



## **Groundwater Quality: Focus on Fluoride in Selected Villages of S.P.S.R. Nellore District, Andhra Pradesh, India**

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**Abstract** - The fluoride concentration in underground water was determined in five revenue mandals of s.p.s.r.nellore district. Six villages from each block were identified to measure fluoride concentration along with other water quality parameters. The fluoride concentration in the underground water varied from 1.05 to 8.43mg/l, which is alarming and foresee to be causing skeletal fluorosis among people especially children of these villages. To stop further disgrace it is immediately required to treat the fluoride contaminated waters of these villages with suitable and cost effective defluoridation techniques.

**Keywords:** Ground water, fluoride, Physico-Chemical Parameters, cost effective defluoridation, S.P.S.R. Nellore district, India.

### **Introduction**

Ground water is the most important source of drinking water in urban as well as in rural Areas. However the chemical composition of groundwater is one of the prime factor on which its suitability depends for various purposes. Groundwater caters to 85% of the total drinking water requirement and 49% of the agricultural requirement in rural India. In groundwater the natural concentration of fluoride depends on the geological, chemical and physical characteristics of the aquifer, the porosity and acidity of the soil and rocks, temperature, the action of other chemicals and the depth of wells<sup>[1]</sup>. Fluoride is known to contaminate groundwater put by globally and sporadic incidence of high fluoride content in groundwater has been reported from around 17 states and 63 million people are suffering from sickness of the teeth or bones through fluorosis in India<sup>[2]</sup>. Though fluoride enters the body through food, water, industrial exposure, drugs, cosmetics, etc. drinking water is the major contributor (80–90% of daily intake)<sup>[3]</sup>. The maximum tolerable concentration for fluoride in drinking water in Indian conditions as per Indian Standards is 1.5 mg/l<sup>[4]</sup>.

Rajiv Gandhi National Mission for Drinking Water and Sanitation declared that no fewer than 63 villages in S.P.S.R. Nellore district of Andhra Pradesh to be fluoride infected<sup>[5]</sup>.

A study conducted by Regional Medical Research Centre, Nellore in Five villages of S.P.S.R. Nellore District revealed that the children of these villages are suffering from a peculiar skeletal deformity

characterized by Knock Knee (genu valgum) because of fluoride contamination<sup>[6]</sup>. All across Nellore, a district of half a million or so people in southern Andhra Pradesh, a steady stream of children have reported to be having deformed limbs that are feared to be affected with fluorosis. Taking these things into concern a study has been conducted in selected villages of Nellore district of Andhra Pradesh to understand the severity of the problem.

### **Study Area**

Nellore is a district situated in the east-coastal part of Andhra Pradesh which lies almost entirely in the catchment of river Penna & its tributaries (Figure 1). It lies between North latitude 13<sup>o</sup> 30' and 15<sup>o</sup> 05' and East longitude 79<sup>o</sup> 05' and 80<sup>o</sup> 15'. The district covers a total area of 13,160 Sq.Km. and consists a total population of around half a million. There are 46 Revenue Mandals and 1192 villages in the district<sup>[7]</sup>. Stratigraphically, A major portion of the district is underlain by Dharwar super group. Peninsular Gneisses complex and older Metamorphic of Archaean Age consisting of granite gneisses, schists intruded by basic dykes and pegmatite reefs. The Baironkonda Quartzites, Cumbum shales of Nallamalai series of Upper kadapa group occur in western margins of the district. Veligonda hills have been subjected to strong compressional forces. A small patch of Gonewada hard sandstones and shales with thin ferruginous encrustations occur around Dubagunta, satyavedu villages in the northern part of the district.

Laterite cappings of sub-Recent age are seen over the crystallines in Kavali, Naidupeta and sullurpeta areas. The laterites which overlie the gritty sandstones and conglomerates are seen around Venkarachalam, Akupalli, Buchireddipalem etc. The climate of this district is characterized by hot summer season and general dryness except in the Southwest monsoon season. The year may be divided into four seasons. The cold season from December to February is followed by the hot season from March to about the middle of June. The period from mid-June to September is the Southwest monsoon season. October and November constitute the post monsoon or retreating monsoon season.

## Material and Methods

The study has been carried out in Marripadu, Kondapuram, Jaladanki, Kaligiri and Balayapalli mandals of Nellore district in the year of 2009-2010. From each mandal five villages have been selected and water samples from handpumps were collected for physico-chemical analysis<sup>[8]</sup>, Turbidity, pH, conductivity, Fluoride<sup>[9]</sup>, Iron<sup>[10]</sup> and Nitrate<sup>[11-12]</sup> were analyzed to understand the water quality conditions of these villages. All the parameters were analyzed in the field itself by Using APHA Standard methods<sup>[13]</sup>. At each sampling point water level was measured by Dipper tape.

## Results and Discussion

The groundwater of the villages had no color and odor. Analytical data for the water samples are presented in Table 1. The data make that considerable variations in the water samples with respect to their chemical composition. The pH of the water samples ranged from 6.33 to 9.93 indicates that the water is alkaline. Fluoride concentration and the severity of fluorosis are directly related to the alkalinity of water which may be one of the deciding factors for the high incidence of fluorosis in many cases. If this alkaline water remains in contact with the fluorite deposit for a longer period, then there is a definite possibility of progressive leaching of fluoride resulting in the increase in fluoride content. The turbidity values are slightly higher at all the villages except Thurpu yerraballe, Tellapadu and Melchuru which recorded  $> 25$ . The conductivity values ranged from 290-1530  $\mu\text{mhos/cm}$ . Fe recorded higher values at all most all villages in five mandals. Nitrate values are also higher than the BIS limits in most of the villages except in Bramhmanakaka(42). The higher nitrate concentrations may be attributed to anthropogenic activities. Out of the 30 villages under study 27 were recorded higher concentrations of fluoride. Highest fluoride concentration (8.43 mg/l) was recorded in Gudavaluru village of Kondapura mandal and lowest in Nandavaram village of Marripadu mandal (1.05 mg/l). Out of the five mandals studied, Marripadu, Kondapuram, Jaladanki, Kaligiri and Balayapalli recorded higher fluoride concentrations in most of the villages.

## Conclusion

Most of the water samples, collected from the five mandals of S.P.S.R. Nellore district of Andhra Pradesh do not meet the water quality standards for fluoride concentration. Hence it is not suitable for consumption without any prior treatment. High oral intake of fluoride rich

drinking water results in physiological disorders, skeletal and dental fluorosis, thyroxine changes and kidney damage in humans<sup>[14]</sup>. Fluoride contamination may be prevented or minimized by using alternate water sources include surface water, rainwater and low-fluoride groundwater. Apart from this poor nutrition also plays an important role in aggravating endemic fluorosis. Defluoridation of drinking water is the only practicable option to overcome the problem of excessive fluoride in drinking water, where alternate source is not available. During the years following the discovery of fluoride as the cause of fluorosis, extensive research has been done on various methods for removal of fluoride from water. Cost effective and low maintenance defluoridation technologies may immediately be introduced in these villages to stop further degradation<sup>[15-16]</sup>.

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Figure 1: Study Area

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**Table 1: Physico-Chemical Analysis of Water samples of selected villages of S.P.S.R. Nellore District**

Name of the Revenue Mandal	Name of the village	Water level m	Water Quality Parameters					
			pH	Turbidity NTU	Conductivity µmhos/cm	Fe mg/l	NO <sub>3</sub> mg/l	F mg/l
	NANDAVARAM	12.4	6.33	9.5	692	1.05	182	1.78
	PALLAVOLU	17.9	8.16	6.3	592	1.1	67	3.33
	D.C.PALLI	10.2	7.57	9.9	670	2.34	107	3.03
MARRIPADU	BRAHMANA PALLE	20.2	7.11	9	315	1.06	174	3.88
	ALLAMPADU	8.35	9.06	8.6	720	1.27	86	2.55
	IRLAPADU	11.4	9.45	8.2	361	3.21	89	3.4
	GUDAVALURU	27.8	9.46	8.6	659	8.43	302	1.65
	THURPU YARRABALLE	7.5	7.24	9.5	652	4.47	166	2.38
	CHINTHALA DEEVI	6.2	9.14	12.5	869	1.66	247	8.24
KONDAPURAM	GOTTIGUNDLA	76.5	8.26	8.9	798	3.08	67	3.8
	SETTIPALLE	11.2	8.89	15.5	795	1.65	287	3.4
	VELIGANDLA	15.6	9.41	12.6	458	1.8	190	5.65
	KESAVARAM	4.8	8.61	11.6	952	1.61	183	6.75
	JAMALLAPALEM	16.9	8.52	7.9	456	2.22	82	4.13
	CHOWDAVARAM	31.2	8.5	16.5	592	1.03	90	6
JALADANKI	CHAMADALA	19.8	6.35	13.6	652	2.03	143	2.5
	BRAHMANA KRAKA	18	7.65	9.9	692	3.07	60	2.15
	ANNAVARAM	39.1	7.68	8.9	650	3.13	90	1.5
	SIDDANA KONDURU	26.4	9.39	7.9	665	2.11	189	1.57
	TELLAPADU	12.4	9.62	7.5	664	2.08	75	1.7
	GUDLADANA	32.3	8.45	8.6	1530	1.11	102	2.07
KALIGIRI	GANGIREDDY PALEM	42	8.98	7.2	512	6.9	148	2.15
	LAXMIPURAM	16	7.69	14.6	290	1.21	74	2.75
	DUBAGUNTA	28.4	9.93	15.3	772	1.26	224	3.4
	MELCHURU	29.4	7.86	15.7	599	1.47	196	1.85
	PALLIPADU	36.7	9.6	9.2	354	4.02	180	2.19
	JAYAMPPU	30.7	8.39	11.5	662	1.48	189	1.9
BALAYAPALLI	RAAVIPADU	25.6	7.69	10.5	653	1.58	143	1.54
	KADAGUNTA	24.5	7.68	10.9	487	1.26	248	1.5