CHITRADURGA DISTRICT

FIG.10 CHITRADURGA DISTRICT

1. Location

Chitradurga district is located in the eastern part of Karnataka State with geographical area of 8388 sq. km. It is bounded by Ananthapur district of Andhra Pradesh State on eastern side, Bellary district on northern side, Davanagere district in the northwestern side, Chikkamagalur district on southwestern side and Tumkur district on eastern and southeastern side. It lies between 13° 34' to 15° 02' N Latitude and 76° 01' to 77° 02' E Longitude.

2. Demography

As per the 1991 census, Chitradurga district has a population of 1,312,717. The total number of villages / habitations in the district are 1,369. Chitradurga district has 6 taluks viz. Challakere, Chitradurga, Hiriyur, Holalkere, Hosadurga and Molakalmur.

3. Climate, Drainage and Soil

Chitradurga district forms part of the southern maidan region, which has extensively undulating plateau with elevations ranging between 600 to 1000 m. The lowest rainfall in the state is 456 mm and is recorded at Challakere. Occurrence of heavy rainfalls of over 200 mm in a day and heavy rainfall on a few days is one of the important characteristics of rainfall distribution in the area. The annual average rainfall in the district is 579.3 mm. Vedavathi and Hagari Rivers drain Chitradurga district. The Vanivilasa Sagara Dam constructed across the Vedavati River is situated in the southwestern portion of the Hiriyur taluk. Chitradurga district experiences temperature variation of 16.7^0 to 36.3^0 C. This district is grouped under the central dry zone of ten fold Agro-climatic classification of Karnataka. Major portion of the district is covered by Red to Black soils.

4. Geology and Groundwater occurrence

Chitradurga district consists mainly of the gneisses, patches of Closepet granite and the younger Chamundi granite. From the groundwater point of view, these rocks are classified as crystalline formations. The fracture / fissure system developed along with joints and faults traversing the rocks facilitate groundwater circulation and hold moderate quantity of water. The quality of groundwater is governed by the mineralogical composition of the rocks. The gneisses are succeeded by the Chikkanayakanahalli Schist belt sequence consisting of conglomerate, orthoquartzite/ quartz chlorite schist, greywacke, metavolcanics and numerous bands of iron formations. The schistose rocks even with well-developed schistosity are relatively impermeable, poor aquifers and yield very less quantity of water of poorer quality. Groundwater, in general occurs in the water table conditions in the weathered and decomposed mantle and also under semi-confined conditions in the deeper fractures.

5. Groundwater quality characterization

To understand and gather information on groundwater quality, 6340 samples collected from 1308 villages / habitations in Chitradurga district have been analysed by RDED.

The water samples have been analysed for only 14 parameters such as Turbidity, Colour, Conductivity, Hydrogen ion concentration (pH), Total Dissolved Salts (TDS), Total Hardness (TH), Calcium Hardness (CalH), Chloride (Cl), Sulphate (SO_4), Fluoride (F), Nitrate (NO_3), Alkalinity (Alk), Iron (Fe) and Bacteria. The data is presented in the Table.

5.1 Physical characters

Turbidity

In total 1012 samples covering 514 villages/habitations have higher turbidity ranging between 10.1 and 559 JTU. The samples with higher turbidity are from Challakere (6 out of 1756 samples), Chitradurga (382 out of 843 samples), Hiriyur (286 out of 1239 samples), Holalkere (204 out of 763 samples), Hosadurga (112 out of 1160 samples) and Molkalmur (22 out of 579 samples). Highest turbidity value of 559 JTU is recorded from Kadur village in Holalkere taluk.

Colour

Only 279 samples from 189 villages have recorded higher Colour intensity in the ranging from 30 to 320 HU. The samples with higher colour intensity in different taluks are: Challakere (18 samples from 15 villages), Chitradurga (63 samples from 44 villages), Hiriyur (100 samples from 60 villages), Holalkere (55 samples from 37 villages), Hosadurga (40 samples from 30 villages) and Molkalmur (3 samples from 3 villages). Highest colour intensity of 320 HU is recorded from Jayasursanapura village of Hosadurga taluk.

Electrical Conductivity (EC)

The range of EC values in the different taluks are: Challakere 255 to 6680 m mhos/cm, Chitradurga 250 to 6990 m mhos/cm, Hiriyur 216 to 9470 m mhos/cm, Holalkere 355 to 8000 m mhos/cm, Hosadurga 109 to 11080 m mhos/cm and Molkalmur 92 to 6880 m mhos/cm.

Hydrogen Ion Concentration (pH)

About 323 samples covering 178 villages have shown the abnormal pH value in the range of 6 to 9.5, with highest (9.5) being reported from Chikkayemmignur village of Holalkere taluk. The range of pH values recorded in different taluks are: Challakere 8.6 to 8.9 (144 samples), Chitradurga 6 to 8.9 (19 samples), Hiriyur 6.3 to 8.7 (3 samples), Holalkere 8.6 to 9.5 (16 samples), Hosadurga 6.1 to 8.9 (6 samples) and Molkalmur 8.51 to 9.1 (135 samples).

5.2 Chemical characters

Total Dissolved Salts (TDS)

Totally 680 samples covering 347 villages / habitations have higher content in the range of 2000.32 to 10800 ppm. The ranges of abnormal TDS content in different taluks are: Challakere 2000.32 to 4395 ppm (110 samples), Chitradurga 2010 to 10800 ppm (83 samples), Hiriyur 2002 to 7860 ppm (140 samples), Holalkere 2015 to 7200 ppm (97 samples), Hosadurga 2002 to 7202 ppm (205 samples) and Molkalmur 2008 to 4472 ppm (45 samples). The highest value of 10800 ppm is reported from Issamudra village in Chitradurga Taluk.

Total Hardness (TH)

As many as 1817 samples spread across 738 villages have indicated the TH value in the range between 600.2 and 4861 ppm. The range of higher TH values in different taluks are: Challakere (361 samples with TH content of 605 to 4492 ppm), Chitradurga (278 samples, with TH content of 600.2 to 4861 ppm), Hiriyur (376 samples with TH content of 601 to 1548 ppm), Holalkere (262 samples with TH content of 601.6 to 3679 ppm), Hosadurga (529 samples with TH content of 601.6 to 3745 ppm) and Molkalmur (11 samples with TH content of 612 to 1248 ppm). The maximum TH content (4861 ppm) is reported from Issamudra village in Chitradurga taluk.

Calcium Hardness (CalH)

In the entire district 4136 samples spread across 1124 villages have shown higher CalH content ranging from 200.34 to 3062 ppm. The maximum abnormal samples are from Challakere (1355 samples with CalH content of 200.88 to 2785 ppm) followed by Hiriyur (933 samples with CalH content of 200.34 to 1724 ppm), Hosadurga (849 samples with CalH content of 200.63 to 1984.87 ppm), Holalkere (567 samples with CalH content of 200.4 to 2318 ppm), Chitradurga (278 samples with CalH content of 201 to 3062 ppm) and Molkalmur (154 samples with CalH content of 202 to 459 ppm).

Chloride (Cl)

Only 89 samples analysed from 53 villages / habitations have shown excess Cl content ranging from 1004 to 3325 ppm. The abnormal Cl content noted in different taluks are: Challakere 1004 to 1544 ppm (21 samples from 13 villages), Chitradurga 1100 to 3325 ppm (10 samples from 6 villages), Hiriyur 1009 to 1856 ppm (30 samples from 16 villages), Holalkere 1054 to 2288 ppm (7 samples from 5 villages), Hosadurga 1377 to 1384 ppm (2 samples from 2 villages) and Molkalmur 1020 to 2016 ppm (19 samples from 11 villages). Highest Cl content of 3325 ppm is reported from Issamudra village in Chitradurga taluk.

Sulphate (SO_4)

In the entire district, 120 samples from 71 villages have shown the higher Sulphate content in the range of 401 to 4300 ppm. The number of abnormal samples in different taluks are: Challakere (11 samples), Chitradurga (12 samples), Hiriyur (60 samples), Holalkere (the lone sample), Hosadurga (17 samples) and Molkalmur (19 samples). Highest Sulphate content of 4300 ppm is recorded from Jodipura village of Hiriyur taluk.

Fluoride (F)

The analytical data has revealed higher fluoride content in 1097 samples from 511 villages / habitations in the range of 1.504 to 5.2 ppm. The range of fluoride concentration in different taluks are: Challakere 1.6 to 3.4 ppm (335 out of 1756 samples), Hiriyur 1.6 to 5.2 ppm (262 out of 1239 samples), Chitradurga 1.53 to 3.6 ppm (193 out of 843 samples), Hosadurga 1.504 to 4.2 ppm (152 out of 1160 samples), Holalkere 1.6 to 3.6 ppm (74 out of 763 samples) and Molkalmur 1.51 to 1.87 ppm (81 out of 579 samples). Highest concentration of Fluoride (5.2 ppm) is reported from Aralikatte village in Hiriyur taluk.

Nitrate (NO_3)

Some 334 samples covering 195 villages / habitations have analysed higher NO_3 content ranging from 101 to 270 ppm. They are from - Challakere (77 samples with Nitrate content of 101 to 245 ppm), Chitradurga (37 samples with Nitrate content of 102 to 262 ppm), Hiriyur (83 samples with Nitrate content of 102 to 270 ppm), Holalkere (24 samples with Nitrate content of 104 to 190 ppm), Hosadurga (75 samples with Nitrate content of 101 to 261 ppm) and Molkalmur (38 samples with Nitrate content of 101 to 199 ppm). Highest Nitrate content of 270 ppm is recorded from Yerabally village in Hiriyur taluk.

Alkalinity (Alk)

Totally 788 samples covering 420 villages in the entire district have analysed alkalinity in excess ranging from 600.1 to 2681 ppm. They are from - Challakere (34 samples with Alkalinity of 604 to 956 ppm), Chitradurga (124 samples with alkalinity of 601 to 1219 ppm), Hiriyur (164 samples with alkalinity of 603.5 to 1386 ppm), Holalkere (152 samples with alkalinity of 600.1 to 1970 ppm), Hosadurga (308 samples with alkalinity of 600.45 to 2681 ppm) and Molkalmur (6 samples with Alkalinity of 616 to 812 ppm).

Iron (Fe)

In the district, 597 samples from 283 villages/habitations have analysed the Fe content in excess, ranging between 1.01 to 55.8 ppm. The numbers of abnormal samples in different taluks are - Challakere (396 samples from 162 villages), Chitradurga (43 samples from 33 villages), Hiriyur (9 samples from 7 villages), Holalkere (7 samples from 6 villages), Hosadurga (14 samples from 13 villages)

and Molkalmur (128 samples from 62 villages). The extreme iron content of 55.8 and 45.2 ppm are recorded from Rampura village in Molkalmur taluk and Palnayakanakote village in Challakere taluk respectively.

Bacteria (*E.coli*)

Nearly 904 samples covering 563 villages have shown the presence of Bacteria with the bacterial count varying between 2 to 321 numbers/100ml. The bacterial count in the different taluks are - Challakere (298 samples with bacterial count of 2 to 321 numbers/100ml), Chitradurga (111 samples with bacterial count of 2 to 218 numbers/100ml), Hiriyur (144 samples with bacterial count of 2 to 286 numbers/100ml), Holalkere (133 samples with bacterial count of 2 to 140 numbers/100ml), Hosadurga (168 samples with bacterial count of 2 to 215 numbers/100ml) and Molkalmur (50 samples with bacterial count of 2 to 115 numbers/100ml). Highest bacterial count of 321 numbers/100ml is recorded from Bandahatty village of Challakere taluk.

5.3 Spatial Variation

Bacteria (*E.coli*)

The map indicates that, bacteria is more commonly seen in the analysed water samples and is spread unevenly throughout the district with more than a half of the analysed samples being affected by the bacterial incidence.

Fluoride (F)

The isoconcentration map of fluoride (Fig.10A) depicts that, higher fluoride concentration in small isolated patches and sometimes slightly bigger patches are spread unevenly throughout the district especially the southern half of the district comprising of Holalkere, Chitradurga, Hosadurga and Hiriyur taluks. The fluoride concentration is comparatively within the safer limits in northern half of the district covering Molkalmur and Challakere taluks.

Total Dissolved Salts (TDS)

The isoconcentration map generated for TDS (Fig.10B) shows that, occurrence of TDS in higher concentrations as isolated patches dominantly in the western half of the district. In the western half also, Hosadurga taluk in the southwest of the district is more affected when compared to the other taluks.

Total Hardness (TH)

Total Hardness on the isoconcentration map (Fig.10C) reveals that, TH in higher concentrations occurs as isolated patches in the western half of the district when compared to slightly sparse patches in the eastern half. In the western half also, Hosadurga taluk in the southwest is more affected in comparison to the other taluks.

Iron (Fe)

The spatial variation map generated for Iron (Fig.10D) shows that major portion of the district especially the southern half is not affected by the Iron at all. However, the northern half is strongly affected by the excess concentration of Iron, whereas the eastern half of the Molkalmur taluk is very badly affected.

6. Conclusion

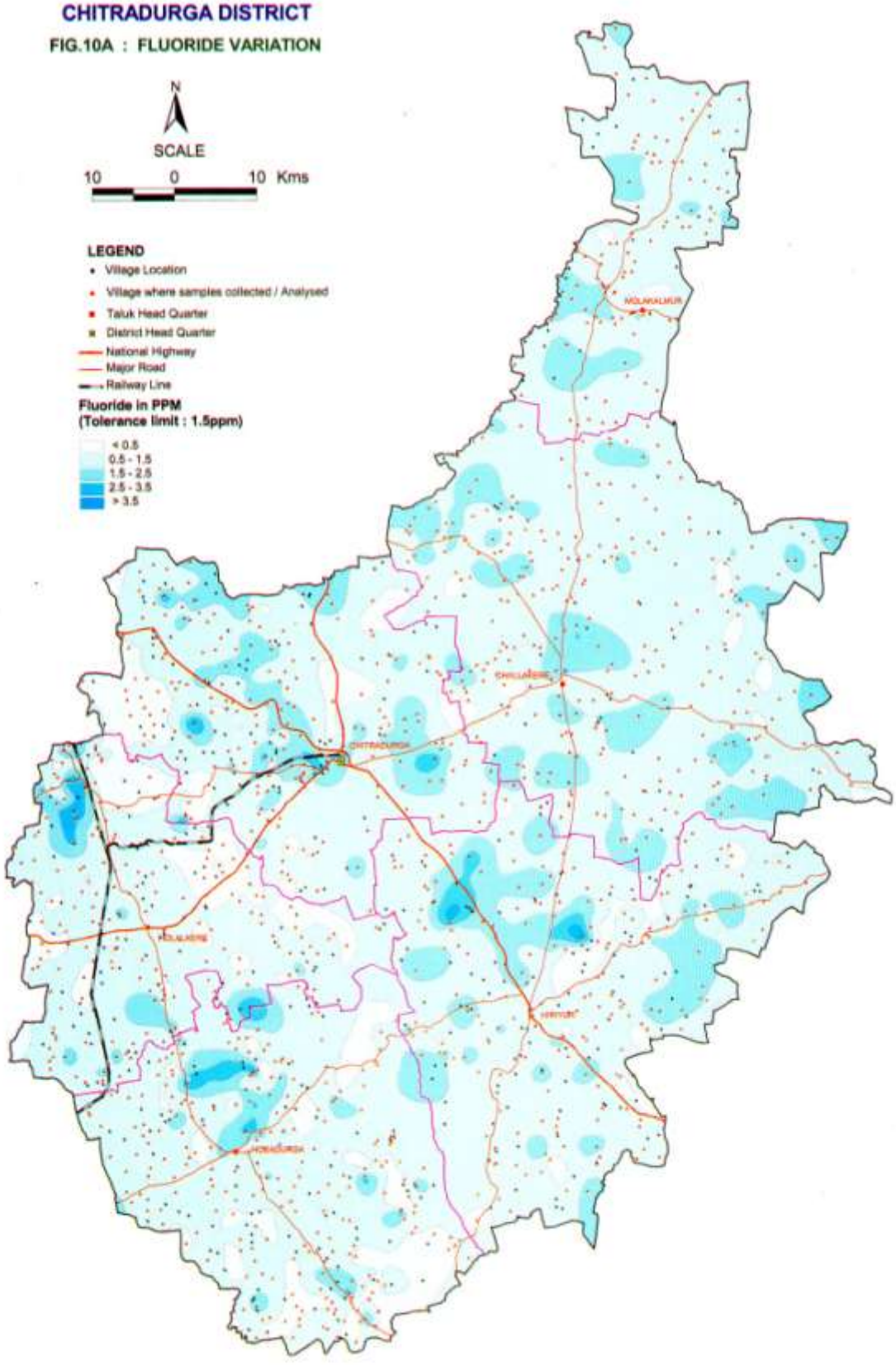
The water quality data of Chitradurga district has reflected the presence of excess Turbidity, Total Dissolved Salts, Total Hardness, Calcium Hardness, Fluoride, Alkalinity, Iron and the Bacterial incidence. Hardness can be reduced by some conventional methods and turbidity by filtration. In case of Fluoride, utmost care has to be taken, since many samples have analyzed excess of Fluoride than the permissible limit. Though a little amount of Fluoride is essential for the bone development in the infants, excess consumption of Fluoride will induce physical disabilities and Dental Fluorosis. Therefore, it is very essential to treat the water to the desirable standard before it is supplied for the drinking purpose. Proper development of the source and usage of galvanised iron or PVC pipes and proper casing can reduce the iron content. The most important component, which is much more harmful, is the presence of Bacteria viz., *E. coli* in drinking water. The consumption of such water may cause the diseases such as Malaria, Diarrhea etc. These organisms might have been introduced into the groundwater regime by anthropogenic activities. This clearly indicates non-hygienic / poor sanitation condition prevailing at village levels. To overcome this both the user and the administrator must be trained properly and awareness has to be created regarding hygienic aspects.

Table: Comprehensive analysis of water quality data of Chitradurga District

SL. NO.	Name of the taluks	Number of villages/ habitations	Number of sampled villages	Number of samples analysed	Water quality scenario	Bact (c/100 ml)-0	Tur (10) JTU	Color (25) HU	Cond - mmhos /cm	pH (6.5-8.5)	TDS (2000) ppm	TH (600) ppm	CalH (200) ppm	Cl (1000) ppm	SO_4 (400) ppm	F (1.5) ppm	NO_3 (100) ppm	Alk (600) ppm	Fe (1) ppm
1	Challakere	304	299	1756	No. of samples beyond permissible limit	298	6	18	-	144	110	361	1355	21	11	335	77	34	396
					No. of Village affected	159	6	15	-	81	52	130	276	13	9	142	47	25	162
					Range	2-321	11.1-59.7	30-85	255-6680	8.6-8.9	2000.32-4395	605-4492	200.88-2785	1004-1544	412-1055	1.6-3.4	101-245	604-956	1.1-45.2
2	Chitradurga	289	216	843	No. of samples beyond permissible limit	111	382	63	-	19	83	278	278	10	12	193	37	124	43
					No. of Village affected	76	169	44	-	14	52	136	136	6	9	93	23	77	33
					Range	2-218	10.1-82.3	30-75	250-6990	6-8.9	2010-10800	600.2-4861	201-3062	1100-3325	403-815	1.53-3.6	102-262	601-1219	1.01-2.5
3	Hiriyur	305	232	1239	No. of samples beyond permissible limit	144	286	100	-	3	140	376	933	30	60	262	83	164	9
					No. of Village affected	86	139	60	-	3	59	146	225	16	24	105	43	91	7
					Range	2-286	10.1-98.5	30-180	216-9470	6.3-8.7	2002-7860	601-1548	200.34-1724	1009-1856	407.5-4300	1.6-5.2	102-270	603.5-1386	1.03-2.04
4	Holalkere	256	184	763	No. of samples beyond permissible limit	133	204	55	-	16	97	262	567	7	1	74	24	152	7
					No. of Village affected	84	104	37	-	12	50	111	169	5	1	40	17	72	6
					Range	2-140	10.1-559	30-280	355-8000	8.6-9.5	2015-7200	601.6-3679	200.4-2318	1054-2288	428.54	1.6-3.6	104-190	600.1-1970	1.1-1.47
5	Hosadurga	320	267	1160	No. of samples beyond permissible limit	168	112	40	-	6	205	529	849	2	17	152	75	308	14
					No. of Village affected	125	76	30	-	5	111	205	248	2	16	96	42	150	13
					Range	2-215	10.2-265	30-320	109-11080	6.1-8.9	2002-7202	601.6-3745	200.63-1984.87	1377-1384	412-684	1.504-4.2	101-261	600.45-2681	1.01-1.58
6	Molkalmur	123	110	579	No. of samples beyond permissible limit	50	22	3	-	135	45	11	154	19	19	81	38	6	128
					No. of Village affected	33	20	3	-	63	23	10	70	11	12	35	23	5	62
					Range	2-115	10.1-39.7	30-40	92-6880	8.51-9.1	2008-4472	612-1248	202-459	1020-2016	401-2176	1.51-1.87	101-199	616-812	1.08-55.8
	Total	1597	1308	6340	No. of samples beyond permissible limit	904	1012	279	-	323	680	1817	4136	89	120	1097	334	788	597
					No. of villages affected	563	514	189	-	178	347	738	1124	53	71	511	195	420	283
					Range	2-321	10.1-559	30-320	92-11080	6-9.5	2000.32-10800	600.2-4861	201-3062	1004-3325	401-4300	1.504-5.2	101-270	600.1-2681	1.01-55.8

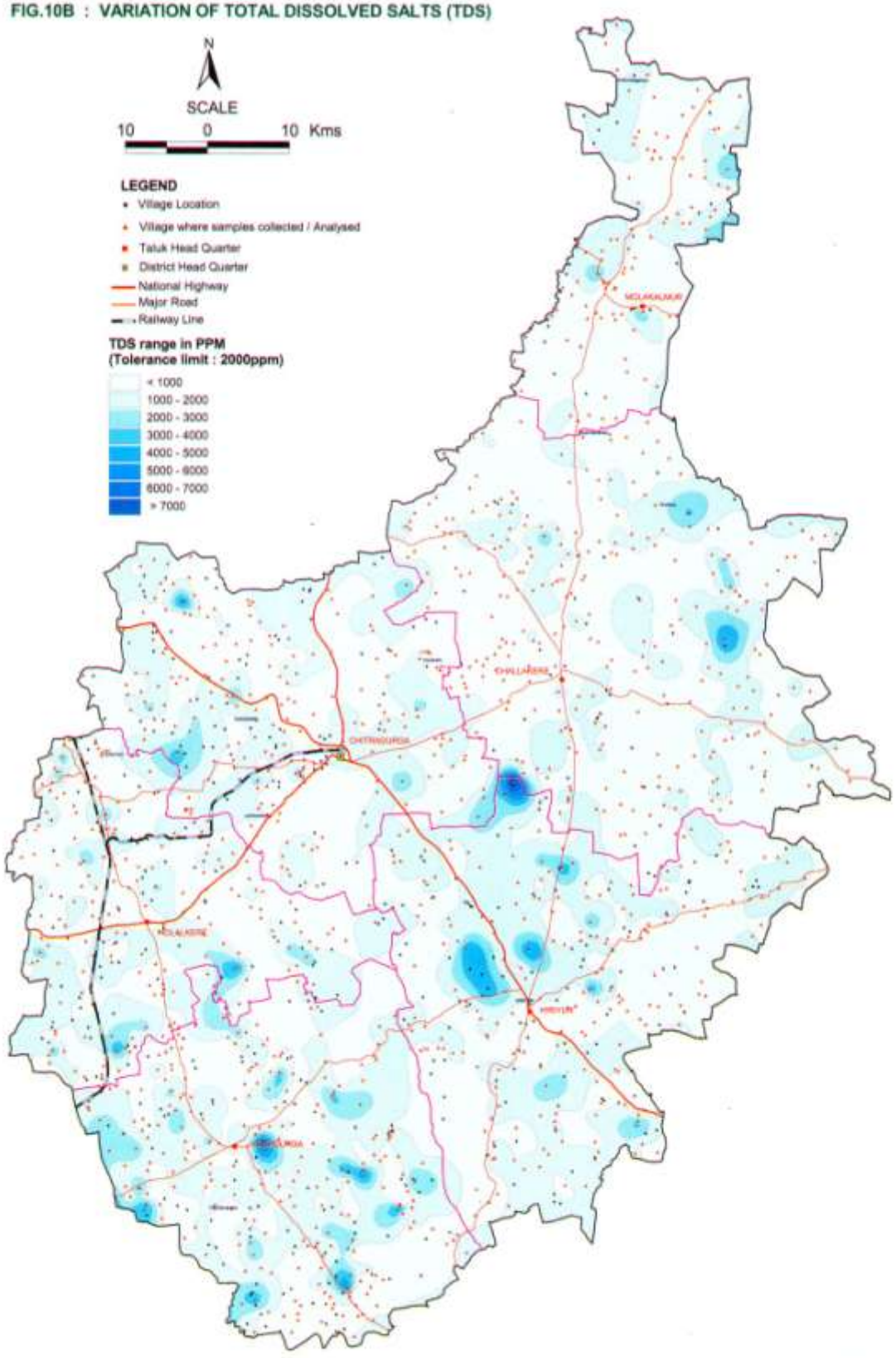
CHITRADURGA DISTRICT

FIG.10A : FLUORIDE VARIATION



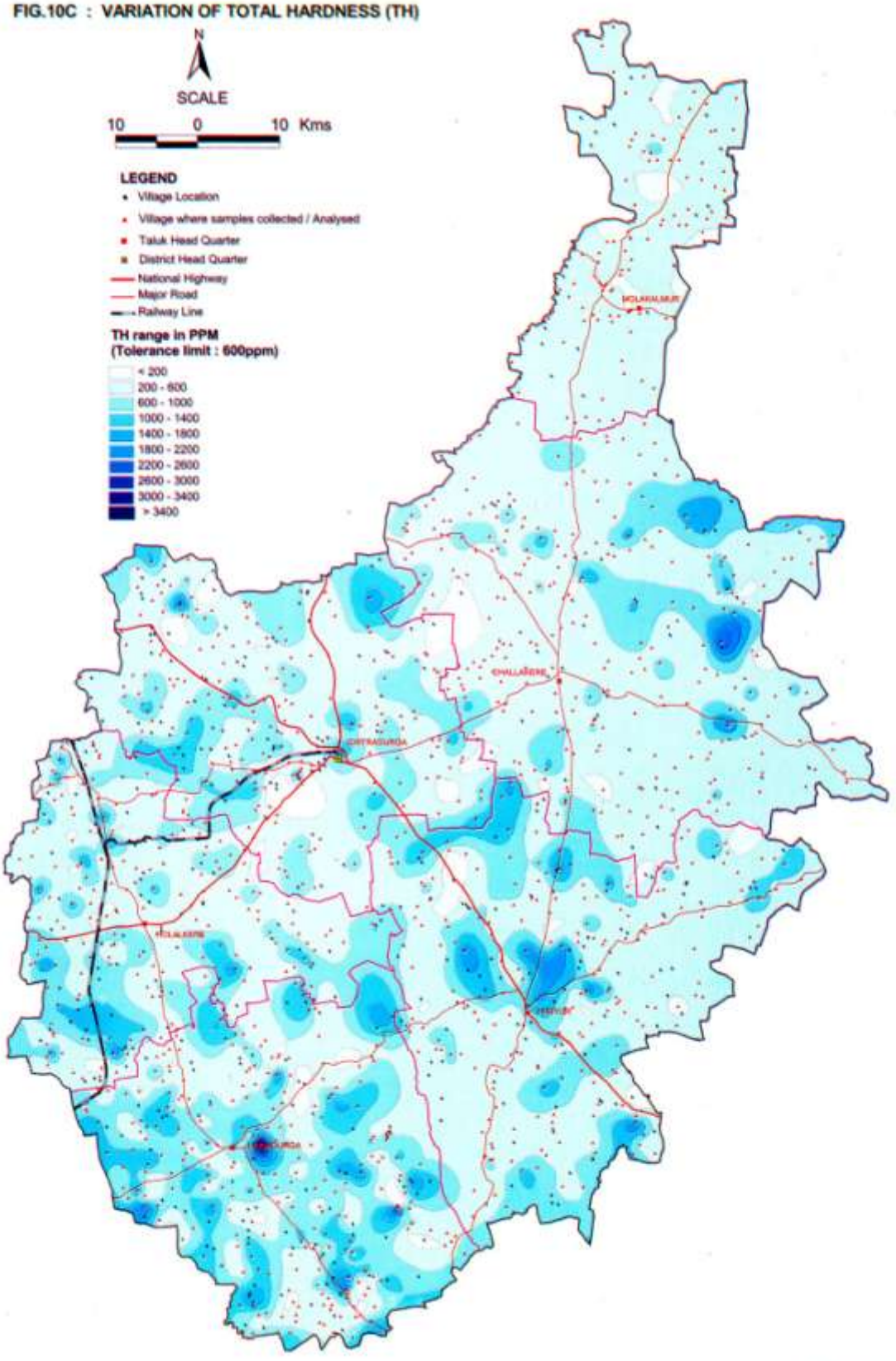
CHITRADURGA DISTRICT

FIG.10B : VARIATION OF TOTAL DISSOLVED SALTS (TDS)



CHITRADURGA DISTRICT

FIG.10C : VARIATION OF TOTAL HARDNESS (TH)



CHITRADURGA DISTRICT

FIG.10D : IRON VARIATION