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Fluoride Distribution in the Groundwater of Narayankher Area, Medak District, Telangana, India: A Geo-Spatial Approach

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Abstract

This investigation was done to survey the fluoride focus in groundwater of Narayankher region, Medak District, where groundwater is the principle wellspring of drinking water. Water tests gathered from bore wells were investigated for pH, Electrical Conductivity (EC), Nitrate (NO3 -) and Fluoride (F-) content. Fluoride grouping of groundwater ranges from 0.4to 2.3 mg/l. Out of44 towns contemplated 41 towns have fluoride fixation beneath 1 mg/l and 3 towns have fluoride focus over 1mg/l. 7 % towns have fluoride over 2 mg/l and 1% towns have fluoride over 2.2 mg/l. According to the alluring and most extreme allowable point of confinement for fluoride in drinking water (1.5 mg/l) endorsed by WHO (2004) and Bureau of Indian Standards (2009), in tree towns groundwater sources in the examination zone is unfit for drinking purposes. Because of the higher fluoride levels in drinking water a few instances of dental and skeletal fluorosis have showed up at disturbing rate in the explored zone. The wells in the examined territory have been delineated into protected and risky wells for utilization of water concerning fluoride and nitrate

Keywords:

groundwater;
ElectricalConductivity (EC);
Nitrate (NO3);
Fluoride (F-).

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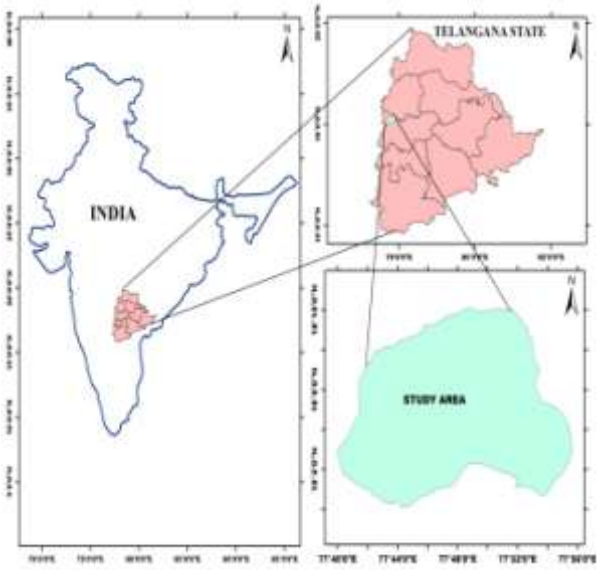
1. Introduction

Nearly 12 million of the 85 million tons of fluoride deposits on the earth's crust are found in India. It is not surprising; therefore, the fluorosis is endemic in 17 states of India (UNICEF 1999). The most seriously affected areas are Andhra Pradesh, Punjab, Haryana, Rajasthan, Gujarat, Tamil Nadu and Utter Pradesh (Kumaran et al.,1971; Teotia et al.,1984). Fluoride is a key aspect of water quality in rural water supply system, which potentially affects the sustainability of water if it exceeds its prescribed limit..Approximately 62 million people including 6 million children suffer from fluorosis because of consumption of water with high fluoride concentrations (Susheela, 1999). The amount of fluoride occurring naturally in groundwater is governed by climate,composition of the host rock, and hydrogeology (Gupta et al.,2006). The major sources of fluoride in groundwater are due to fluoride bearing minerals such as fluorspar, cryolite, fluor-apitite and Hydroxylapatite. The fluoride content is a function of many factors such as availability and solubility of fluoride minerals, velocity of flowing water, temperature, pH, concentration of calcium and bicarbonate ions in water, etc. (Meenakshi et al.,2004). In Indian continent, the higher concentration of fluoride in groundwater is associated with igneous and metamorphic rocks.Fluorine is the most electronegative of all chemical elements and is therefore never found in nature in elemental form. Combined chemically in the form of fluorides, it ranks 17thin abundance of elements in the earth's crust representing about 0.06–0.09% of the earth's crust (WHO, 1994). Fluoride is one of important life elements to human health. It is essential for normal mineralization of bones and formation of dental enamel with presence in small quantity (Chouhan and Flora, 2010). When fluoride is taken up more than permissible limit, it become toxic and causes clinical and metabolic disturbance in animals and human being such as dental and skeletal Fluorosis (Hussain et al., 2012; Singh et al.,2007).Owing to the universal presence of fluorides in earth's crust, all water contains fluorides in varying concentrations ranging from trace levels to several milligrams per liter (WHO, 1994). In surface fresh water such as rivers and lakes, fluoride concentrations are usually low, ranging from 0.01 to 0.3 mg/l (Murray, 1986). However, exceptionally high values can be found such that some lakes in Kenya have fluoride content >2000 mg/l. For example, Lake Nakuru, which is situated in the rift valley in Kenya, has a fluoride concentration of 2800 mg/l and it is reported that this is the highest natural fluoride concentration ever found in water (Murray, 1986). The selected part for this study is situated in western part of the state where groundwater is a major source of drinking water. Detailed hydrogeochemical investigations have been carried out to know the geochemical behavior and to assessthe quality of groundwater in the study area by sudhakar (2014),with reference to fluoride and fluorosis problem. The objective of this study is to investigate the quality of drinking water (underground water) with special reference to the concentration of fluoride in Narayankher area, Medak, Telangana, India. The present study brings out distribution of fluoride in the groundwater in the area underlain mostly by granites.

2. LOCATION OF THE STUDY AREA:

Study region arranged at separation of 120 kms from the Telangana state, capital of Hyderabad. The examination zone in Medak locale lies between North scopes 18^0 21^1 and East longitudes 77^0 46^1 and is incorporated into Survey of India topo sheet 56F/12 and 56F/16. It has a normal rise of 610 meters above mean ocean level. The aggregate examination region is secured 343.47 Sq.km. The zone involves a few towns and real town is Narayankher, which is on Hyderabad-Nagpur high go through the region .Fig:1 Location delineate

Geology



Basalts happening in and around Nrayankhermandal of Medak region frame the eastern furthest point of the colossal mass of Deccan traps and rocks that expands westwards into adjoining Karnataka and Maharastra states. The Deccan traps show up as step like patios or levels involving vast territories. They are uncovered between the rises of 512 to 627 meters in the examination region they indicate spheroidal weathering and columnar joints Basalts are very weathered and are decayed bringing about the development of laterites which are believed to happen as topping on top levels and furthermore along the inclines of the hillocks and as red loamy soil in low lying zones while the out harvests of the bed shake are seen uncovered in profound crevasses. It is entrenched that geography assumes an indispensable part in the dissemination and event of groundwater, (Krishnamurthy and Srinivas 1995).

MATERIALS AND METHODS

With a specific end goal to survey the groundwater quality, 44 groundwater tests have been gathered from hand-pumps, bore wells, open wells in Narayankher territory, Medak District. The examples were gathered in clean two liter polythene bottles and examined for pH, Electrical Conductivity (Ec), Nitrate (NO3 -) and Fluoride (F-) according to standard techniques (APHA, 1985). The outcomes were assessed as per the drinking water quality principles given by the World Health Organization (2004) and Bureau of Indian Standards (2009). The pH was estimated with Digital pH Meter (Model 802 Systronics), EC was estimated withConductivity Meter (Model 304 Systronics), Nitrate was dictated by spectrophotometer and Fluoride focus wasmeasured with Orion particle analyzer with fluoride particle specific cathode. The centralization of EC is communicated in miniaturized scale siemens/cm at 25ºC, Nitrate (N-) and Fluoride(F-) are communicated in mg/l.the logical outcomes are displayed in the (Tables 1), the fixations are contrasted and the models (WHO, 2004.BIS, 2009) and the factual parameters of the factors, for example, least, greatest, mean, middle, standard deviation of various substance parameters of groundwater are given in Table 2. Circulation maps are produced for pH, EC, Nitrate, and Fluoride with the assistance of GIS programming to know the spatial appropriation of the focuses Figure (2-5).

RESULTS AND DISCUSSION

pH

The pH of water is an imperative sign of its quality and gives critical data in numerous sorts of geochemical harmony or solvency estimation (Hem, 1985). The present examination zone of pH is ranges from 6.69 to 7.15 with a normal of 7.58, which demonstrate that the groundwater quality is somewhat acidic to marginally basic in nature (Table 1), in greater part of the examples, it is inside as far as possible (Fig 2) of the WHO principles and Bureau of Indian Standards (BIS). A slight increment in pH was seen in the north and south-eastern piece of the locale

Electrical Conductivity (EC):

The electrical conductivity of water relies upon the water temperature, sorts of particles display in the water and their fixation (Sherif et al., 2006; Hem et al., 1991). The most

extreme point of confinement of electrical conductivity in drinking water is recommended as 1500 µS/cm (WHO, 2004). EC of the groundwater is differing from 100 to 5100 µS/cm at 25ºC with a normal estimation of 938 µS/cm (Table 1). The examination territory least esteem is watched granitic landscape is at Venkatapuram town with an estimation of 300 µS/cm and a most extreme esteem is seen at 5100 µS/cm at Nizampet town (Table 1).

Spatial dispersion, circulation guide of EC is appeared in (Fig 3). The grouping of groundwater based on EC is given in Table 1. It is discovered that lone 72% of the examples are inside as far as possible, 22% of the examples fall in the not admissible utmost but rather they are barely poor in quality and 18% of the example areas can be delegated perilous as per the WHO standard (Table 2). EC of the groundwater higher than 3000 µS/cm was recorded in three areas which are like the high estimations of EC announced by (Brindha and Kavitha, 2015; Jameel and Hussain, 2011). Higher EC of groundwater relies upon the weathering of aquifer material and impact of anthropogenic exercises contaminating the ground and surface water.

Nitrate (NO_3^-):

In regular conditions, principally from the non-lithological sources, the grouping of NO3-does not surpass 10 mg/L in the water (Cushing et al. 1973; Ritzi et al. 1993). For the most part in unadulterated water, NO3-is occasionally present. A higher centralization of it, surpassing 10 mg/L, mirrors the artificial contamination (Hem et al., 1991), here because of an utilization of composts focused for higher product yields. The wellspring of NO3-in groundwater is because of rotting natural issue, sewage squanders, spillage of septic tanks and manures (Subrahmanyam and Yadaiah, 2000). Nitrate tainting in groundwater is one of the significant issues in water quality examinations (Schilling and Wolter, 2007; Raju et al. 2009). The event of abnormal amounts of nitrate in groundwater is an unmistakable issue in numerous parts of the nation. The centralization of nitrogen in groundwater is gotten from the biosphere (Saleh et al., 1999). Nitrogen is initially settled from the environment and mineralized by soil microorganisms into ammonium.

Nitrate centralization of groundwater tests differed from 8 to 80 mg/L with a normal estimation of 34 mg/L in the granitic aquifer and from 8 to 84 mg/L with a normal estimation of 33 mg/L in the basaltic aquifer (Table 4.1 and 4.1a). It is discovered that exclusive 11 groundwater tests surpass the attractive furthest reaches of 45 mg/L according to WHO (1993) and BIS (1991) standard (Table 2). The high nitrate focus (Sheligera 82 mg/L; Narayankher 84 mg/L; Mirkampet 80 mg/L; Baddaram 79 mg/L; Nizampet 75 mg/L; Kadpol 74 mg/L; Timmapur 79 mg/L; Kodapur 73 mg/L and Mansurpur 46 mg/L) may happen because of draining of NO3-from composts and pesticides amid the water system of horticulture arrive (Table 1). The high convergence of nitrate in drinking water is poisonous and causes blue infant illness/methemoglobinaemia in youngsters and gastric carcinomas, goiter, birth contortions and hypertension (Comly et al., 1945; Gilly et al., 1984; Majumdar and Gupta, 2000). Nitrate delivers no shading or smell in water and can cause malignancy in people when expended over a drawn out stretch of time (Jahed et al., 2008). High nitrate fixations in the groundwater are accounted for in numerous parts of India in light of escalated agrarian practices which use nitrogen manures changing the regular waste examples concentrated urbanization and industrialization (Raju et al., 2009). The spatial circulations of nitrate fixations for granitic and basaltic aquifers are portrayed . Of course, water tested from the northern piece of the investigation had the most reduced nitrate focuses (Fig 4). Conversely, tests taken from inspecting points southwest and in agricultural areas (e.g., north-eastern of the study area) had clearly the highest nitrate concentrations.

Table 1 Major ion concentrations of water samples in the Narayankher, Medak District

Sample ID	Village	pH	EC µS/cm	NO_3^- mg/L	F^- mg/L	Sample ID	Village	pH	EC µS/cm	NO_3^- mg/L	F^- mg/L
MNG-1	Shankarampet	7.59	740	8	0.9	**MNB-1**	Kajapur	7.25	900	16	1.38
MNG-2	Malkapur	6.99	2500	24	0.6	**MNB-2**	Kajapur	7.3	1500	17	0.9
MNG-3	Baddaram	7.46	650	14	1.39	**MNB-3**	Kajapur Tank	7.07	2100	9	0.36
MNG-4	Baddaramvill	6.81	1700	79	2.19	**MNB-4**	Kadpol	6.8	700	74	0.14
MNG-5	Shankarampet	7	1400	26	0.85	**MNB-5**	Sirgapoor	7.46	700	8	0.68
MNG-6	Kamalapuram	7.22	1200	16	1.5	**MNB-6**	Sirgapoor	7.21	700	15	1.52
MNG-7	Venkatapuram	7.87	300	11	0.4	**MNB-7**	MomyaTanda	7.22	600	12	0.12
MNG-8	Kamalapuram	7.39	900	13	1.78	**MNB-8**	JamlaTanda	7.39	600	10	0.4
MNG-9	Tenkati	7	400	41	0.73	**MNB-9**	RekhalTanda	6.9	1300	44	0.22
MNG-10	Nizampet	6.96	1000	12	0.25	**MNB-10**	Thurkpally	7.58	700	10	0.5
MNG-11	Nizampet	6.89	5100	75	0.9	**MNB-11**	Thurkaplly	7.29	900	14	0.81
MNG-12	Nizampet	7.35	1030	8	0.78	**MNB-12**	kondapur	7.17	1000	73	0.4
MNG-13	Bachupalli	6.98	2500	75	0.4	**MNB-13**	Mansurpur	7.03	1500	46	0.74
MNG-14	Bachupalli	7.14	1400	38	0.17	**MNB-14**	GadidiHukran	7.55	800	17	0.82
MNG-15	Mirkampet	6.79	800	80	0.22	**MNB-15**	Abbanda	7.08	2100	62	0.6
MNG-16	Raparthi	6.88	3000	71	0.15	**MNB-16**	AbbandaDargga	7.39	1100	8	2.3
MNG-17	Raparthi	7.22	1000	17	1.69	**MNB-17**	Narayankher	6.83	3500	84	0.4
MNG-18	Ankampalli	7.06	1400	23	1.06	**MNB-18**	Narayankher	6.69	100	20	0.5
MNG-19	Kishnapura	7.19	1300	33	0.17	**MNB-19**	Narayankher	7.12	1000	10	0.5
MNG-20	Kanapur.K	7.53	600	16	1.31	**MNB-20**	Thimmapur	6.98	1900	79	0.14

MNG-21	Kanapur	7.3	2300	16	2.16	**MNB-21**	Sheligera	7.29	800	17	0.2
MNG-22	KanapurChrvuu	7.29	1100	27	0.5	**MNB-22**	Sheligera	6.95	2000	82	0.5
Sample ID	**Village**	**pH**	**EC** µS/cm	**NO_3^-** mg/L	**F^-** mg/L	**Sample ID**	**Village**	**pH**	**EC** µS/cm	**NO_3^-** mg/L	**F^-** mg/L
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MNG-4	Baddaramvill	6.81	1700	79	2.19	**MNB-4**	Kadpol	6.8	700	74	0.14
MNG-5	Shankarampet	7	1400	26	0.85	**MNB-5**	Sirgapoor	7.46	700	8	0.68
MNG-6	Kamalapuram	7.22	1200	16	1.5	**MNB-6**	Sirgapoor	7.21	700	15	1.52
MNG-7	Venkatapuram	7.87	300	11	0.4	**MNB-7**	MomyaTanda	7.22	600	12	0.12
MNG-8	Kamalapuram	7.39	900	13	1.78	**MNB-8**	JamlaTanda	7.39	600	10	0.4
MNG-9	Tenkati	7	400	41	0.73	**MNB-9**	RekhalTanda	6.9	1300	44	0.22
MNG-10	Nizampet	6.96	1000	12	0.25	**MNB-10**	Thurkpally	7.58	700	10	0.5
MNG-11	Nizampet	6.89	5100	75	0.9	**MNB-11**	Thurkaplly	7.29	900	14	0.81
MNG-12	Nizampet	7.35	1030	8	0.78	**MNB-12**	kondapur	7.17	1000	73	0.4
MNG-13	Bachupalli	6.98	2500	75	0.4	**MNB-13**	Mansurpur	7.03	1500	46	0.74
MNG-14	Bachupalli	7.14	1400	38	0.17	**MNB-14**	GadidiHukran	7.55	800	17	0.82
MNG-15	Mirkampet	6.79	800	80	0.22	**MNB-15**	Abbanda	7.08	2100	62	0.6
MNG-16	Raparthi	6.88	3000	71	0.15	**MNB-16**	AbbandaDargga	7.39	1100	8	2.3
MNG-17	Raparthi	7.22	1000	17	1.69	**MNB-17**	Narayankher	6.83	3500	84	0.4
MNG-18	Ankampalli	7.06	1400	23	1.06	**MNB-18**	Narayankher	6.69	100	20	0.5
MNG-19	Kishnapura	7.19	1300	33	0.7	**MNB-19**	Narayankher	7.02	2300	10	0.5

MNG-20	Kanapur.K	7.53	600	16	1.31	**MNB-20**	Thimmapur	6.98	1900	79	0.14
MNG-21	Kanapur	7.3	2300	16	2.16	**MNB-21**	Sheligera	7.29	800	17	0.2
MNG-22	KanapurChrvuu	7.29	1100	27	0.5	**MNB-22**	Sheligera	6.95	2000	82	0.5

Fluoride (F^-):

Fluorides are pervasive in the earth and the measure of fluoride happening normally is reliant upon the individual topographical condition (Kahama et al., 1997). Particularly high fluoride levels in water have been found in India, China and Africa (Tirumalesh et al., 2007; Suma Latha et al., 1999; Muralidharan et al., 2002; RamamohanaRao et al., 1993; Handa et al., 1975; Ramesam et al., 1985; Saxena et al., 2001 and Tamta et al., 1994; Yoder et al., 1998; Cao et al., 2000; Fantaye et al., 2004; Tekle-Haimanot et al., 2006). The characteristic convergence of fluoride in water relies upon a few contributing variables, for example, pH, add up to broke up solids, alkalinity, the porosity and causticity of the dirt and rocks, the temperature, the profundity of wells, and so on. (Kahama et al., 1997; Grobler et al., 2001; Harrison et al., 2005; Msonda et al., 2007; Viswanathan et al., 2009). The event of F-in groundwater is predominantly because of common or geogenic tainting and the wellspring of pollution is regularly obscure (Handa et al., 1975; Saxena and Ahmed, 2001). Irregular levels of fluoride in water are regular in broke hard shake zone with pegmatite veins. It happens in the earth covering alongside the fluoride rich mineral bearing rocks. Minerals like topaz, fluorite, fluor-apatite, villuamite, cryolite and fluoride replaceable hydroxide particle in ferro- - magnesium silicates add to fluoride in groundwater (Ramesham et al., 1985).

Table.2 Statistical summary along with different official limits of drinking water quality

Water Quality Parameters	Units	BIS (1991)		WHO (2006)		Concentration in the study area	Percentage of samples exceeding HDL	Percentage of samples exceeding MPL
		Highest Desirable Limit (HDL)	Maximum Permissible Limit (MPL)	Highest Desirable Limit (HDL)	Maximum Permissible Limit (MPL)			
pH		**6.5**	**8.5**	**7**	**8.5**	**6.69 - 7.87**	**-**	**-**
EC	**µS/cm**	**-**	**-**	**-**	**1500**	**100 - 5100**	**12**	**32**
TDS	**mg/L**	**500**	**2000**	**500**	**1500**	**62 - 3162**	**5**	**39**
TH	**mg/L**	**100**	**500**	**100**	**500**	**50 - 660**	**5**	**39**
Ca2+	**mg/L**	**75**	**200**	**75**	**200**	**14 - 246**	**1**	**43**
Mg+	**mg/L**	**30**	**100**	**30**	**150**	**00 - 265**	**1**	**43**
Na+	**mg/L**	**100**	**-**	**-**	**200**	**26 - 596**	**7**	**37**
K+	**mg/L**	**10**	**-**	**12**	**-**	**01 - 126**	**8**	**36**
CO3-	**mg/L**	**10**	**-**	**10**	**-**	**00 - 90**	**1**	**43**
HCO3-	**mg/L**	**300**	**-**	**-**	**-**	**31 - 653**	**19**	**25**
Cl-	**mg/L**	**250**	**1000**	**200**	**600**	**28 - 568**	**-**	**44**
SO42-	**mg/L**	**200**	**400**	**200**	**400**	**3 t0 40**	**-**	**-**
NO3-	**mg/L**	**45**	**-**	**45**	**-**	**8 to 84**	**12**	**32**
F-	**mg/L**	**0.6**	**1**	**1**	**1.5**	**00 - 2.30**	**5**	**39**

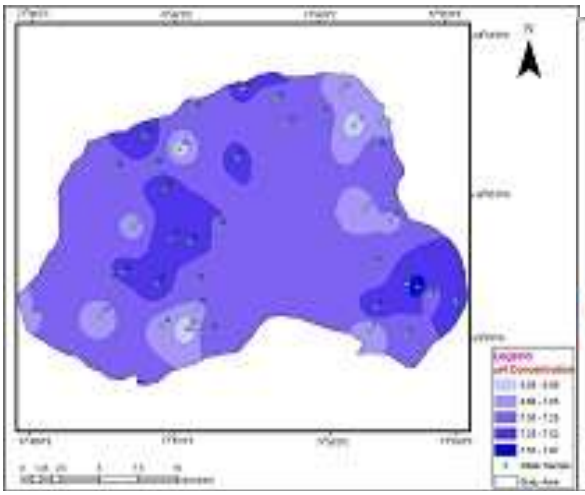

Fig.2 Distribution of pH

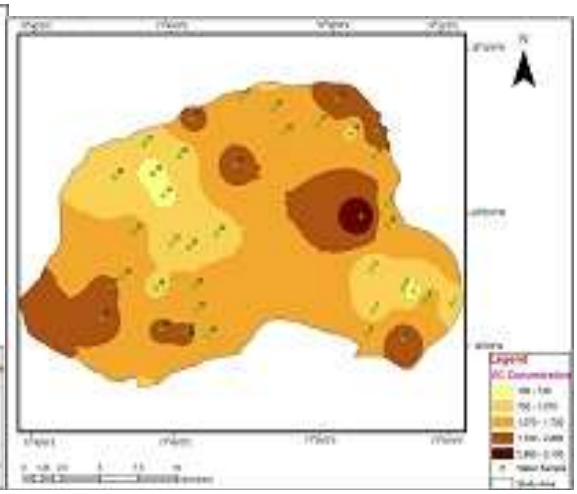

Fig.3 Distribution of EC

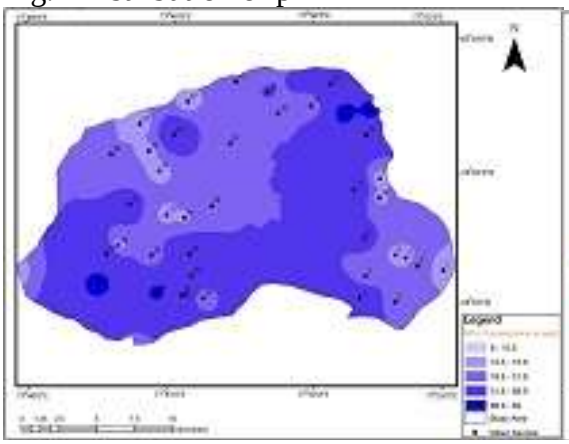

Fig.4 Distribution of Nitrate (NO3)

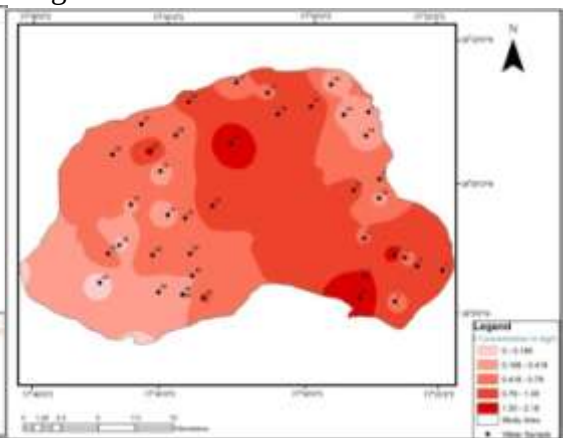

Fig.5Distribution of Fluoride (F-)

CONCLUSIONS

Hydrogeo substance examinations did in the Narayankher,area of Medak area uncovered that the groundwater is antacid in nature. About 2 % of groundwater of the examination region indicates focuses higher than the endorsed furthest reaches of 1500 micromhos/cm for drinking reason. The higher esteems show that ionic fixations are more in the groundwater. Nitrate fixation in the groundwater of the zone differs from 8mg/l to 84 mg/l, while 43% of the groundwater contains in excess of 45 mg/l of nitrate which is as far as possible for drinking reason and is ascribed to the relocation of nitrates from anthropogenic sources amid blustery season. the greater part of the towns are in beneath as far as possible. in Three towns of groundwater indicates abundance fluoride recommended for drinking reason. It is watched that the general population living in high fluoride focus territories are experiencing mottled teeths and furthermore knee joint agonies particularly in more youthful individuals. In addition, dental and skeletal fluorosis is at disturbing stage in nearby inhabitant of these zones

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