GROUNDWATER QUALITY ASSESSMENT IN RESPECT OF FLUORIDE CONCENTRATION IN THE WESTERN PART OF WANAPARTHY DISTRICT, TELANGANA.

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ABSTRACT

Hydrogeochemical investigations were carried out in the western part of Wanaparthy district, Telangana, India, to identify the high fluoride concentrations in groundwater. Forty-six groundwater samples are collected from bore wells and dug wells in pre-monsoon and post-monsoon sessions and analyzed for major ions. The fluoride concentration in groundwater ranges from 1.2 to 4.6 mg/l with a mean of 2.57 mg/l in pre-monsoon and from 0.35 to 2.95 mg/l with a mean 1.17 mg/l in post-monsoon. Approximately 76.08% and 17.13% of samples exceeded the permissible limit of 1.5 mg/l for fluoride concentration in the pre-monsoon and post-monsoon seasons, respectively. The results clearly indicate that fluoride concentration in the study area was influenced by geogenic process.

Keywords: **Groundwater, Fluoride, Wanaparthy.**

INTRODUCTION

Water is one of the most valuable and essential natural resources for sustaining life on earth and supporting developmental activities. Groundwater is prime source of freshwater on the planet. Groundwater containing dissolved ions beyond the permissible limit is harmful and not suitable for domestic and agriculture use. The natural occurrence of fluoride in groundwater is influenced by climate, composition of the host rock, and hydrogeology (Gupta *et al.,* 2006). Fluoride enters groundwater through both geogenic processes (rock weathering, mineral dissolution, ion exchange and evaporation) and anthropogenic sources (irrigation return flows, wastewater, agrochemicals and constructional activities), with the major contribution typically from geogenic sources (Subba rao *et al* 2017).

The primary sources of fluoride in groundwater include fluoride bearing minerals such as fluorspar, flour-apatite, crysolite and villiaumite, lepidolite, muscovite, hornblende etc, (Adimalla and Venkatayogi 2017; Apambire *et al.* 1997; Ayoob and Gupta 2006; Chatterjee *et al*. 2017;

Jacks *et al.* 2005; Machender *et al.* 2014; Narsimha and Rajitha 2018; Saxena and Ahmed 2003; Subba Rao 2017; Sudheer Kumar *et al.* 2017). These minerals significantly influence groundwater chemistry and also progressively increase the fluoride concentration through various chemical processes. In the Indian subcontinent, the higher concentrations of fluoride in groundwater are associated with igneous and metamorphic rocks.

Fluoride, the most electronegative of all chemical elements, is never found in elemental form in nature. Chemically, combined as fluorides, it ranks 17th in abundance of elements in the earth's crust, representing about 0.06-0.09% of the earth's crust (WHO 1994). Fluoride is essential for human health, contributing to normal bone strength and formation of dental enamel (WHO 2011). However, excessive intake (> 1.5 ppm) can be toxic, causing clinical and metabolic disturbance in humans and animals, such as dental and skeletal Fluorosis (WHO 2011,BIS 2012). The present study is carried out with the objective of understanding the distribution trends of Fluoride and its probable sources.

Location and Geology of the study area

Study area is located in western part of Wanaparthy district, Telangana, India. The study area lies between $77^{0}40^{1}$E-$78^{0}00^{1}$E and $16^{0}14^{1}30^{11}$N -$16^{0}25^{1}30^{11}$N and the area is covered in Survey of India Toposheet numbers 56H/11, 56H/15 and 56H/16 (**Fig. 1**).

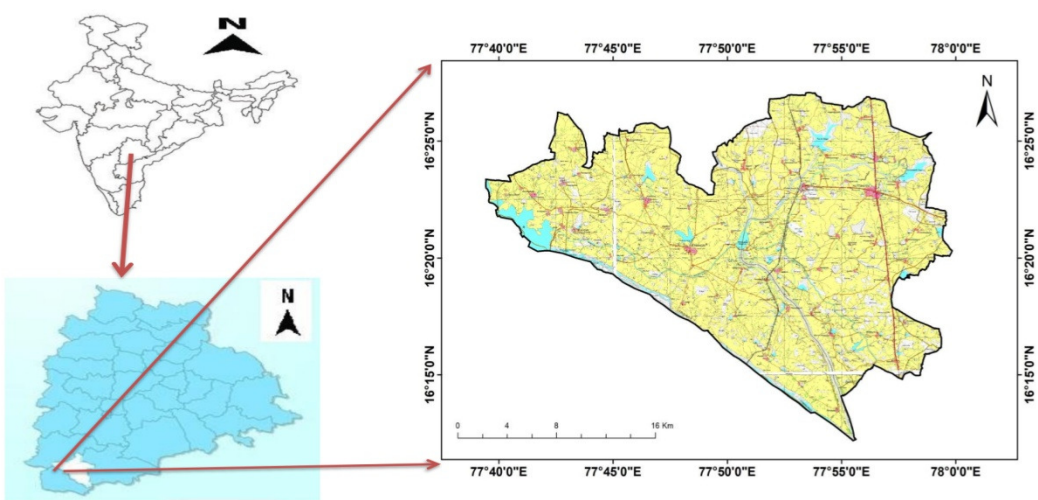


Fig.1. Location map of the study area

The study area is part of the stable Dharwar craton of the south Indian shield. It is underline by Peninsular Gneissic Complex (PGC) where the dominant rock types are granite and granite gnesiss (**Fig.2**). These rocks are composed of feldspar, quartz and biotite and they exhibit medium to course grained equigrannular texture. Younger intrusive includes dolerites and quartz veins.

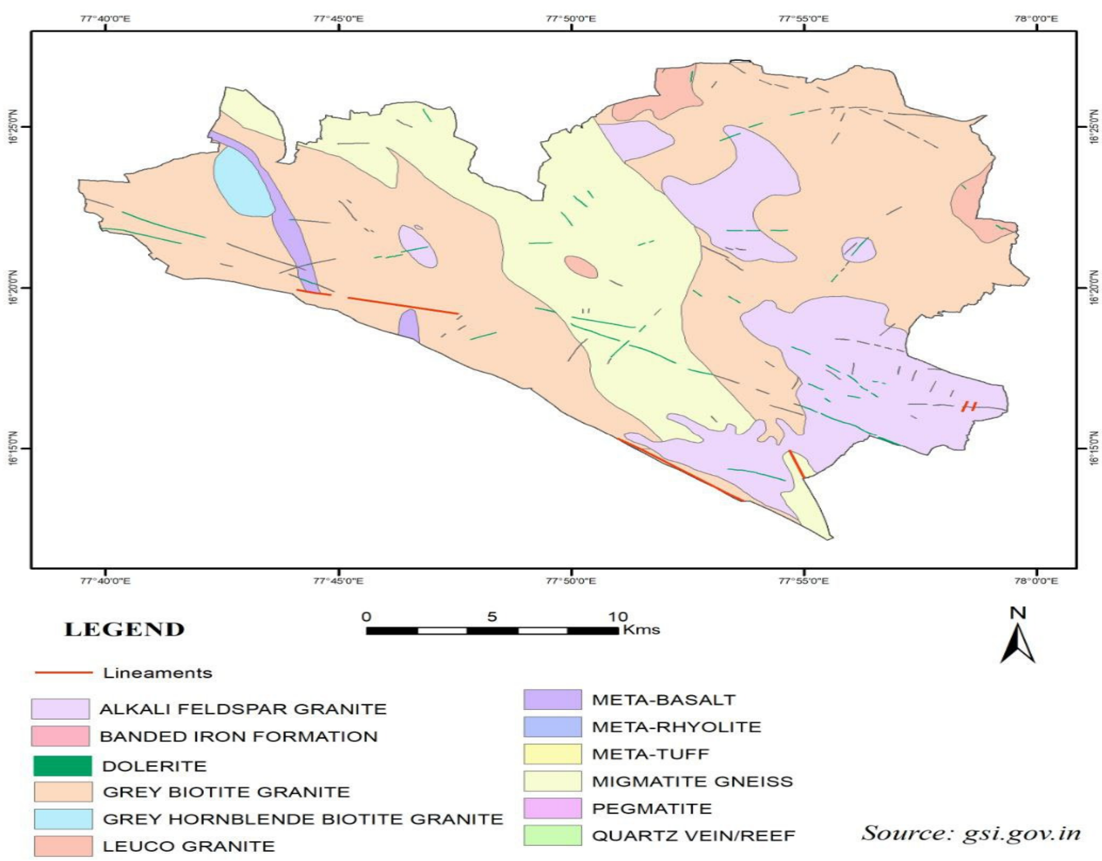


Fig.2. Geological map of the study area

MATERIALS AND METHODS

To assess the groundwater quality, forty-six groundwater samples were collected from bore wells and dug wells in April (Pre-Monsoon) and November (Post Monsoon) for year 2019. One liter polyethylene bottles were rinsed with distilled water followed by deionized water and samples were collected after pumping out water for about 10 min to remove stagnant water from the well. The pH and Electrical conductivity were measured immediately after sampling in the field using portable pH/EC meter. The sampling locations are shown in **(Fig.3)**. Samples were analyzed in the wet chemical laboratory in the C-MET, Hyderabad and Applied Geochemistry Department, Osmania University using standard methods recommended by APHA. Fluoride concentration in water was measured with Orion ion analyzer with fluoride ion-selective electrode **(APHA 1985).**

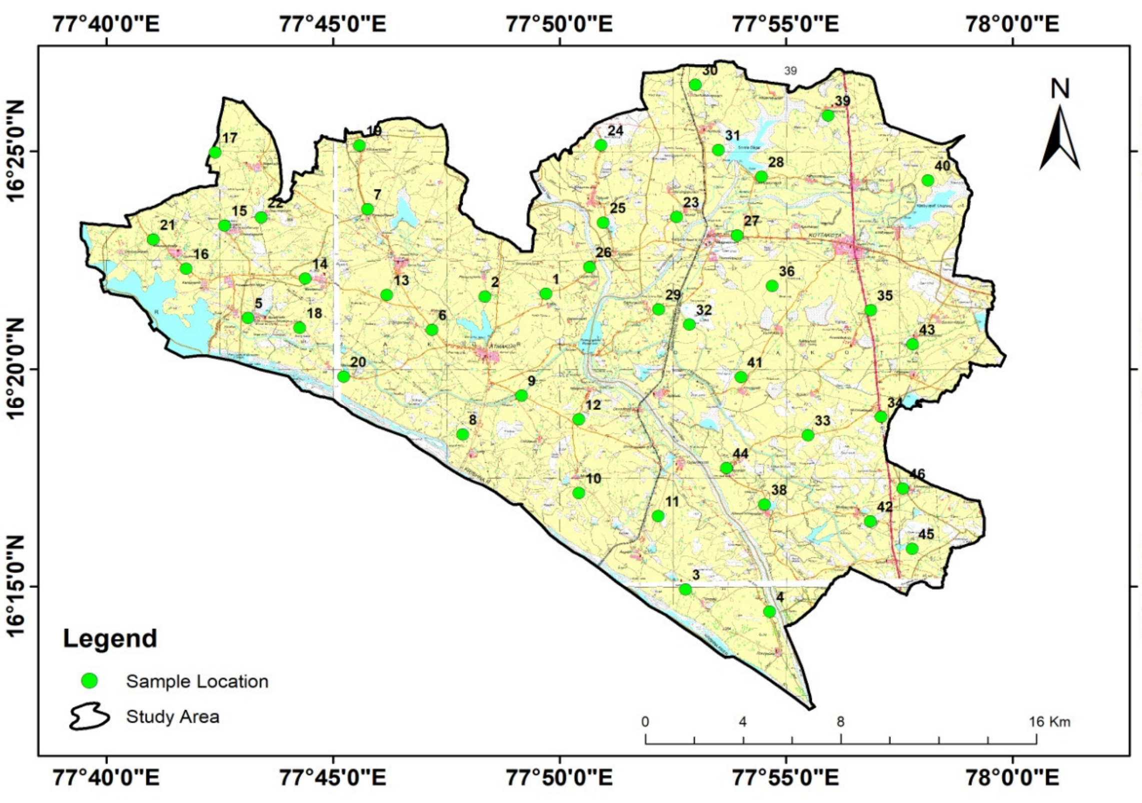


Fig 3. Sample location map of the study area

RESULTS AND DISCUSSIONS

The concentrations were compared with the standards WHO (2011) and the statistical parameters of the variables such as minimum, maximum and average of fluoride ion are given **Table (1).** The fluoride ion concentration in groundwater in this area varied between 1.2 to 4.6 mg/l with mean of 2.57 mg/l during the pre-monsoon season and between 0.35 to 2.95 mg/l with a mean of 1.17 mg/l during post monsoon season. Fluoride ion concentration values for the study area listed in **Table (2).**

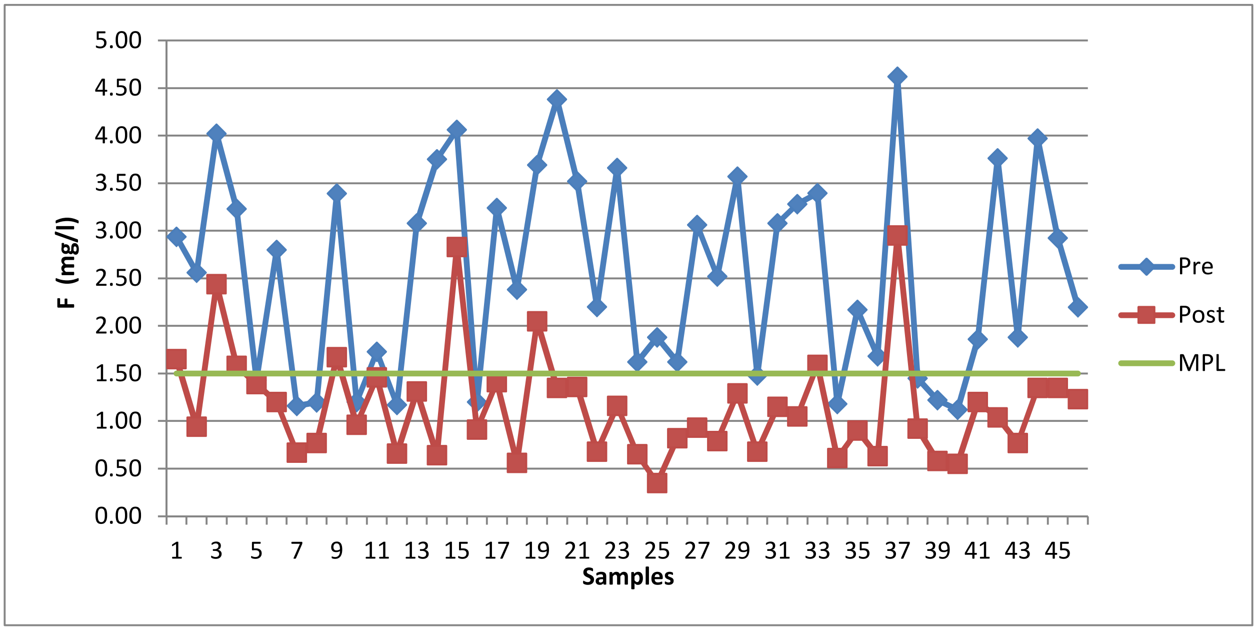
Table: 1 Abstract of Fluoride distribution

No of Samples	Season	Mininum	Maximum	Average	% of samples exceeding the limits	WHO 2011
46	Pre Monsoon	1.12	4.62	2.55	76.08	1.5
46	Post Monsoon	0.34	2.95	1.17	17.13	1.5

Fluorosis is a disease caused by excessive fluoride concentration in drinking water. A concentration above 2.0 mg/l gives rise to mottling of enamel of teeth, a condition known as "dental fluorosis". Higher amounts in excess of 3.0 mg/l cause abnormalities in bone structure, known as skeletal fluorosis. Another symptom of fluorosis is Knock Knees, often observed in high fluoride areas.

Fluoride concentration in the groundwater of the study area shows that 76.08% and 17.13% of the total number of samples are higher than allowable limit of 1.5 mg/l (WHO 2011) in pre monsoon and post monsoon periods, respectively. The geogenic origins (apatite, biotite, hornblende and clays) and anthropogenic sources (chemical fertilizers), coupled with higher rates of evaporation and prolonged contact of water with the aquifer system, are the primary factors contributing to the concentration of Fluoride content under alkaline environment in the groundwater (Subba Rao and John Devadas 2003; Narsimha and Sudarshan 2017a,b ; Subba Rao 2017; Adimalla2019).

Spatial and Temporal variation of fluoride concentration is shown in (**Fig.4**).From the figure it is very clear that there is no specific trend of fluoride distribution in the area under study.



*** Pre- Pre-monsoon, Post- Post-monsoon, MPL- Maximum Permissible Limit (WHO 2011)**

Fig.4.Spatial and Temporal variation of Fluoride in pre and post monsoon seasons

Table: 2 Fluoride ion concentration in villages of western part of Wanaparthy District, Telangana

	F mg/l		
Well id	**Pre Monsoon**	**Post Monsoon**	**Village Name**
B/w1	2.94	1.65	Balkrishnapuram
B/w2	2.56	0.94	Pinnamcherla
B/w3	4.02	2.44	Thoompally
B/w4	3.23	1.58	Rechintala
B/w5	1.43	1.39	Mulamalla
D/w6	2.80	1.2	Khanpurgate
B/w7	1.16	0.67	Pamireddypalli
B/w8	1.20	0.77	Jurial
B/w9	3.39	1.67	Guntipally
D/w10	1.20	0.96	Motlampally

D/w11	1.73	1.46	Arepally
B/w12	1.17	0.66	Medepally
B/w13	3.08	1.31	Amarachintha
D/w14	3.75	0.64	Mastipoor
D/w15	4.06	2.83	Chandraghad
D/w16	1.20	0.91	Erladiney
B/w17	3.24	1.41	Bekkarpally
B/w18	2.38	0.56	Nadimalla
B/w19	3.69	2.05	Kankanvanipally
B/w20	4.38	1.35	Mulamalla
B/w21	3.52	1.36	Mittanandimalla
D/w22	2.20	0.68	Dharmapur
B/w23	3.66	1.16	Nelvidi
D/w24	1.62	0.65	Duppally
B/w25	1.88	0.35	Kothapally
D/w26	1.62	0.82	Gopanpeta
D/w27	3.06	0.93	Madanapur
B/w28	2.52	0.79	Shankarampeta
D/w29	3.57	1.29	Ramanpadu
B/w30	1.48	0.68	Konnur
B/w31	3.08	1.15	Dwarakanagar
B/w32	3.28	1.05	Ajjakollu
B/w33	3.40	1.59	Ramakrishnapuram
B/w34	1.18	0.61	Mummallapalli
B/w35	2.17	0.9	Ammadabakula
B/w36	1.68	0.63	Vaddevadu
B/w37	4.62	2.95	Veltoor
B/w38	1.45	0.92	R k puram
B/w39	1.22	0.58	P.j palli
B/w40	1.12	0.55	Nirveni
B/w41	1.86	1.2	Charlapalli
B/w42	3.76	1.04	Mirsapalli
D/w43	1.88	0.77	Sankireddypalli
D/w44	3.97	1.35	Apparala
D/w45	2.93	1.35	Natavalli
D/w46	2.20	1.23	Ullamkonda

CONCLUSIONS

Hydrogeochemical investigations were conducted to assess the suitability of groundwater for drinking in the western part of wanaparthy district, Telangana. This study revealed high concentrations of fluoride in groundwater, measuring up to 4.62 mg/l in the pre-monsoon and 2.95 mg/l post monsoon periods. About 76.08% of samples during the pre-monsoon and 17.13% of samples during the post monsoon exceeded the permissible limit of 1.5 mg/l set by the WHO (2011) drinking water standard, indicating unsuitability for drinking purpose. The results indicate that the high fluoride levels in groundwater are primarily geogenic in nature. The rocks in this area contain high fluoride content, weathering of these rocks and leaching of fluoride bearing minerals are the major contributors to the elevated fluoride concentration in groundwater**.** The other natural phenomenon that contributes to high fluoride is evaporation. It is recommended to implement defluorination techniques for groundwater before use and to practice rainwater harvesting to recharge the groundwater, thereby improving its quality in this area.

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