BELLARY DISTRICT

FIG.5 BELLARY DISTRICT

1. Location

Bellary district is located in the northern half of Karnataka State and has geographical area of 8,419 sq. km. It is bounded by Raichur, Koppal and Gadag districts on northern side, Haveri district on western side, Davanagere district on southwestern side and Chitradurga district on southern side. It lies between 75^0 42' to 77^0 10' E Longitude and 14^0 33' to 15^0 50' N Latitude.

2. Demography

According to the 1991 census, Bellary district has a total population of 1,656,000. There are as many 1,168 habitations / villages. Bellary is the District Headquarter and is the major city in the district. Hospet is the other city from which mining products are being transshipped to other countries. Bellary district has seven taluks viz. Bellary, Hagaribommanahalli, Hospet, Huvinhadagali, Kudligi, Sandur and Siruguppa.

3. Climate, Drainage and Soil

Bellary district is part of the northern maidan region in the extensively undulating plateau forming the northern part of the State and receives an annual rainfall between 350 to 650 mm. The average annual rainfall in the district is 574.9 mm. Occurrence of heavy rainfall of over 200 mm in a day have also been recorded. Occurrence of heavy rainfall on a few days is one of the important characteristics of rainfall distribution in these areas. Sometime, one-third to two thirds of the annual rainfall has occurred in a single day. The intensity of rainfall over short periods of 15 minutes to an hour can sometimes be as high as 125 to 200 mm an hour. Hagari and Thungabhadra rivers drain Bellary district. One of the major reservoirs- The Thungabhadra reservoir is located along the district border in Hospet and Hagaribommanahalli taluks. Bellary district experiences temperature variation between 22 ^{0} to 43 ^{0} C. This district is grouped under the northern and 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

Bellary district mainly consists of gneisses and granites. 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 schistose rocks belonging to Sandur Schist belt even with well-developed schistosity are relatively impermeable, poor aquifers and yield very less quantity of water of poorer quality. Groundwater occurs in the water table conditions in the weathered and decomposed mantle also under semi-confined conditions in the deeper fractures.

5. Groundwater quality characterization

To understand and gather information on groundwater quality, 3756 samples collected from 763 villages/habitations in Bellary 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 all 471 samples (12. 5%) show higher turbidity ranging between 11 and 2290 JTU. The samples showing higher turbidity are from: Hospet (155 out of 779 samples), Sandur (99 out of 543 samples), Huvinhadagali (80 out of 503 samples), Kudligi (64 out of 752 samples), Hagaribommanahalli (37 out of 318 samples), Bellary (23 out of 446 samples) and Siruguppa (13 out of 415 samples). The water with highest turbidity of 2290 JTU is from Sandur town in Sandur taluk.

Colour

In total 111 samples covering 84 villages / habitations show higher colour intensity in the range of 25 to 241 HU. Samples showing higher colour intensity in different taluks are: Bellary (3 samples from 3 villages), Hagaribommanahalli (10 samples from 10 villages), Hospet (43 samples from 24 villages), Huvinhadagali (8 samples from 8 villages), Kudligi (27 samples from 25 villages), Sandur (14 samples from 8 villages) and Siruguppa (6 samples from 6 villages). Highest colour intensity of 241 HU is recorded from Devarahalli village in Sandur taluk. This high colour intensity is probably because of the dense suspended mater in the water.

Electrical Conductivity (EC)

The range of EC values noted in different taluks of the district are: Bellary 300-10000 mmhos/cm, Hagaribommanahalli 530-6600 mmhos/cm, Hospet 129-10120 mmhos/cm, Huvinhadagali 150-6860 mmhos/cm, Kudligi 415-5600 mmhos/cm, Sandur 359-8510 mmhos/cm and Siruguppa 380-8720 mmhos/cm.

Hydrogen ion concentration (pH)

About 245 samples covering 100 villages have shown the variation in pH from 8.51 to 9.8. The ranges in pH values in other taluks of the district are: Bellary (8.52 to 9.8, 137 samples), Hagaribommanahalli (8.53 – 8.77, 4 samples), Huvinhadagali (8.53-8.68,4 samples), Hospet (8.6-9.2, 57 samples), Kudligi (8.51-8.93, 8

samples), Sandur (8.82-8.88, 2 samples) and Siruguppa (8.53-9.07, 33 samples). The highest of 9.8 is reported from Somasamudra village in Bellary taluk.

5.2 Chemical Characters

Total Dissolved Salts (TDS)

Totally 440 samples covering 202 villages / habitations have higher content of TDS which varies between 2004 to 10300 ppm. The ranges of abnormal TDS content in different taluks are: Bellary (2036-10300 ppm, 82 samples), Hagaribommanahalli (2004-4368 ppm, 36 samples), Hospet (2020-6370 ppm, 87 samples), Huvinhadagali (2010-7940 ppm, 20 samples), Kudligi (2008-4260 ppm, 64 samples), Sandur (2010-5250 ppm, 44 samples) and Siruguppa (2004-7892 ppm, 107 samples). The highest value of 10300 ppm is reported from Shankarabande village of Bellary taluk.

Total Hardness (TH)

Nearly 700 samples spread across 294 villages have higher TH values in the range of 602 - 5200 ppm. The range of TH values in the taluks of the district are: Bellary (610 – 4896 ppm, 96 samples covering 32 villages), Hagaribommanahalli (610 to 2092 ppm, 66 samples covering 33 villages), Hospet (604-2880 ppm, 120 samples covering 38 villages), Huvinhadagali (602-5200 ppm, 75 samples covering 35 villages), Kudligi (605-1952 ppm, 127 samples covering 72 villages), Sandur (602 - 2732 ppm, 102 samples covering 36 villages) and Siruguppa (610-2002 ppm, 114 samples covering 48 villages). The maximum TH content (5200 ppm) is reported from Siddeshwarnagar village of Huvinhadagali taluk.

Calcium Hardness (CalH)

There are as many as 367 samples spreading across 167 villages having higher CalH ranging from 200.4 to 988 ppm. The abnormal samples are from: Hospet (78 samples with CalH content of 206-780 ppm), Bellary (64 samples with CalH content of 200.4-623.2 ppm), Kudligi (57 samples with CalH content of 201-581 ppm), Sandur (55 samples with CalH content of 202-740 ppm), Siruguppa (50 samples with CalH content of 204-593 ppm), Huvinhadagali (38 samples with CalH content of 201-988 ppm) and Hagaribommanahalli (25 samples with CalH content of 208-477 ppm). The highest CalH content of 988 ppm is recorded from Nandihalli village of Huvinhadagali taluk.

Chloride (Cl)

About 85 samples from 48 villages have shown Cl content ranging from 1004 – 2900 ppm. The chloride content in different taluks of the district are: Bellary (1004-1747.5 ppm, 16 samples), Hagaribommanahalli (1049-1255 ppm, 4 samples), Hospet (1016-2492 ppm, 36 samples), Huvinhadagali (1012-1849 ppm, 3 samples), Kudligi (1028 ppm, a lone sample), Sandur (1105-2900 ppm,

7 samples) and Siruguppa (1028-1787 ppm, 18 samples). The highest value 2900 ppm is reported from Bommagatta village of Sandur taluk.

Sulphate (SO_4)

In the entire district 203 samples covering 91 villages / habitations have higher SO_4 content in the range of 401 to 6100 ppm. The numbers of samples having higher sulphate content in different taluks of the district are: Bellary (99 samples), Hagaribommanahalli (22 samples), Hospet (27 samples), Huvinhadagali (5 samples), Kudligi (5 samples), Sandur (23 samples) and Siruguppa (22 samples). The highest content of 6100 ppm is reported from Shankarabande village in Bellary taluk.

Fluoride (F)

About 1412 samples covering 460 villages have shown fluoride content in the range of 1.51 to 37.2 ppm. The abnormal variation of Fluoride content reported from different taluks is: 1.57 to 9.51 ppm in Bellary (185 out of 446 samples), 1.53 to 8.01 ppm in Hagaribommanahalli (99 out of 318 samples), 1.51 to 37.2 ppm in Hospet (154 out of 779 samples), 1.51 to 4.42 ppm in Huvinhadagali (183 out of 503 samples), 1.51 to 5.42 ppm in Kudligi (435 out of 752 samples), 1.52 to 4.68 ppm in Sandur (71 out of 543 samples) and 1.51 to 14.9 ppm in Siruguppa (285 out of 415 samples). Highest concentration of fluoride, 37.2 ppm is reported from Kamalapura village of Hospet taluk.

Nitrate (NO_3)

Totally 503 samples covering 207 villages have shown higher nitrate content ranging between 101-1275 ppm. The abnormal samples are from Bellary (128 out of 446 samples), Hagaribommanahalli (77 out of 318 samples), Kudligi (198 out of 752 samples) and Siruguppa (100 out of 415 samples). Hospet, Huvinhadagali and Sandur taluks have not shown abnormal nitrate content.

Alkalinity (Alk)

In total, 193 samples analysed in the district have Alkalinity in excess ranging between 604 to 4720 ppm. Abnormal Alkalinity in the different taluks of the district are: Bellary (18 samples with alkalinity content of 629-1098 ppm), Hagaribommanahalli (9 samples with alkalinity content of 610-831 ppm), Hospet (38 samples with alkalinity content of 612 to 1360 ppm), Huvinhadagali (68 samples with alkalinity content of 608-4720 ppm), Kudligi (37 samples with alkalinity content of 604 to 901 ppm), Sandur (16 samples with alkalinity content of 608-2732 ppm) and Siruguppa (7 samples with alkalinity content of 613 to 751 ppm).

Iron (Fe)

Totally 335 samples covering 185 villages/habitations have analysed Iron content ranging between 1.01 to 18 ppm. These samples are from: Bellary (7), Hagaribommanahalli (85), Hospet (38), Huvinhadagali (a lone sample), Kudligi (206), Sandur (lone sample) and Siruguppa (35). The highest Fe content of 18 ppm is recorded from Kappagallu village in Bellary taluk.

Bacteria (*E.coli*)

Nearly 28 % of the analysed samples (1034) covering about 49 % of habitations/villages (372) have shown the presence of hazardous organisms *E.coli* in the drinking water. The Bacterial count generally varies between 1-300 No.s/ 100 ml. Majority of these abnormal samples are from Hospet (386 samples), Sandur (249 samples), Huvinhadagali (178 samples), Siruguppa (94 samples), Bellary (65 samples), Hagaribommanahalli (41 samples) and Kudligi (21 samples).

5.3 Spatial Variation

Bacteria (*E.coli*)

A perusal of the bacterial incidence map indicates that, maximum number of sampled villages have reported the presence of bacteria in drinking water in various quantities. However, bacterial incidence is less pronounced in Hagarbommanhalli and Kudligi taluks and is randomly distributed in the rest of the district. The bacterial incidence can be point specific and may be due to local contamination.

Fluoride (F)

The isoconcentration map (Fig.5A) generated for the fluoride reveals that, the eastern part of the district consisting of Bellary and Siruguppa taluks is having comparatively higher concentration and highest content is recorded along the taluk boundary. Similarly, the western part of the district consisting of Kudligi and Hagaribommanahalli taluks also has higher fluoride content. Hospet, Huvinhadagali and Sandur taluks have below permissible limit fluoride content.

Total Dissolved Salts (TDS)

The isoconcentration map (Fig.5B) shows that, in general, the TDS content in the district is within the tolerance limit. However, isolated patches of higher TDS concentrations are confined to small areas in Siruguppa and Bellary taluks in the eastern portion and Hospet, Hagaribommanahalli and Kudligi taluks in the western portion.

Total Hardness (TH)

Total hardness of the water samples analysed for the district, on the isoconcentration map (Fig.5C) indicates that, small areas in the eastern part of the

district covering Siruguppa, Bellary and eastern portion of Hospet taluk and western part consisting of Kudligi and Hagaribommanahalli taluks have patches of higher TH content.

Iron (Fe)

Isoconcentration map generated for Iron in the district (Fig.5D) has shown confinement of higher concentrations of Iron to the western portion of the district comprising of Hagaribommanahalli and Kudligi taluks only. Rest of the district is relatively unaffected by iron concentration in the drinking water source.

6. Conclusion

The water quality data of Bellary district has indicated the presence of excess Turbidity, Total Hardness, Calcium Hardness, Nitrate, Iron, Fluoride and the Bacterial content. While hardness can be reduced by some conventional methods, Turbidity is reduced by filtration. In case of Fluoride, utmost care has to be taken, since many samples have analyzed excess of Fluoride content. 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. To overcome the problem arising due to excess of Iron, attention is required during the source development such as use of galvanized iron / PVC pipes and proper casing. High nitrate content is due to the excess usage of fertilizers. By the reduced usage of fertilizers, the nitrate content can be reduced in the water. 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, Diorrhoea etc. Probably, these organisms have been introduced into the groundwater regime by anthropogenic activities. This clearly indicates non-hygienic / poor sanitation condition prevailing at village level. 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 Bellary 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	Bellary	137	68	446	No. of samples beyond permissible limit	65	23	3	-	137	82	96	64	16	99	185	128	18	7
					No. of Village affected	28	11	3	-	40	28	32	23	11	32	41	37	12	5
					Range	1-150	11-152	26-85	300-10000	8.52-9.8	2036-10300	610-4896	200 4-623.22	1004-1747.5	405-6100	1.57-9.51	103-920	629-1098	1.01-18
2	Hagari Bommanahalli	129	104	318	No. of samples beyond permissible limit	41	37	10	-	4	36	66	25	4	22	99	77	9	85
					No. of Village affected	29	25	10	-	4	20	33	13	2	14	51	40	7	48
					Range	<30->300	11-119	25-40	530-6600	8.53-8.77	2004-4368	610-2092	208-477	1049-1255	401-896	1.53-8.01	104-552	610-831	1.06-9.86
3	Hospet	116	87	779	No. of samples beyond permissible limit	386	155	43	-	57	87	120	78	36	27	154	-	38	38
					No. of Village affected	80	57	24	-	23	31	38	28	13	14	48	-	12	12
					Range	1-22	11-437	26-214	129-10120	8.6-9.2	2020-6370	604-2880	206-780	1016-2492	412-985	1.51-37.2	-	612-1360	1.03-5.4
4	Huvinhadagali	107	108	503	No. of samples beyond permissible limit	178	80	8	-	4	20	75	38	3	5	183	-	68	1
					No. of Village affected	86	50	8	-	4	10	35	22	2	1	64	-	29	1
					Range	1-18	12-294	28-45	150-6860	8.53-8.68	2010-7940	602-5200	201-988	1012-1849	450-658	1.51-4.42	-	608-4720	2
5	Kudligi	268	196	752	No. of samples beyond permissible limit	21	64	27	-	8	64	127	57	1	5	435	198	37	206
					No. of Village affected	20	52	25	-	8	43	72	34	1	4	150	97	23	106
					Range	80->300	11-112	25-45	415-5600	8.51-8.93	2008-4260	605-1952	201-581	1028	442-816	1.51-5.42	101-895	604-901	1.01-6.99
6	Sandur	157	102	543	No. of samples beyond permissible limit	249	99	14	-	2	44	102	55	7	23	71	-	16	1
					No. of Village affected	88	51	8	-	2	19	36	23	6	13	28	-	6	1
					Range	1-14	11-2290	26-241	359-8510	8.82-8.88	2010-5250	602-2732	202-740	1105-2900	410-680	1.52-4.68	-	608-2732	1.11
7	Sirguppa	112	98	415	No. of samples beyond permissible limit	94	13	6	-	33	107	114	50	18	22	285	100	7	35
					No. of Village affected	41	13	6	-	19	51	48	24	13	13	78	33	7	24
					Range	<30->300	11-89	35-40	380-8720	8.53-9.07	2004-7892	610-2002	204-593	1028-1787	415-1440	1.51-14.9	101-1275	613-751	1.01-2.14
	Total	1026	763	3756	No. of samples beyond permissible limit	1034	471	111	-	245	440	700	367	85	203	1412	503	193	335
					No. of villages affected	372	259	84	-	100	202	294	167	48	91	460	207	96	185
					Range	1-300	11-2290	25-241	129-10120	8.51-9.8	2004-10300	602-5200	200 4-988	1004-2900	401-6100	1.51-37.2	101-1275	604-4720	1.01-18

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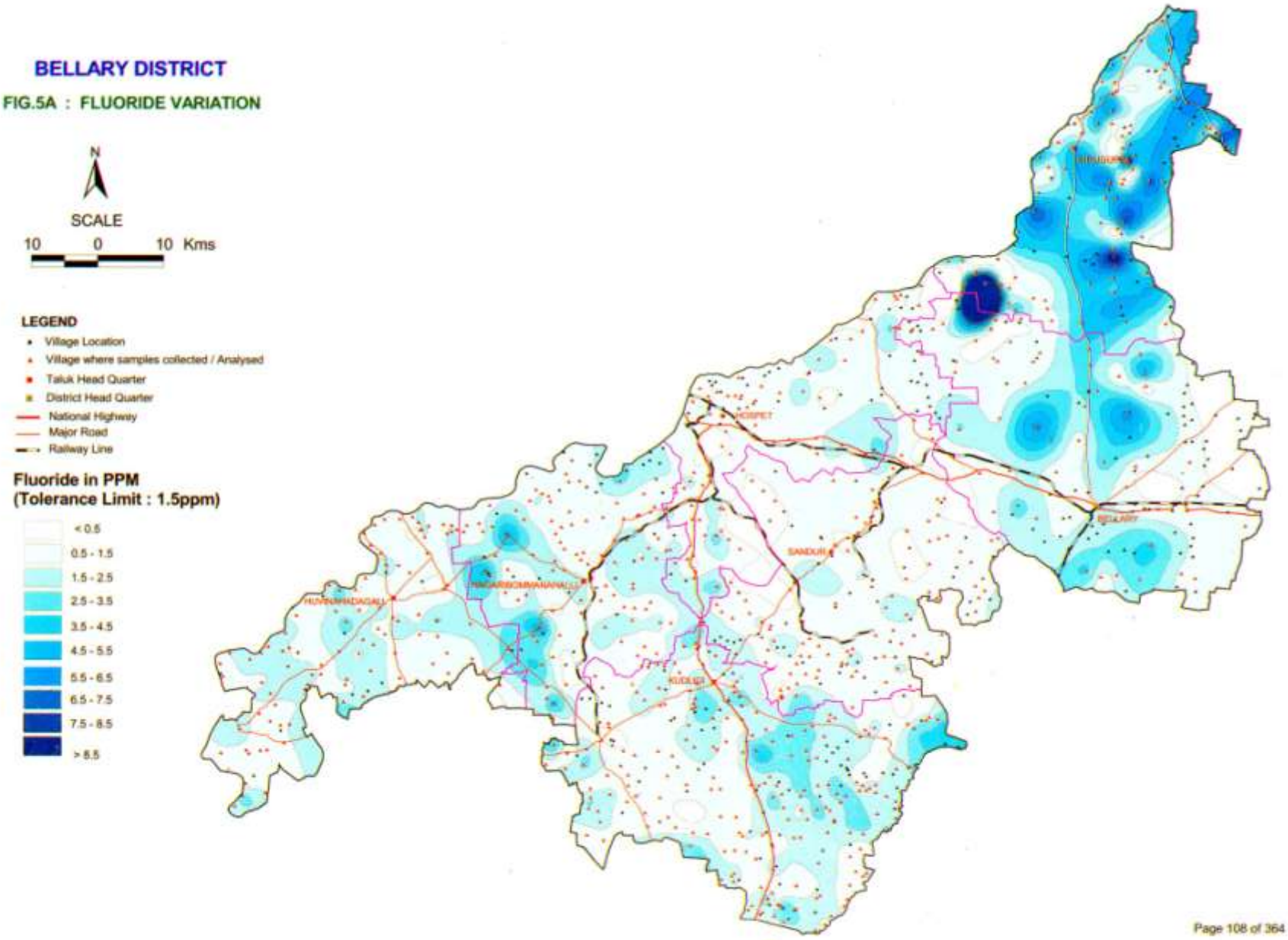
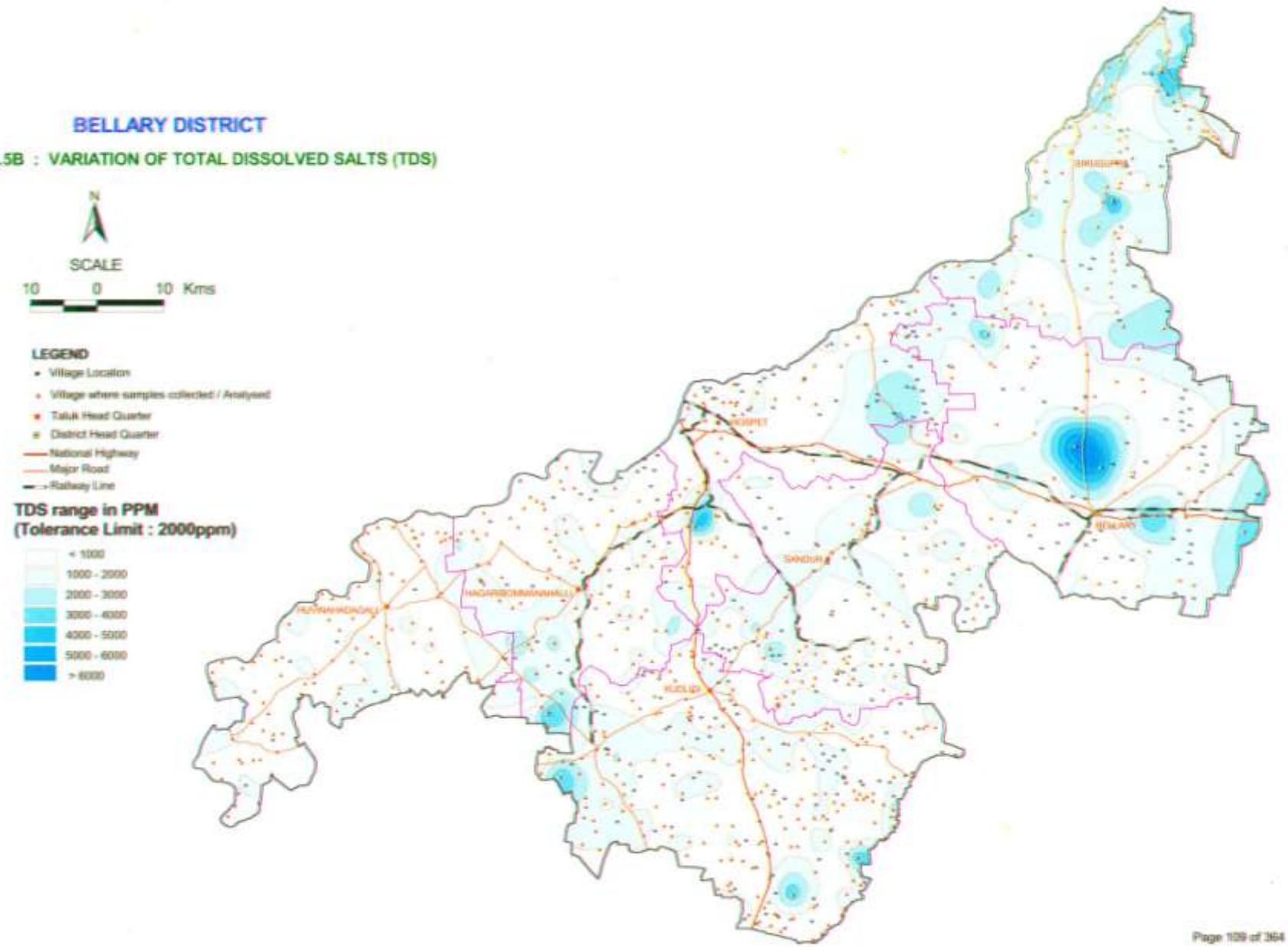
FIG.5A : FLUORIDE VARIATION



BELLARY DISTRICT

FIG.5B : VARIATION OF TOTAL DISSOLVED SALTS (TDS)



BELLARY DISTRICT

FIG.5C : VARIATION OF TOTAL HARDNESS (TH)

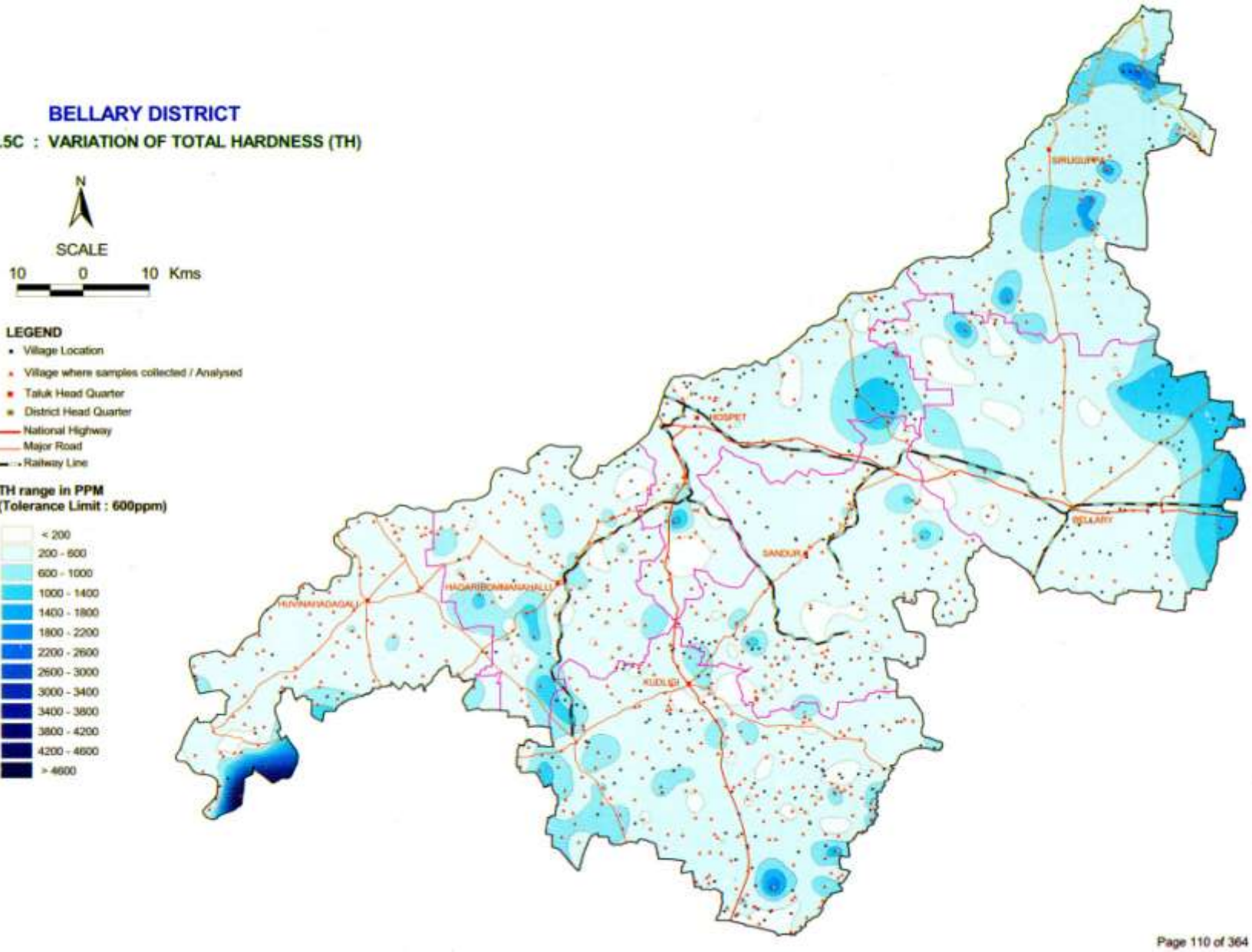


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FIG.5D : IRON VARIATION