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Research Article

FLUORIDE AND NITRATE CONTAMINATION IN GROUNDWATER OF WEEPANAGANDLA, MAHABUBNAGAR, TELANGANA, INDIA

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ABSTRACT

Every living organism is dependent on water. The groundwater quality is dependent on various natural and anthropogenic activities. The present study is in Weepanagandla area, where a large number of cases of skeletal fluorosis and dental fluorosis are reported. The study area is a part of Krishna river basin, in Mahabubnagar district and is also a part of Eastern Dharwar Craton, The groundwater samples (48) were analyzed for fluoride and nitrate. The Fluoride and Nitrate concentrations are in range up to 0.734to 2.68mg/l and 0.036to 541.2 mg/l, respectively.

INTRODUCTION

Fluorosis is a substantial health problem, which is troubling millions of biota in the world. Fluoride is the essential micro mineral in the groundwater. Naturally the fluoride contamination in the groundwater largely depends on rocks, soil and anthropogenic procedure water movement reaching the aquifers (Brunt *et al*; 2004), which can change the composition and adapt the system of the hydro geochemical process.

Generally, fluoride in the groundwater less than 1.00 mg/l. is suitable for potable and has beneficial effects on health, but excess of greater than 1.5 mg/l. fluoride can lead to typical detrimental effects on health, The World Health Organization has set the permissible limit of Fluoride in drinking water at 1.5 mg/l. (WHO, 2011). Many investigators have previously proved long life impact of fluoride and its buildup causes not only affects human skeletal bones (main potential health threat is fluorosis or bone diseases by fluoride) and teeth injury, but many changes in the DNA (Deoxyribonuceic acid) structure, bones become softy, crumble and chalky white (Buswell, 1943), and higher values of fluoride are related to damaging of nervous systems (Edmunds and Smedley, 1996) fluoridation of drinking water has been banned in several countries. According to Pouwels and Ahmed (2007) about 62 million people in 14 states in India are at risk of developing fluorosis due to drinking water. The fluoride is naturally occurring in minerals such as Fluorite (CaF_2), Apatite [$Ca_5(PO_4)_3F$], Cryolite (Na_3AlF_6)and biotite [K(Mg,Fe)2(AlSi2O10)(F,OH)2] etc.

Nitrates is common pollutant in groundwater in rural areas. Nitrate is an essential component for all living organisms, the nitrate in groundwater has localized impact, the regular causes of nitrate additions in groundwater are the result of agricultural fertilizers, runoff, animal agricultural activities and leakage from septic systems and sewer pipes. (BIS, 2012), As per the guidelines of Bureau of Indian Standard, the maximum permissible limit of nitrate contamination in groundwater is 45 mg/l without relaxation. A significant portion of nitrogen applied in food production globally is in excess of crop requirements (Spalding and Exner 1993), resulting in nitrate percolating into groundwater, eutrophication of aquatic ecosystems via surface runoff.

Study Area

The present hydro-geochemical work was carried out in Weepanagandla, southern part of Mahabubnagar District, on Krishna River Basin and this geographical location lies between Longitude 78°3" to 78°16"East and Longitudes 15°57" to 16°10"North, and falls in the Survey of India Toposheets No. E44S4, E44S8 and D44A1, covering an area of 355 sq.km. The district has mostly Subtropical conditions and distribution of rainfall is moderate, to a maximum rainfall

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(600mm above) during the monsoon season and the temperature ranges with minimum 15°C winter to maximum 39°C in summer season respectively. The elevation in the study area ranges from minimum 260m to 330m above the mean sea level. Barren Rocky hills covers the study area and the main streamsare (Laxman Sagar Vagu and Mallappaharani Vagu) flow from the north to south, making tributaries of Krishna River. The location map of the study area is shown in Fig. 1. The study area comprises of alternating geological formations of Eastern Dharwar Granite Gneisses and Cuddapah Basin. North of the study area is exposed by Granite Gneiss and Dolerites which are very hard and exfoliated, which are of Archaean, Kurnool and Cuddapah basin sediments (Goldberg E.D. and Griffin J.J. 1970); are comprises Shales (Nandyal) and Owk Shales, Quartzites(Panyam) and (Nallamalai), Flaggy, Massive and Limestone with Shale (Koilkuntla) and Conglomerate) age of Neoproterozoic. These half of two geological formations are divided by Fault (Breccia). The geological map of the study area shown in Fig. 2.The groundwater samples were from dug wells, dug-cum-bore wells and hand pumps, which are regular used for drinking and agricultural purposes. The depth of open wells ranges from 5.0 to 20.0 m below ground level and depth to water level varies from 3 to 18 mbgl. The yield of dug wells varies from 10-220m³/day for a pumping period of 3 to 6 hrs/day.

MATERIAL AND METHODOLOGY

For the present study, 48 random groundwater samples have been collected throughout the Weepanagandla, Mahabubnagar, Telangana State. Samples were collected in pre-tested polyethylene bottles. For sample collection, preservation and analysis standard methods were followed. The fluoride concentration in groundwater was analyzed electrochemically by Thermo Scientific Orion fluoride ion selective electrode. This is the technique for analysis to the quantity of fluoride in drinking water concentration range from 0.4 to 1.00 mg/L (WHO 2011). Nitrate was analyzed using (APHA 2012) a Systronics UV-VIS Double beam Spectrophotometer 2201 with 1cm matching quartz cell were used for the absorbance measurements.

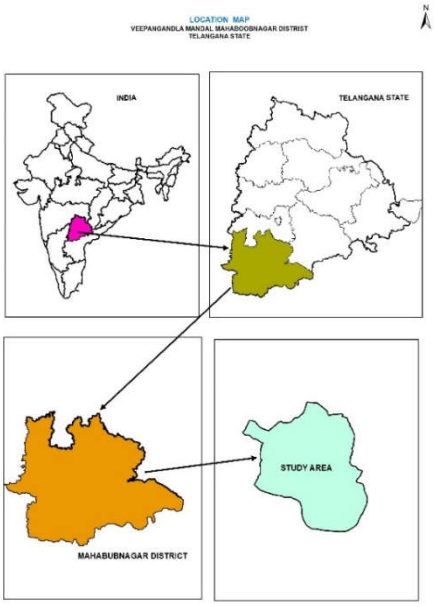

Fig 1 Location map of the study area

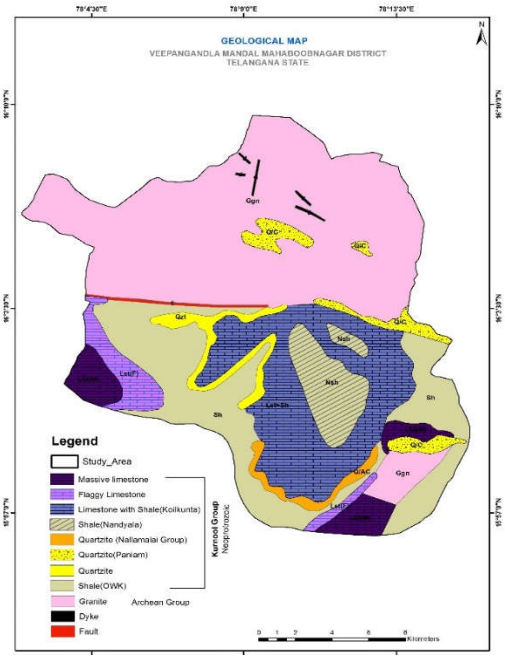

Fig 2 Geological map of the study area

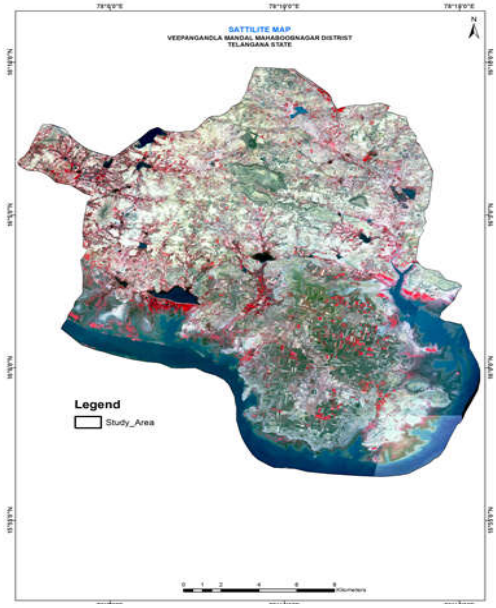

Fig 3 Satellite map of the study area

The geology and geomorphology map of the study area was digitized and prepared using the geology and geomorphology map of Mahabubnagar district published by the Geological Survey of India (GSI) and updated with the remote sensing satellite data (Fig. 3) like LISS-IV image. The groundwater sample data were spatially analyzed in geographic information system (GIS) platform to find out the relationship of fluoride and Nitrate contaminations with reference to geology, geomorphology, groundwater yield, and soil of the study area. GIS proves to be a very efficient tool for analyzing, interpreting, manipulating, and incorporating the geological, hydrogeological, and geomorphological data (Anbazhagan and Nair, 2004; Jha and Peiffer, 2006; Jha *et al*. 2007; Shekhar *et al*. 2014).

RESULTS AND DISCUSSION

Presence of fluoride in groundwater of a particular area depends majorly on the geological setting of the study area. The spatial and temporal distribution pattern of fluoride ion in groundwater of the study area has been presented in Fig. 4. A part in the study area where high fluoride has been reported is dominated by granites. The F^- ion replaces the OH^- ion easily due to their similar ionic radii (Hitchon, 1995), thus enhancing chances of presence of high fluoride in water circulating in clay-dominated regions. Granitic rocks are a main source of fluoride. They have been reportedly found to contain much higher fluoride than any other rock type, (Koritnig, 1978; Krauskopf and Bird, 1995; Brindha and Elango, 2011).

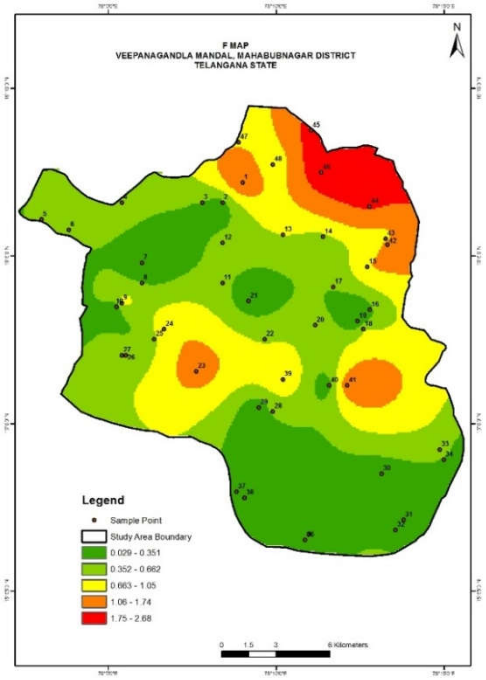

Fig 4 Fluoride map of the study area

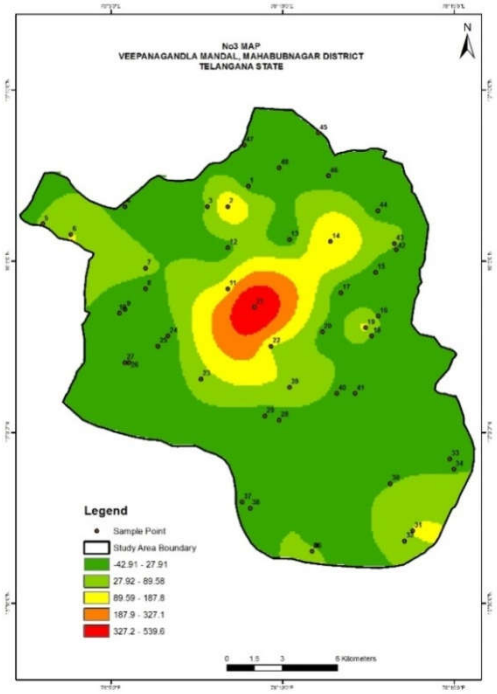

Fig 5 Nitrate map of the Study area

The results showed that the minimum fluoride concentration was 0.0361 mg/l, a maximum of 2.68mg/l, and an average of 0.615mg/l, greater than 1.5mg/l above 8.33% of the samples at 4 locations and above 1mg/l at four locations are in the study area. The results are presented that the highest percentage of fluoride was in Thoomukunta village, station number 46.

Table-1 Results of the Fluoride and Nitrate in the Study Area

S.No.	Floride	NO3	S.No.	Floride	NO3	S.No.	Floride	NO3
1	1.53	3.652	17	0.37	3.0712	33	0.449	6.776
2	0.282	148.72	18	0.641	7.216	34	0.201	15.136
3	0.351	32.12	19	0.0361	102.52	35	0.14	5.808
4	0.613	1.6544	20	0.496	18.92	36	0.055	54.12
5	0.336	0.9108	21	0.198	541.2	37	0.235	4.444
6	0.488	89.76	22	0.604	78.76	38	0.236	5.368
7	0.0664	38.016	23	1.22	58.08	39	0.976	72.16
8	0.346	9.064	24	0.888	1.2408	40	0.216	20.152
9	0.762	3.4452	25	0.61	3.1196	41	1.39	0.7348
10	0.185	5.764	26	0.395	3.0668	42	1.21	1.1704
11	0.421	127.16	27	0.595	13.244	43	0.919	47.96
12	0.447	17.424	28	0.401	1.9668	44	1.89	1.5488
13	0.667	2.0152	29	0.189	4.3472	45	2.07	4.0084
14	0.601	177.32	30	0.19	25.872	46	2.36	2.8072
15	1	2.3848	31	0.141	89.76	47	0.735	7.788
16	0.294	20.988	32	0.385	11.66	48	0.718	21.34

The lowest percentage at Jetaprol village station number was 19.Below 1mg/l at 40 locations of 83.33% of groundwater low percentage of fluoride bearing mineral, although maximum locations are shown in below 1mg/l., in the study area maximum were in permissible range for drinking, highest fluoride contamination is available at totally north east, east and west of the study area. The nitrate levels were generally, the home made brews/spirits and were found to be below the maximum contamination levels of 45mg/l set by the (BIS, 2009). The Nitrate concentrations were generally high in the agricultural land maximum highest range about541.2mg/l and minimum 0.7348mg/l, an average of nitrate 39.911mg/l. The highest percentage of nitrate occurred at Chinna Dagada village, station number 21 and the lowest percentage at Koppunur village, station number 41. The highest percentage nitrate >45mg/l respectively 22.91% at 11 locations and 77.08% shows below 45mg/l at 37 locations shown in (Fig. 5). Most of the highest nitrate at central part of the study area. Maximum ratio of the values was the less than BIS standard recommendation.

CONCLUSION

The analytical results shows that the fluoride and nitrate contaminations in maximum samples were less than recommended ranges by World Health Organization and Indian National Standards. Nitrate concentrations above standard ranges can cause health problem as methemogolobinema (Ziv-El MC and Rittmann BE 2009); based on fluoride analysis of the water 83% samples are within the permissible limits. Nitrate in 77% of the samples are within permissible drinking water range. All the samples having higher fluoride content are in the northern part of the study area, dominated by Granite Gneiss and recent alluvial deposits and hard rock clays.

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