	S7	Kallusadaralli	0.5	0.8	1.5

8.	S8	Bendekere	0.1	0.8	1.6
9.	S9	MaruthiNagara	1.1	1.4	1.9
10	S10	Lakshmipura	1.6	1.8	2.9

Fig No:3 Fluoride concentration in the sampling sites - 2022-23



CONCLUSION

As a result, they are becoming unpalatable and the quality of water is being deteriorated and in many cases it is not suitable for drinking purpose. However, it is everybody's right to drink safe water and to get sufficient quantity of water for his daily needs. But the present scenario is very alarming and that in future if there is any war is fought it is for the water. Furthermore, the cost of each liter of mineral water is more than a liter of milk, which itself indicates that water is high priced commodity. The foregoing reveals that one has to give a special attention towards water resources and their conservation for the future generation to come.

In the present investigation, we understand that the concentration of fluoride in the ground water of some selected villages of Arasikere, Hassan District, Karnataka may fluctuated and affected to the villagers.The World Health Organization (WHO) considers that fluoride is one water contaminant, adversely affecting human health. Drinking water is measured as the critical fluoride carrier in the human body, where the digestive system absorbs 90% of the fluoride intake through water.

There is a required of optimum amount of fluoride for human consumption. If there is consumption of fluoride above permissible limit, it is very harmful to life. When fluoride enters the body, they become most exclusive bone seeking element, owing to its affinity for calcium phosphate when the fluoride is more than (BIS 2012) 1.5mg/L which accumulate in body, its exhibit mainly dental fluorosis and other nerve related diseases.

In this investigation, high level of fluoride concentration has been noticed in some of the sampling stations. We observed the high-level fluoride concentration and also the zero level of fluoride concentration in some area. This is due to the geological strata of the study area.

REFERENCES

- Beck, Erwin. 1985 ,Sorghum and Salinity: I. Response of Growth, Water Relations, and Ion Accumulation to NaCl Salinity, crop science society of America 677 . P797 - 805. N
- Devi, S. and R.Premkumar. 2012. Physicochemical Analysis of Groundwater samples near Industrial Area, Cuddalore, District Tamilnadu, India. International Journal of ChemTech Research, 4(1): pp 29-34
- Ghosh, G.K. 1992. Environmental pollution, In: A scientific dimensions, (Ed). New Delhi, p. 174.
- Jacobson, J.S and Weinstein, L.H. (1977) Sampling and analysis of fluoride: Methods for ambient air, plant and animal tissues, water, soil and foods. J. Occ.Med. **19,** 79 – 87
- Mohammed Naji Taresh Ali, Hina Kousar and Adamsab M. Patel, 2011." Fluoride Concentration in Groundwater of Arsikere Taluk, Hassan District, Karnataka, India" Nature Environment and Pollution Technology An International Quarterly Scientific Journal, ISSN: 0972-6268 Vol. 10 No. 3 pp. 455-457.
- Mohammad Zakir Hossain, 2015, "water: the most precious resource of our Life" Global journal of advanced research, Vol-2, Issue-9 PP. 1436-1445.
- Sunil Kumar Jha , Vinay Kumar Mishra, Dinesh Kumar Sharma, Thukkaram Damodaran 2011, "Fluoride in the environment and its metabolism in humans"National library of Medicine.
- Tripathi, A.K. and S.N. Pandey. 1990. Water pollution. *Ashish Publishing House, New Delh*i. 326.
- V. Saxena And S. Ahmed 2001,Dissolution of fluoride in groundwater: a water-rock interaction study, Environmental Geology. P1084–1087.
- WHO 1973. Trace Elements in Human Nutrition. Tech. Report, World Health Organization.
- Yogananda.et.al , 2016 "Study of Ground Water Quality of Arsikere Town and Surrounding Areas, Hassan, Karnataka, India" Journal for Research , Volume 02 Issue 04| ISSN: 2395-7549.
- Zaheeruddin and Shadad Khurshid 1998. Dispersion of heavy metals and it toxic effect on water quality in the parts of Faridabad, Haryana. *J. Ecotoxicol. Environ. Monit.*, **8(1):** 9-14
- Stefanie Dehnen**,** Laurel L. Schafer,Thomas Lectka, and Antonio Togni, 2021," Fluorine: A Very Special Element and Its Very Special Impacts on Chemistry" ACS publications,
- Zheng BS, Ding ZH, Huang RG, Zhu JM, Yu XY, Wang AM, et al. Issues of health and disease relating to coal use in southwestern China. Int J Coal Geol 1999;40:119-