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Analysis of Fluoride fluctuations in groundwater samples of pre-monsoon and post-monsoon seasons in and around Suryapet, Nalgonda district, Telangana, India

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ABSTRACT

Groundwater is the real hotspot for different purposes in many parts of the world. Presence of low or high convergence of specific chemical compounds is a noteworthy issue, as they make the groundwater unacceptable for different purposes. Fluoride grouping of at least 0.6 mg/l is required for human utilization as it is the minimum required amount for proper nourishment of teeth and bones. Utilization of water with fluoride fixation above 1.5 mg/l results in intense to chronic dental fluorosis, where the teeth become hued from yellow to chestnut. Vicinity of low or high centralization of fluoride in groundwater is a direct result of regular or anthropogenic causes or a mix of both. Natural sources are related to the topographical states of a territory. A few rocks have fluoride bearing minerals like apatite, fluorite, biotite and hornblende. The weathering of these stones and infiltration of precipitation through it increases fluoride levels in groundwater. In the present study, it is observed that groundwater samples collected from Nemmikal and yarkaram villages contained fluoride more than acceptable limit. Spatial distribution maps of fluoride and location maps are generated by using Geographical Information System (GIS) software 9.3 version and fluoride fluctuation graph prepared for analysis.

Keywords: Fluoride, groundwater, monsoon seasons and GIS

INTRODUCTION

Fluoride is a naturally occurring element found in certain igneous and metamorphic rocks. It can be introduced to the environment through natural erosive processes or land disturbances associated with construction and land development [14]. Usually found in low concentrations in surface and groundwater sources, fluoride is sometimes added to drinking water to help prevent tooth decay in children. Fluoride can be toxic at high concentrations (approximately 5 mg/l or higher); however, additions to drinking water rarely exceed 1.5 to 2 mg/l. Concentrations greater than 2 mg/l can result in tooth discolorations and mottling, and, in excessive dosages, skeletal abnormalities.

Abnormal levels of fluoride in water are common in fractured hard rock zone with pegmatite veins. It occurs in the earth crust along with the fluoride rich mineral bearing rocks. Minerals like topaz, fluorite, fluor-apitite, villuamite, cryolite and fluoride replaceable hydroxide ion in ferromagnesium silicates contribute to fluoride in groundwater [26]. Fluoride ions of these minerals leach in to groundwater and contribute to the high fluoride concentrations. Minerals such as muscovite and biotite (Mica group) contribute to water fluoride content [17]. Fluoride presence in the groundwater and its regional dispersion is mostly due to major fluoride – bearing minerals, such as, fluorspars (fluorite), rock phosphate (apatite, thiroapatite, triplite, etc) and phosphorites. Rock minerals weathers and form calcium and magnesium carbonates and serve as a sink for fluoride ions. The variation of fluoride concentration in groundwater samples may be due to irregular distribution of rocks [11]. Due to its strong electronegativity, F^- is attracted by positively charged

calcium ions in teeth and bones and hence excessive intake can results in pathological changes in teeth and bones, such as mottling of teeth or dental fluorosis followed by skeletal fluorosis [10] & [11].

In India, fluoride is one of the most undesired elements present in groundwater extracted for drinking purposes in many areas [9],[16],[25-27],[30]&[32-33]. In drinking water the permissible limit of fluoride is 1.5mg/l [8].

Study Area

The area under study lies between 16°56'-17°18' degrees latitude and 79°25'-79°48' degrees longitude and falls in SOI toposheet number 56O/12 and partially in its adjacent toposheet, covering total area of approximately-1253 sq. km and height from the mean sea level is 571 m. It forms a part of Nalgonda District which is bounded on the north by Ranga Reddy & Warangal districts and south by Krishna & Guntur districts respectively, on the east by Khammam and on the west by Mahabubnagar district (Figure 1).

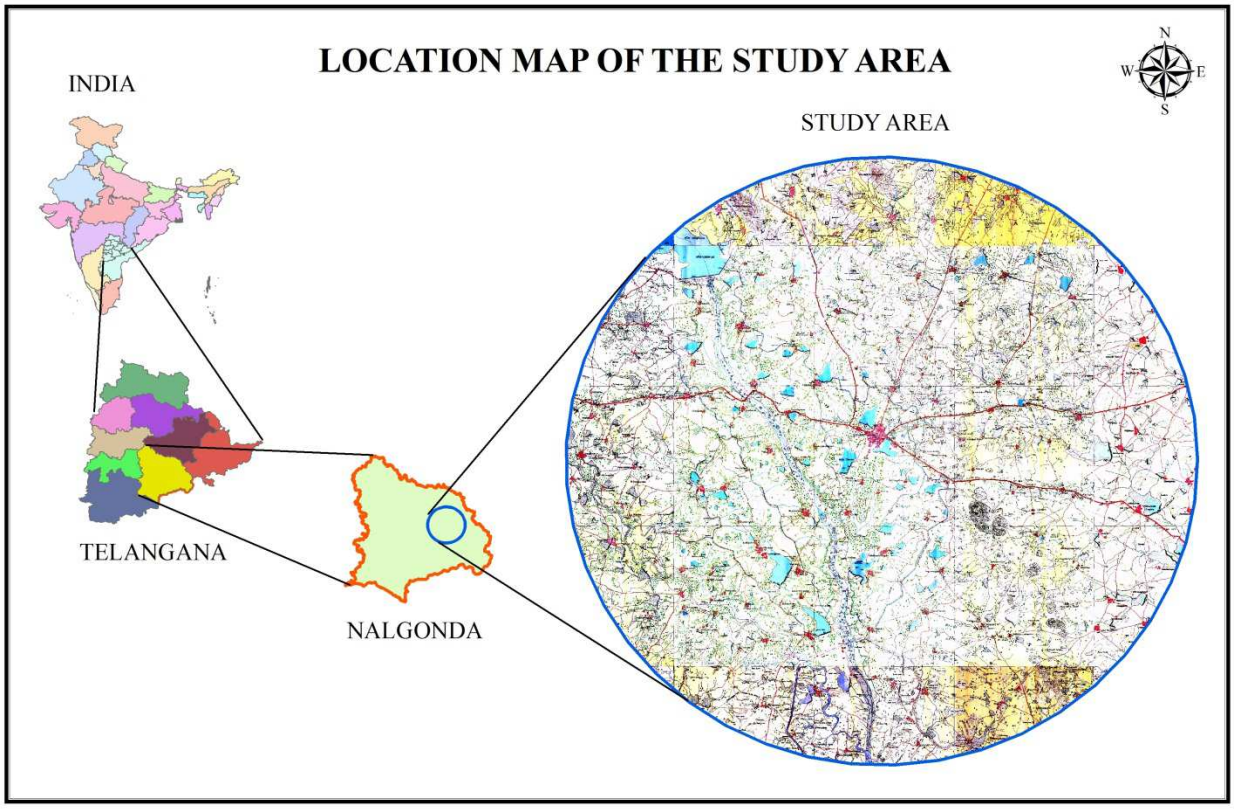


Figure 1 Location map of the study area

MATERIALS AND METHODS

Twenty two ground water samples were collected from the bore wells of the following villages in the area under study in two seasons namely pre-monsoon and post-monsoon seasons.(Figure.2): Sirikonda,Yandlapally, Pamulapahad, Nelamarri, Ravulapenta, Nomula, Gajula Molkapuram, Nemmikal, Ambedkarnagar-Suryapet, Shantinagar-Suryapet, Thakkellapahad,vallabapuram, Lingala, Thimmapuram, Potlapahad, T.Kampahad, Imampet, Yarkaram, Patarlapad, Vati kampahad, Chandupatla and Cherkupally and samples were analyzed for major ion chemistry employing standard methods [4]. Fluoride (F^-) was analyzed, using Ion selective electrodes (Model-Orion 4star).

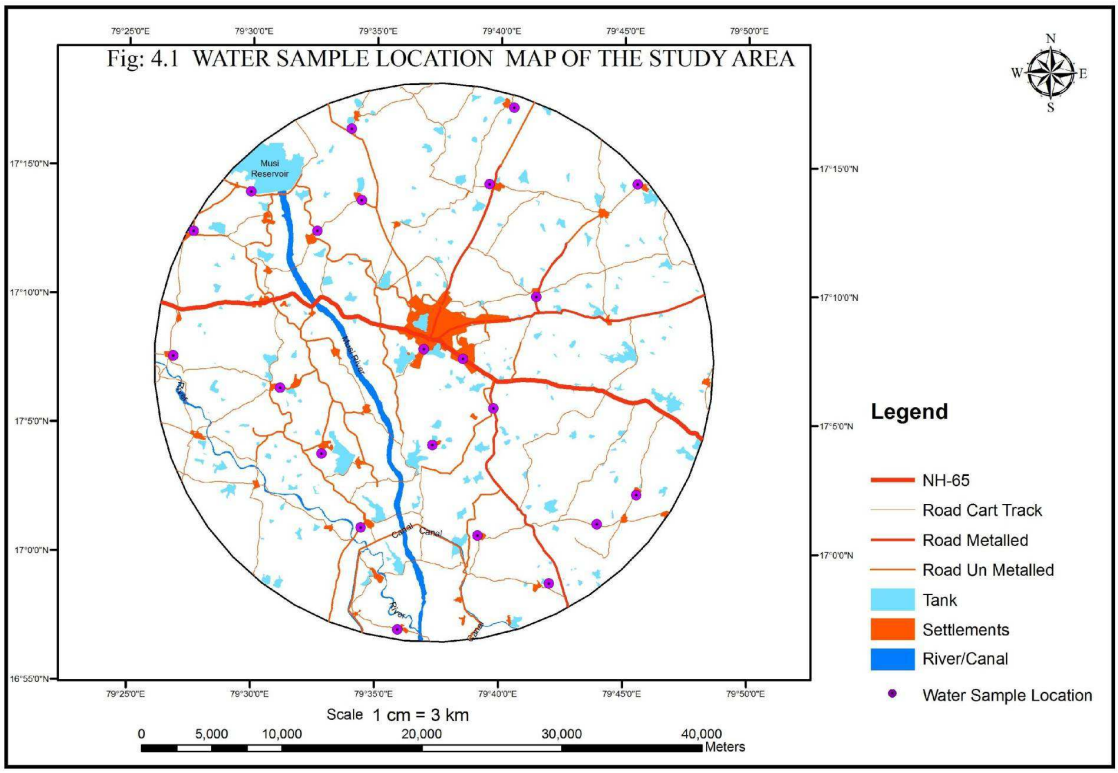


Figure 2 water sample location map of the study area

RESULTS AND DISCUSSION

Fluoride is a desired element and it can forestall or lessen dental rot and fortify bones, in this manner counteracting bone cracks in more seasoned individuals. Where the fluoride level is normally low, research about have demonstrated larger amounts of both dental caries (tooth rot) and breaks. On account of its constructive outcome, fluoride is added to water amid treatment in a few regions with low levels.

Table 1 Table Fluoride levels vs. its effect

F^- level in water	Effects
0.8–1.2 mg/l	Prevention of tooth decay, strengthening of skeleton
Above 1.5 mg/l	Fluorosis: pitting of tooth enamel and deposits in bones
Above about 10 mg/l	Crippling skeletal fluorosis

(*Source: WHO)*

Fluoride concentration in the study area in groundwater samples of pre monsoon varied from 0.11 mg/l – 1.71 mg/l with a mean of 0.77 mg/l, whereas in groundwater samples of post monsoon, it varied from 0.31 mg/l – 1.64 mg/l with a mean of 0.66 mg/l. About 95% of the ground water samples in both pre monsoon and post monsoon have fluoride concentrations within the permissible limit. The fluoride distribution pattern in the study area in groundwater samples of pre monsoon and post monsoon are shown in (Figure 3) and (Figure 4) respectively. Seven samples of pre monsoon and four samples of post monsoon show fluoride content within desirable limit i.e. 1 mg/l (Figure 5), (Table1) and (Table2). Dissolution of fluorite increase the concentrations of fluoride and calcium and since this dissolution is favored in presence of bicarbonate, it is expected that fluoride and bicarbonate exhibit a positive correlation, and fluoride and calcium exhibit a negative correlation as calcite starts precipitating.

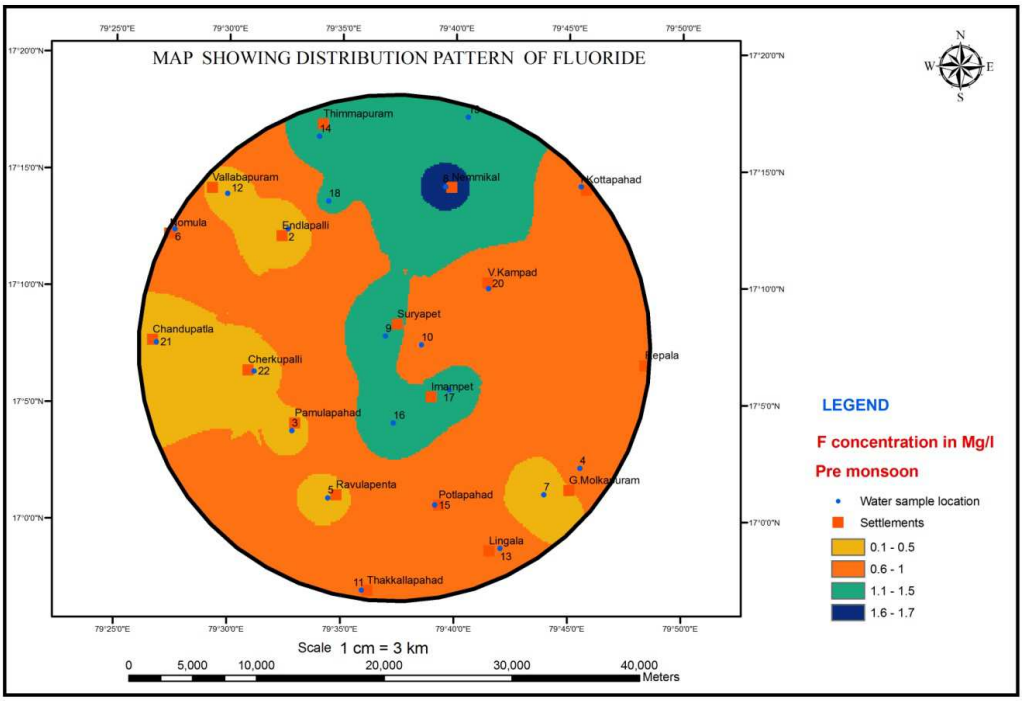


Figure 0 distribution map of Fluoride – Pre-monsoon

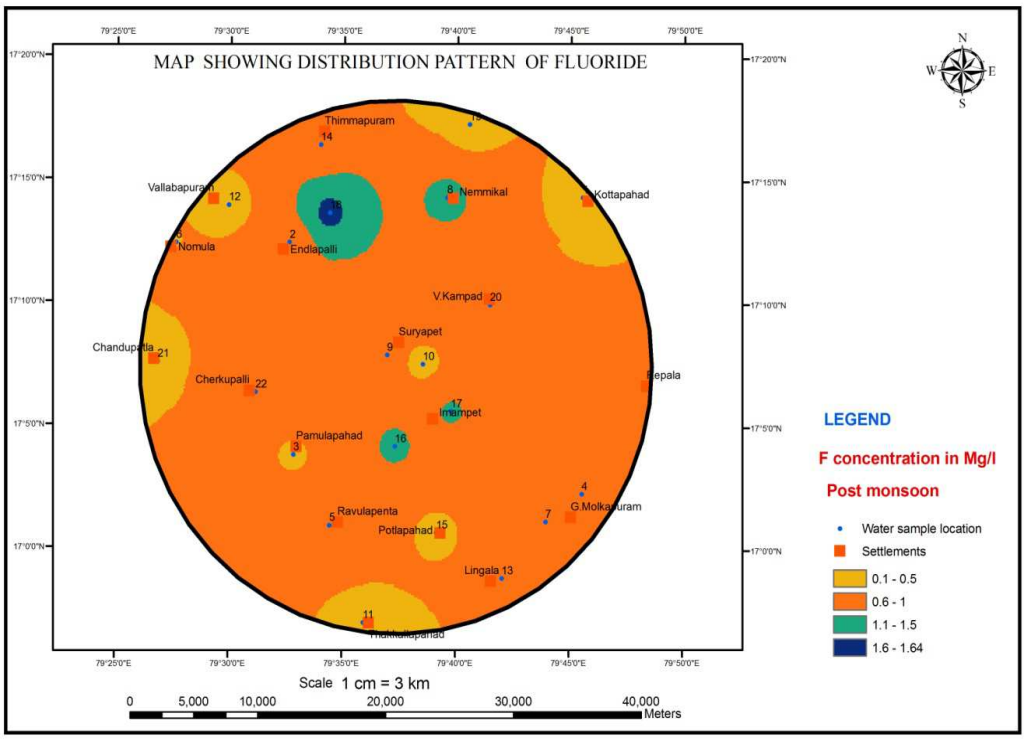
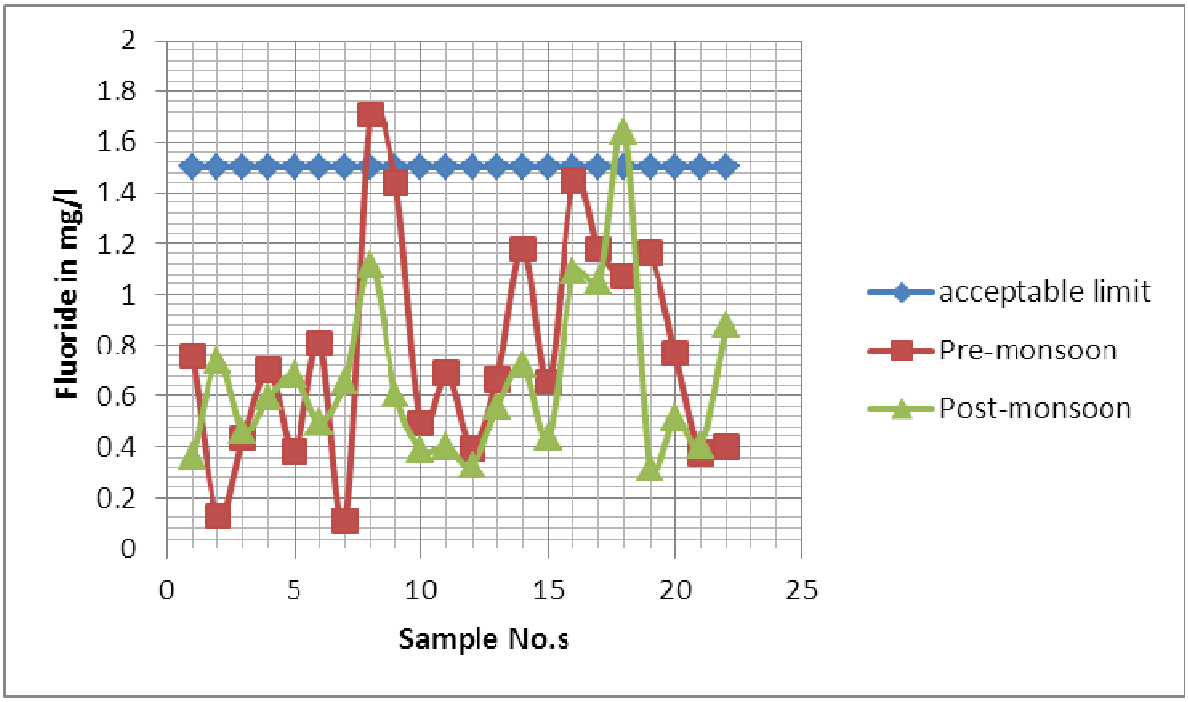


Figure 4 distribution map of Fluoride – Post-monsoon

Table 2 Fluoride levels vs. its effect

Sample no.	Acceptable limit	Pre-monsoon	Post-monsoon
1	1.5	0.758	0.362
2	1.5	0.128	0.741
3	1.5	0.437	0.462
4	1.5	0.702	0.595
5	1.5	0.38	0.683
6	1.5	0.805	0.499
7	1.5	0.109	0.654
8	1.5	1.71	1.116
9	1.5	1.44	0.606
10	1.5	0.493	0.389
11	1.5	0.688	0.401
12	1.5	0.392	0.325
13	1.5	0.669	0.556
14	1.5	1.18	0.719
15	1.5	0.653	0.439
16	1.5	1.45	1.09
17	1.5	1.18	1.05
18	1.5	1.07	1.64
19	1.5	1.16	0.314
20	1.5	0.767	0.514
21	1.5	0.375	0.408
22	1.5	0.402	0.876

Figure 5 Fluoride fluctuations-Pre &Post-monsoon water sample



CONCLUSION

Fluoride fluctuations in the study area were collected in groundwater samples of Pre-monsoon and Post-monsoon seasons especially from Yarkam and Nemmikal villages. It is observed that due to being near to musi reservoir, the fluoride concentration decreased in yarkaram groundwater sample from pre-monsoon to post-monsoon, whereas in Nemmikal groundwater sample, it increased due to being close to weathered rock particles of biotite and hornblende which are causing fluorosis. Also at Nemmikal, there are no groundwater sources like Reservoirs or Tanks to dilute the fluoride concentration. It is observed that there is no clear trend found between fluoride and calcium or fluoride and bicarbonate. A detailed study is needed for finding the correlation. However with the available data, it can be predicted that weathering of fluoride rich minerals present in granite rocks may be the cause for presence of excess fluoride in some of the groundwater samples.

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