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GROUNDWATER QUALITY WITH SPECIAL EMPHASIS ON FLOURIDE AND NITRATE CONTAMINATION IN AMRABAD AND PADARA MANDALS, NAGARKURNOOL DISTRICT, TELANGANA.

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ABSTRACT

Amrabad and Padara Mandal's located 65 kilometers East of Nagar kurnool, The focus of this data is to evaluated the groundwater quality and the fluoride and Nitrate concentration in groundwater. Analysis is carried out pH, EC, TDS, NO_3^-, and F^- were all measured in 48 pre and post monsoon samples. During pre and post monsoon seasons, fluoride concentration range from 0.2 to 3.3 mg/l and 0.15 to 2.54 mg/l, and Nitrate NO_3^- range from 3.4to597 mg/l and 0.01to897 mg/l respectively. When compared to the World Health Organizations tolerance limit (1.5mg/l) and (45 mg/l), 29.16% and 18% of fluoride, groundwater sources in the study area is unfit for drinking purposes. Due to the higher fluoride levels in drinking water several cases of dental and skeletal fluorosis have appeared at alarming rate in the investigated area. The study revealed that 72% and 70% of nitrate samples of the samples were found to be unsuitable for drinking purposes due to excess nitrate (>45 mg/l) content in the groundwater. High Nitrate concentration may cause blue baby syndrome or methemoglobinemia.

Key words: Groundwater, fluoride, nitrate.

1.INTRODUCTION

According to Gupta et al. (2006), the climate, the make-up of the host rock, and hydrogeology all affect how much fluoride naturally occurs in groundwater. Fluoride-bearing minerals like fluorspar, cryolite, fluor-apatite, and hydroxyl apatite are the main sources of fluoride in groundwater. According to Meenakshi et al. (2004), there are numerous variables that affect the fluoride content, including the solubility and availability of fluoride minerals, the velocity of flowing water, temperature, pH, the concentration of calcium and bicarbonate ions in the water, and many more. On the Indian continent, igneous and metamorphic rocks are linked to greater groundwater fluoride concentrations.

Fluorine is the most electronegative chemical element, it is never encountered in its elemental form in the natural. It ranks 17th in terms of quantity of elements in the earth's crust when combined chemically as fluorides, accounting for 0.06-0.09% of the crust (WHO, 1994). One of the vital elements for human health is fluoride. Even in modest amounts, it is necessary for the normal mineralization of bones and the synthesis of tooth enamel (Chouhan and Flora, 2010). Fluoride becomes toxic and causes clinical and metabolic disturbances in both animals and humans, such as dental and skeletal fluorosis, when it is consumed in excess of the allowed limit (Hussain et al., 2012; Singh et al., 2007).

Nitrogen exists in a variety of forms, the most common of which are N_2, N_2O, NO, NO_2, and NH_3 [2]. It is thought to make up almost 80% of the atmosphere (Berner, 1987). The most oxidised chemical form of nitrogen that may be found in natural systems is nitrate, which is a component of the nitrogen cycle in nature. Since nitrogen is utilised to create numerous vital components, including proteins, DNA, RNA, vitamins, hormones, and enzymes, all living systems depend on it for survival. Despite being vital to life itself, nitrates are one of the most common groundwater pollutants in many parts of the world, and in many cases, this is because agriculture is becoming more intensive. (Goldberg, 1989).

2.LOCATION OF THE STUDY AREA

The study region, which encompasses 246 sq. km, is located in India's Telangana state Nagar Kurnool district. It is located 150 km from Hyderabad. Study area is located on the Toposheet Nos. 56 L/15 is bounded by North Latitudes 16° 34′ 30″ to 16° 42′ 00″ and East Longitudes 78° 24′ 00″ to 78° 28′ 48″ (figure 1). The research location has a hot climate in general. The average summer temperature is 39.3 degrees Celsius; the average winter temperature is 25 degrees Celsius, and there are 642.30 millimetres of rain per year.

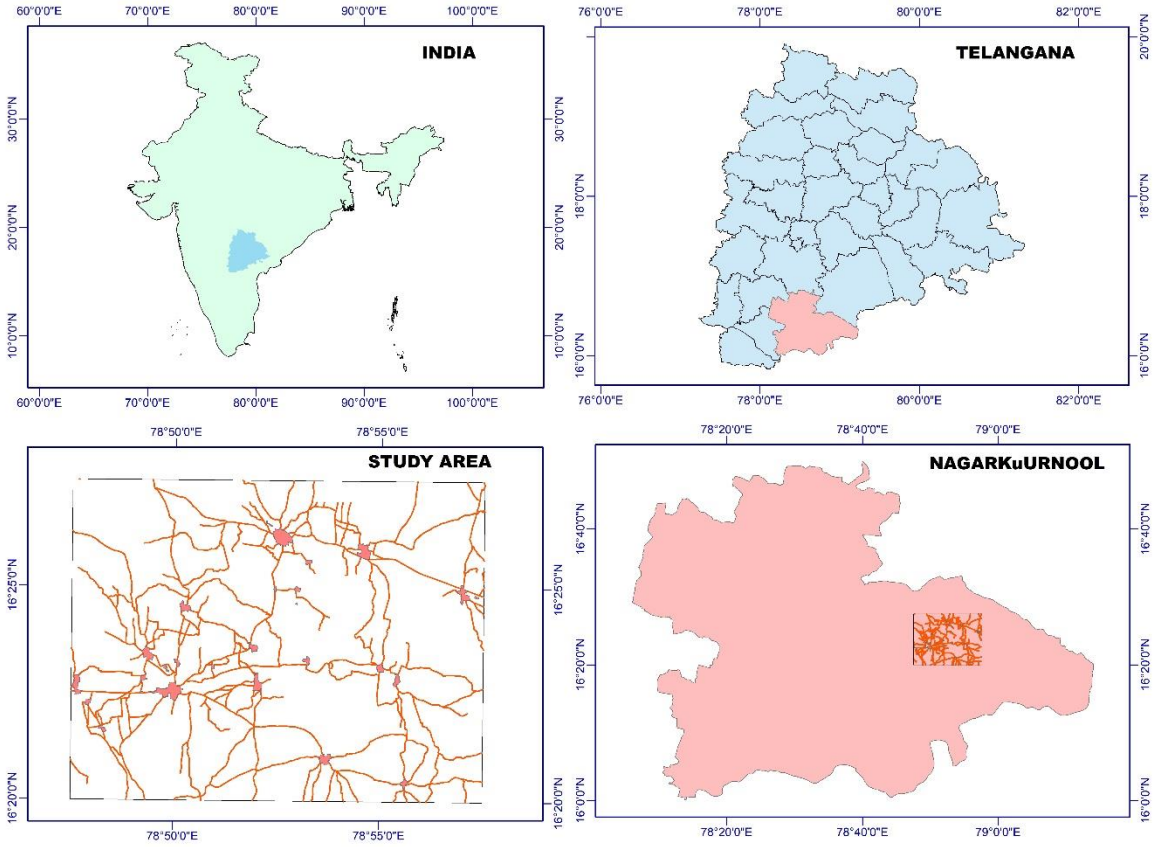

Fig.1. Location of the study area

3.GEOLOGY

The study area is a portion of the south Indian shield's stable Dharwar craton. The majority of the area is covered by Quartizite with shale (Srisailam quartzite) and Granite, which is made up of quartz, it is medium to coarsely crystalline. Shale is a fine grained, clastic sedimentary rock formed from mud that is a mix of flakes of clay minerals and tiny fragments of other minerals,especially quartz and calcite. Granite is a coarse grained phaneritic intrusive igneous rock composed mostly of quartz, Plagioclase feldspar and responsible for

the usual grey colour. The rock contains orthoclase and microcline potash feldspars, though in lesser amounts. The most common mineral in these rocks is biotite. (Geological Survey of India, G.S.I.,1995).

4.MATERIALS AND METHODS

48 groundwater samples were taken from hand pumps, bore wells, and open wells in the Amrabad and Padara area of the Nagarkurnool District in order to evaluate the quality of the groundwater. According to standard methods (APHA, 1985), the samples were taken in clean one-litter polyethylene bottles and tested for pH, Electrical Conductivity (EC), Nitrate ($NO3^-$), and Fluoride (F^-). The outcomes were assessed in accordance with the World Health Organization's (2011) and the Bureau of Indian Standards' (2009) guidelines for drinking water quality. The pH was determined using a Digital pH Metre (Model 802Systronics), the conductivity was determined using a Conductivity Metre (Model 304 Systronics), the nitrate concentration was determined using a spectrophotometer, and the fluoride concentration was determined using an Orion Ion Analyzer and a fluoride ion selective electrode. The concentrations are compared to the standards (WHO, 2011; BIS, 2009), and statistical aspects of the variables, such as the lowest and maximum mean of various chemical parameters of groundwater, are also taken into consideration. Are given in Table 1.

Table:1. Statistic of physical and chemical parameters of groundwater samples in pre and post monsoon seasons**.**

	Pre-Monsoon Season				**Post-Monsoon Season**				
Parameter	Min	Max	Mean	% of samples exceeded the limits	Min	Max	Mean	% of samples exceeded the limits	WHO,2011
pH	6.5	7.7	7	0	6.2	8.3	6.7	0	6.5-8.5
EC **(µS/cm)**	359.3	2187	1048	20.83	102.2	3083	662.63	8.33	1500
TDS (mg/l)	230	1400	673	58.33	77.6	2302	907	79.16	500
NO_3^-(mg/l)	3.4	597	166.4	72.91	0.01	879.1	179.6	70.83	45
F^-(mg/l)	0.2	3.3	1.4	29.16	0.15	2.54	0.87	18.75	1.5

5.RESULTS AND DISCUSSIONS

pH:

The pH of water is a crucial indicator of its quality and contributes significantly to many calculations involving geochemical equilibrium or solubility (Hem,1985). Acidity and alkalinity intensity are measured using the pH scale. It ranges from zero, which is extremely acidic, to 14 which is extremely alkaline, with 7 being exactly neutral at twenty-five degrees Celsius. Thus, the pH of water that is completely pure is 7. There is a tenfold difference between neighbouring values since the pH scale is logarithmic. For instance, water at pH 3 is ten times more acidic than water at pH 4, and water at pH 5 is one hundred times more acidic. The pH range under examination at the moment is 6.5 to 7.7, with an average value of 7, and 6.2 to 8.3 an average 6.7 pre and post-monsoon correspondingly.

Electrical Conductivity (EC):

The electrical conductivity of the groundwater ranges from 359.3 to 2187 µS/cm At 25^0 degrees Celsius, with average: 402.8 µS/cm. And 102.2 to 3083 µS/cm an average 662.6 µS/ cm According to (WHO ,2011), the permissible limit of EC in drinking water is less than 1500 micromhos/cm. 20% to8.3% of samples have amounts above the allowed limit, pre and post-monsoon. Increased ionic concentrations in the groundwater are indicated by higher concentrations. Ionic concentration is determined by the conductivity measurement.

It is dependent on the temperature, ion concentration, and kind of ions (Hem, 1985). High salt content in groundwater is thought to be the cause of high conductivity (Davies and Dewiest, 1966).

TDS:

The TDS concentration range were between 230 to 1400 mg/l with average 673 mg/l and 77.6 to 2302 mg/l an average 907 mg/l. groundwater samples were mostly fresh,with most of the samples having TDS values above the recommended value of 500 mg/l. WHO,2011

Nitrate (NO_3^-)

The area of groundwater has a range of 3.4 mg/l to 597 mg/l of nitrate. The groundwater has an average NO_3 concentration of 166.4 mg/l. and 0.01 to 879.1 mg/l an average 179.6 mg/l NO_3 pre and post-monsoon season. According to WHO (2011), the acceptable limit for NO3-content in drinking water is 45 mg/l. While 72.91% and 70.83% of the study area pre and post monsoon groundwater samples exceeds the allowable limit. The highest nitrate concentration in the groundwater is in the Chintlankunta village (BW-20) (Fig.2.1) and Padara govt.school (BW-15) (Fig.2.2) pre and post-monsoon. It has been noted that there is a significant concentration of nitrate in the groundwater in the research area, which is due to nitrates migrating from various anthropogenic sources during the rainy season. The use of synthetic N-fertilizers like urea, calcium ammonium nitrate, ammonium phosphate, and ammonium sulphate is on the rise in the agricultural sector, which is the main source for nitrates in the groundwater, and is the cause of the high concentration of nitrate in groundwater.

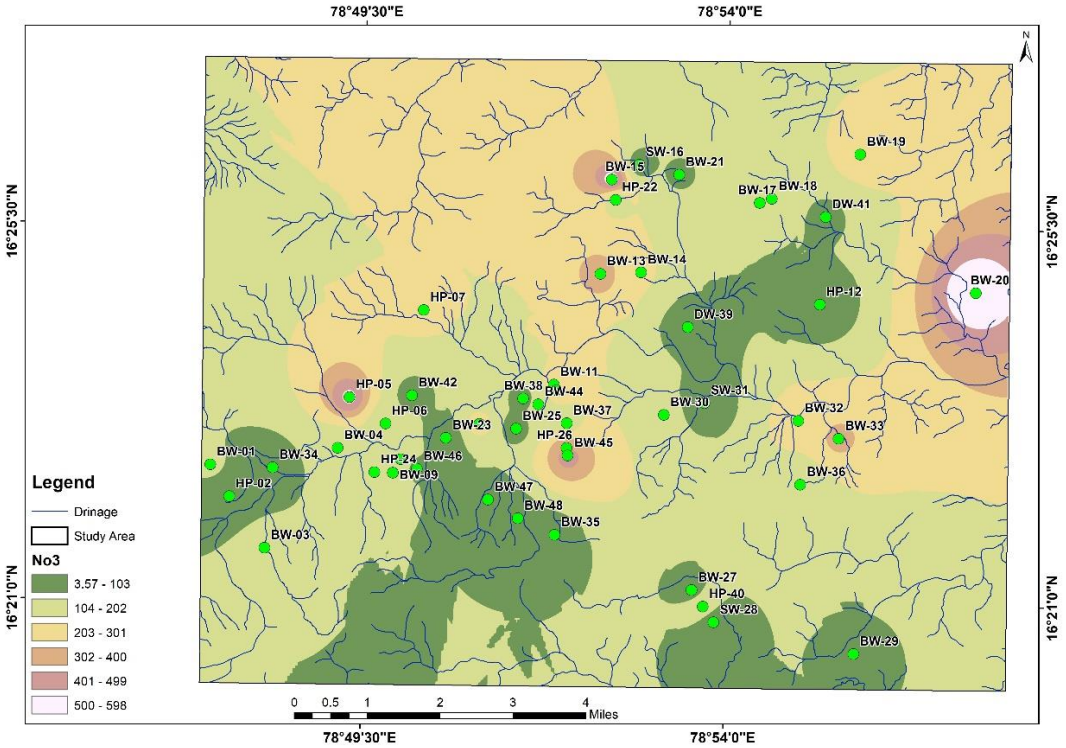

Fig.2.1 spatial distribution of map of NO_3 in pre-monsoon.

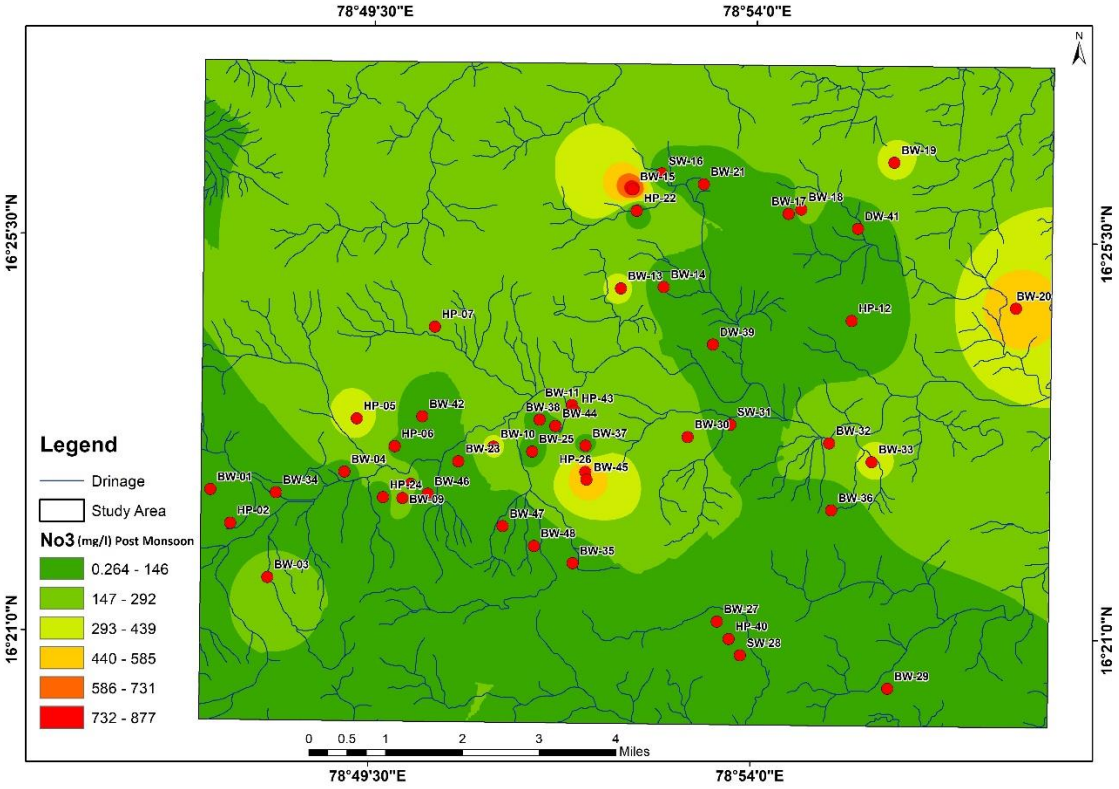

Fig.2.2 spatial distribution of map of NO_3 in post-monsoon

Fluoride (F-):

Fluorosis is an illness brought on by too much fluoride in drinking water. The disorder known as "dental fluorosis" is caused by concentrations above 1. mg/l, and higher levels above 3.0 mg/l result in anomalies in bone structure. Skeletal fluorosis is a condition that causes these symptoms. Knock knees are another fluorosis sign that are frequently seen in places with high fluoride levels. The average fluoride concentration in the groundwater of the research area is 1.4 mg/l to 0.87mg/l pre and post monsoon, ranging from 0.2 to3.3 mg/l and 0.15 to 2.54 mg/l. both seasons. After evaluating the data it is suggested that groundwater of some villages Chennampally(BW19) (3.3mg/l),Edulabavi(BW10) (3.2mg/l),Chitlankunta(BW20) (2.5mg/l), and Ellampally kothapally gate(BW34) (2.54mg/l), Laxmapur Thanda (BW33)2.37mg/l, Madhavanpally sub station(BW37) 2.27mg/l, are respectively pre and post-monsoon,is notsuitable for drinking purposes. According to WHO (2011),the preferred and maximum acceptable limits for fluoride in drinking water, 29.16 to 18.75% of groundwater exhibits excess fluoride that is not intended for human consumption. The distribution map (Fig.3.1 &3.2) displays the fluoride content. It has been noted that those who live in places with high fluoride concentrations experience knee discomfort, discoloured teeth, and other dental problems. Additionally, local residents in these locations are experiencing worrying levels of dental and skeletal fluorosis.

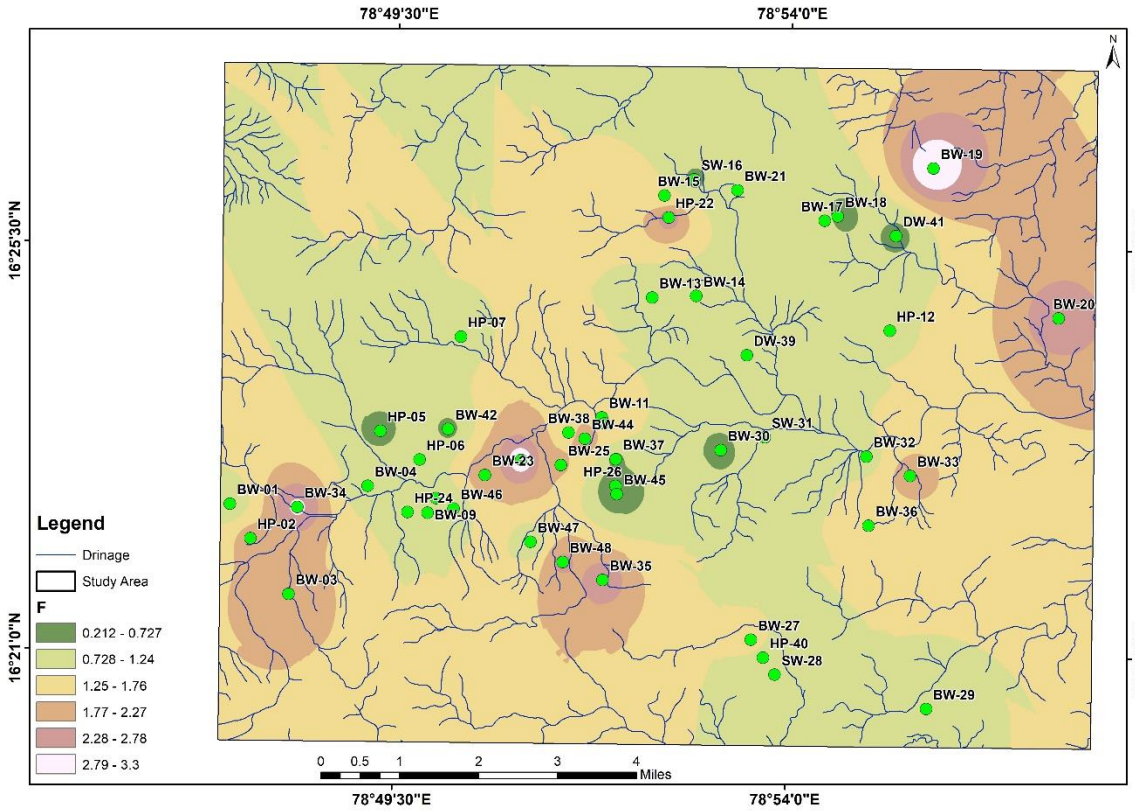

Fig.3.1 spatial distribution of map of Fluoride in pre-monsoon.

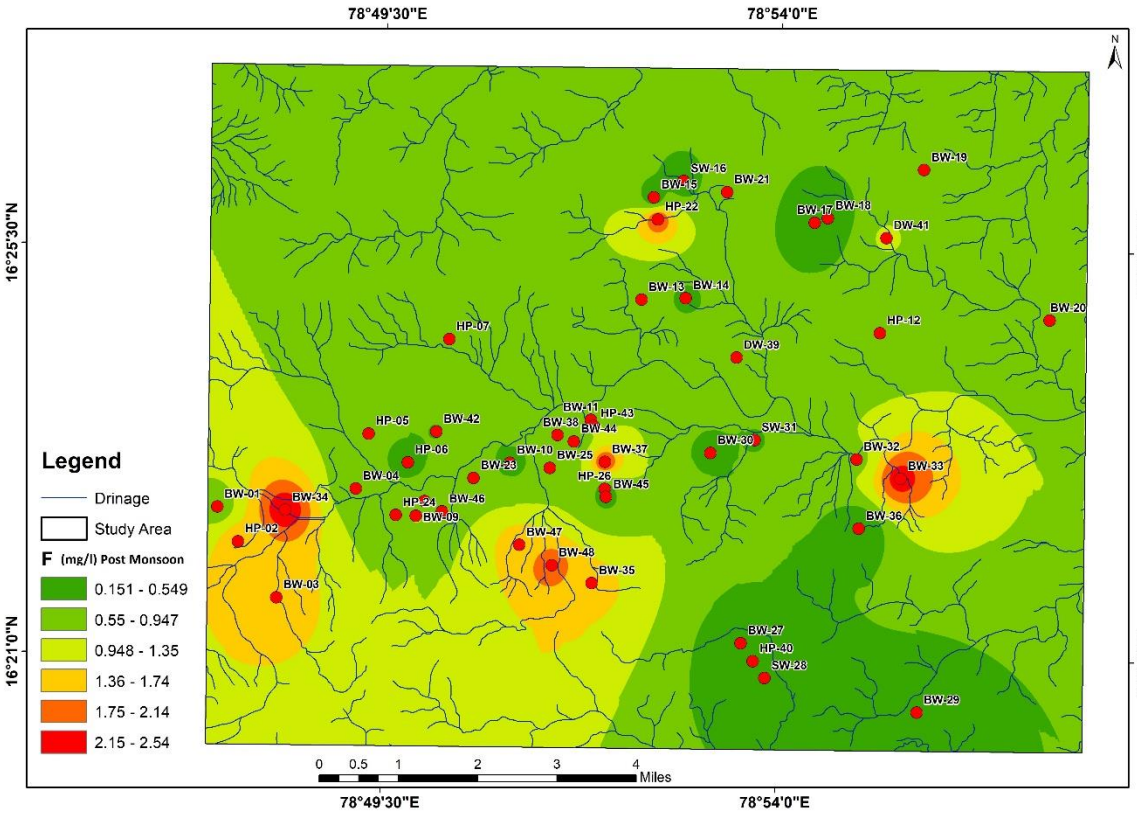

Fig.3.2 spatial distribution of map of Fluoride in post-monsoon

6. CONCLUSIONS:

Groundwater in the Amrabad and Padara neighbourhood of the Nagarkurnool district is acidic to alkaline, according to hydrogeochemical tests. 20.83 to 8.33 % of groundwater of the study area exhibits concentrations higher than the recommended limit of 1500 micromhos/cm for drinking purposes. The higher results show that there are greater ionic concentrations in the groundwater. The area's groundwater contains nitrate concentrations ranging from3.4 mg/l to 597 mg/l, and 0.01 to 879.1 mg/l, but 72.91% and 70.83% of it exceeds the 45 mg/l limit, which is the legal limit for drinking water. This is because nitrates from anthropogenic sources migrate through the groundwater during the rainy season. While 29.16 to 18.75% of groundwater has excessive fluoride that is recommended for drinking. It has been noted that residents of places with high fluoride concentrations experience knee discomfort, discoloured teeth, and other dental problems. This is especially true for younger people.

Additionally, local residents in these locations are experiencing worrying levels of dental and skeletal fluorosis.

ACKNOWLEDGEMENTS:

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