BELGAUM DISTRICT

FIG.4 BELGAUM DISTRICT

LIST OF FIGURES

1. Location

Belgaum district is located in the northwestern extremes of Karnataka State with a geographical area of 13,415 sq. km. It is bounded by Bijapur district on eastern side, Dharwad and Uttara Kannada districts on southern side, Goa State on the west and Kolhapur district of Maharashtra State on northern side. It lies between 15° 21' to 16° 58' N latitude and 74° 05' to 75° 28' E longitude.

2. Demography

As per the 1991 census, Belgaum district has a population of 3,583,606. The total number of villages / habitations in the district are 1,506. Belgaum, Khanapur and Gokak are the bigger cities. Belgaum is the Divisional Head quarters of northwestern division of Karnataka. Belgaum district has 10 taluks viz., Athani, Bailhongal, Belgaum, Chikkodi, Gokak, Hukkeri, Khanapur, Raibag, Ramdurg and Saudatti.

3. Climate, Drainage and soil

Belgaum District forms part of the northwestern hilly region and lies just to the east of Western Ghats (Sahyadri) mountain region. Hence, it experiences quite good rainfall and relatively cooler atmosphere. Malaprabha, Markandeya, Dudhganga, Krishna, Mahadai and Ghataprabha rivers (east flowing rivers) drain it. Hidkal,Renuka sagar reservoirs and Rakaskoppa tank are the larger water bodies. The average annual rainfall in the district varies from 510 to 1684 mm with an average of 785 mm. The rainfall is maximum in the western parts of the district lying adjacent to the Sahyadri mountains and Khanapur receives the highest rainfall of 1684 mm per annum while Raibag in the northeastern part of the district receives the least rainfall of 510 mm. Majority of the rainfall is received during southwest monsoon season with 42-50 rainy days annually. Winter season is usually cold with lowest temperature of around 14° C. The hottest period is between March and June, with maximum temperature reaching 37° C during May. The district has medium black soil in the most part and parts of Belgaum and Ramdurg taluks have red lateritic soil. The district falls in the northeastern dry to northeastern transition zone of the Ten-fold agro-climatic zone classification.

4. Geology and Groundwater occurrence

Major portion, mostly the northern and western portions of the Belgaum district is covered by Deccan basalts and the groundwater within these rocks occurs in upper weathered zone and permeable zones between the flows. The size and inter connectivity of the vesicles, joint pattern, faults / fractures and intertrappean beds control the occurrence and movement of groundwater within the basalts. Basalts normally yield better quality water. Laterite capping generally act as shallow aquifers. Sandstones of Kaladgi formation occupying the eastern portion have structures like bedding planes, folds, faults and the fractures which act as conduits for water movement as well as repository of groundwater.

The other rock types encountered in the district are peninsular gneisses; granite, conglomerate, orthoquartzite, greywacke, limestone and manganiferrous iron formations. In these rocks groundwater 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, 6,909 groundwater samples collected from 1,075 villages/habitations in Belgaum district have been analysed by RDED.

The water samples have been analysed for 14 parameters only 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

About 1020 samples show higher turbidity in the range of 10.5 to 224 JTU and are from - Athani (84 out of 580 samples), Bailhongal (190 out of 933 samples), Belgaum (110 out of 766 samples), Chikkodi (38 out of 622 samples), Gokak (124 out of 849 samples), Hukkeri (127 out of 673 samples), Khanapur (170 out of 898 samples), Raibag (7 out of 375 samples), Ramdurg (40 out of 360 samples) and Saudatti (130 out of 853 samples). The highest turbidity is recorded in Gokak taluk.

Colour

About 104 samples covering 70 villages / habitation show colour intensity to be more than the desired 25 HU. Higher colour intensity ranges from 30 to 120 HU in Saudatti taluk (8 samples) followed by Gokak 30-111 (8 samples), Bailhongal 40-1080 (3 samples), Belgaum 27-40 (78 samples), Chikkodi 28 – 36 (2 samples), Athani 27-35 (4 samples) and Hukkeri 44 (the lone sample) taluks.

Electrical Conductivity (EC)

In Belgaum district, the EC value ranges from 10 to 8600 mmhos/cm. The maximum value recorded is from Athani taluk (8600 mmhos/cm) while the minimum value is recorded from Khanapur taluk (10 mmhos/cm). The range of EC values recorded in the other taluks are: Athani (840-8600 mmhos/cm), Bailhongal (240-6970 mmhos/cm), Belgaum (120-3650 mmhos/cm), Chikkodi (320-7120 mmhos/cm), Gokak (300-8370 mmhos/cm), Hukkeri (200-4090 mmhos/cm),

Khanapur (10-2560 mmhos/cm), Raibag (310-2840 mmhos/cm), Ramdurg (240-7080 mmhos/cm) and Saudatti (400-3680 mmhos/cm).

Hydrogen Ion Concentration (pH)

In total 424 samples covering 205 villages have shown the fluctuation in pH value from acidic to basic in the range of 0.5 to 9.62 with highest (9.62) being reported from Belgaum taluk. The ranges of pH value recorded in the other taluks are: Athani 8.5 to 8.6 (13 samples), Bailhongal 0.5 – 8.8 (84 samples), Belgaum 5.0 - 9.62 (69 samples), Chikkodi 4-6.3 (17 samples), Gokak 4.8 - 6.3 (16 samples), Hukkeri 4.9 – 6.3 (15 samples), Khanapur 5.50 – 8.6 (192 samples) and Saudatti 5.9 – 9 (18 samples).

5.2 Chemical characters

Total Dissolved Salts (TDS)

About 281 samples covering 122 villages / habitations have higher content of TDS. The ranges of abnormal TDS content in different taluks are: Athani 2004-10008 ppm (76 samples), Bailhongal 2008 to 4650 ppm (63 samples), Belgaum 2365 to 2767 ppm (4 samples), Gokak 2004 to 5520 ppm (44 samples), Chikkodi 2014 to 4566 ppm (28 samples), Hukkeri 2027 to 2601 ppm (7 samples), Khanapur 7267 ppm (the lone sample), Raibag 2081 to 4190 ppm (20 samples), Ramdurg 2047 to 5032 ppm (28 samples), Saudatti 2016 to 2788 ppm (10 samples). The highest value of 10008 ppm is reported from Shankarahatti village in Athani taluk.

Total Hardness (TH)

Nearly 24% of samples, 1639 samples spread across 489 villages (about 45% of the sampled villages) have analysed TH value in the range of 601 to 5050 ppm. The range of TH values recorded in the taluks are: Athani 620-5050 ppm (264 samples), Bailhongal 610 to 2332 ppm (325 samples) Belgaum 601 to 1660 ppm (66 samples) Chikkodi 610 – 3350 ppm (199 samples), Gokak 610 to 3500 ppm (289 samples), Hukkeri 616 to 2010 ppm (116 samples), Khanapur 630 to 1400 ppm (28 samples), Raibag 610 – 3050 ppm (100 samples), Ramdurg 610 – 2830 ppm (85 samples), Saudatti 610 – 2050 ppm (167 samples). The maximum TH content (5050 ppm) is reported from Athani taluk.

Calcium Hardness (CalH)

There are 1106 samples spread across 387 villages having CalH in the range of 201 to 1740 ppm. The abnormal samples are from: Bailhongal (310 samples with CalH 208 to 768 ppm), Gokak (205 samples with CalH 204 to 1220 ppm), Chikkodi (181 samples with CalH 204 to 1320 ppm), Saudatti (97 samples with CalH 204 to 680 ppm), Hukkeri (71 samples with CalH 204 to 528 ppm), Athani (70 samples with CalH 204 to 1740 ppm), Raibag (49 samples with CalH 208 to 904 ppm), Ramdurg (33 samples with CalH 204 to 760 ppm) and Khanapur (29 samples with CalH 201 to 400 ppm).

Chloride (Cl)

Only 42 samples analysed from 28 villages / habitations have shown Cl content in the range of 1005 to 7171 ppm. The abnormal Cl content noted in other taluks of the district are: Athani 1005 to 2270 ppm (12 samples), Chikkodi 1010 to 1960 ppm (12 samples), Ramdurg 1310 to 1486 ppm (4 samples), Gokak 1095 to 1345 ppm (5 samples), Bailhongal 1010 – 1330 ppm (5 samples), Raibag 1022 to 1230 ppm (3 samples). Highest Cl content reported is 7171 ppm (the lone sample) and is from Belgaum taluk. Hukkeri, Khanapur and Saudatti taluks have not reported abnormal concentration of Cl.

Sulphate (SO_4)

In the entire district, 273 samples covering 123 villages / habitations have higher SO_4 content in the range of 406 to 4580 ppm. The affected taluks are: Athani 412 to 4580 ppm (106 samples), Gokak 410 to 1600 ppm (54 samples), Ramdurg 406 to 1330 ppm (18 samples), Chikkodi 417 to 1400 ppm (22 samples), Raibagh 432 to 1364 ppm (18 samples), Saudatti 420 to 720 ppm (18 samples), Bailhongal 408 to 1330 ppm (17 samples), Hukkeri 414 to 672 ppm (12 samples), Belgaum 446 to 715 ppm (5 samples) and Khanapur 430 to 870 ppm (3 samples).

Fluoride (F)

The fluoride content in 289 samples from 132 villages / habitations is higher in the range of 1.51 to 115 ppm. The concentrational variation in different taluks of the district are: Bailhongal 1.6 to 115 ppm (14 samples), Athani 1.6 to 21.9 (36 samples), Belgaum 10.2 ppm (the lone sample) Khanapur 2 to 6.5 ppm (6 samples), Gokak 1.6 to 18 ppm (83 samples), Chikkodi 1.6 to 2.6 (36 samples), Saudatti 1.6 to 2 (45 samples), Hukkeri 1.6 to 2 ppm (19 samples), Ramdurg 1.51 to 1.8 ppm (48 samples) and Raibag 1.6 ppm (the lone sample). Highest concentration of Fluoride (115 ppm) is reported from Mastamaradi village in Bailhongal taluk.

Nitrate (NO_3)

Only 11 samples covering 8 villages / habitations have analysed higher NO_3 content. These samples are from Bailhongal 404 ppm (the lone sample), Chikkodi 256 to 806 ppm (3 samples), Gokak 177 & 385 ppm (2 samples), Saudatti 177 to 214 ppm (3 samples), Hukkeri 177 to 190 ppm (2 samples).

Alkalinity (Alk)

Only 12 samples in the entire district have analysed higher alkalinity. They are from Hukkeri 1312 ppm (the lone sample), Saudatti 670 & 680 ppm (2 samples), Khanapur 2014 ppm (the lone sample), Bailhongal 623 ppm (the lone sample), Belgaum 1701 ppm (the lone sample), Gokak 608 to 694 ppm (4 samples) and Chikkodi 661 & 832 ppm (2 samples).

Iron (Fe)

About 24% (1689 samples) of the analysed samples covering 636 villages/habitations have analysed the iron in the range of 1.2 to 17.1 ppm. The concentration variation of Fe in different taluks are: Athani 1.2 to 3.4 ppm (89 samples), Bailhongal 1.2 to 1.6 ppm (352 samples), Belgaum 1.2 to 17.1 ppm (282 samples), Chikkodi 1.2 to 9 ppm (109 samples), Gokak 1.2 to 9 ppm (137 samples), Hukkeri 1.2 to 9 ppm (124 sámples), Khanapur 1.2 to 4 ppm (405 samples), Raibag 1.2 to 5.2 ppm (39 samples), Ramdurg 1.2 to 8.4 ppm (44 samples) and Saudatti 1.2 to 5.2 ppm (108 samples). The highest Fe value of 17.1 ppm is recorded in a sample from Belgaum taluk.

Bacteria *(E.coli)*

Nearly 19% of analysed samples (1,368) covering 574 villages have shown the presence of the Bacteria in the water samples. The bacterial count generally varies between 1 to 20 No.s /100 ml of water. The bacterial counts reported in different taluks are: Athani 1 to 12 No.s /100 ml (138 samples), Bailhongal 1 to 15 No.s /100 ml (203 samples), Belgaum 1 to 20 No.s /100 ml (173 samples), Chikkodi 1 to 12 No.s /100 ml (139 samples), Gokak 1 to 12 No.s /100 ml (125 samples), Hukkeri 1 to 10 No.s /100 ml (126 samples), Khanapur 1 to 20 No.s /100 ml (209 samples), Raibag 1 to 10 No.s /100 ml (69 samples), Ramdurg 1 to 12 No.s /100 ml (18 samples) and Saudatti 1 to 10 No.s /100 ml (168 samples).

5.3 Spatial Variation

Bacteria *(E.coli)*

The map depicting the bacterial incidence reveals that, quite a good number of villages in the district have indicated the presence of bacteria. However, the southeastern part of the district covering Ramadurg and part of Gokak taluks are relatively less affected.

Fluoride (F)

The isoconcentration map of fluoride (Fig.4A) indicates that, concentration of fluoride shows a decreasing trend from eastern to western part of the district. The highest fluoride concentrations are seen in the northern tip, central and southeastern parts of the district.

Total Dissolved Salts (TDS)

The spatial variation map of TDS (Fig.4B) shows a marked decrease in the TDS content from northeast to southwest. The maximum abnormality is observed in Athani and Raibag taluks in the north and Bailhongal taluk in the south.

Total Hardness (TH)

The isoconcentration map generated for TH (Fig.4C) indicates that, excepting a small portion covering parts of Khanapur and Belgaum taluks in the southwest, other parts of the district show abnormal concentration of TH varying widely. The maximum abnormality is observed along the border between Raibag, Athani and Chikkodi taluks.

Iron (Fe)

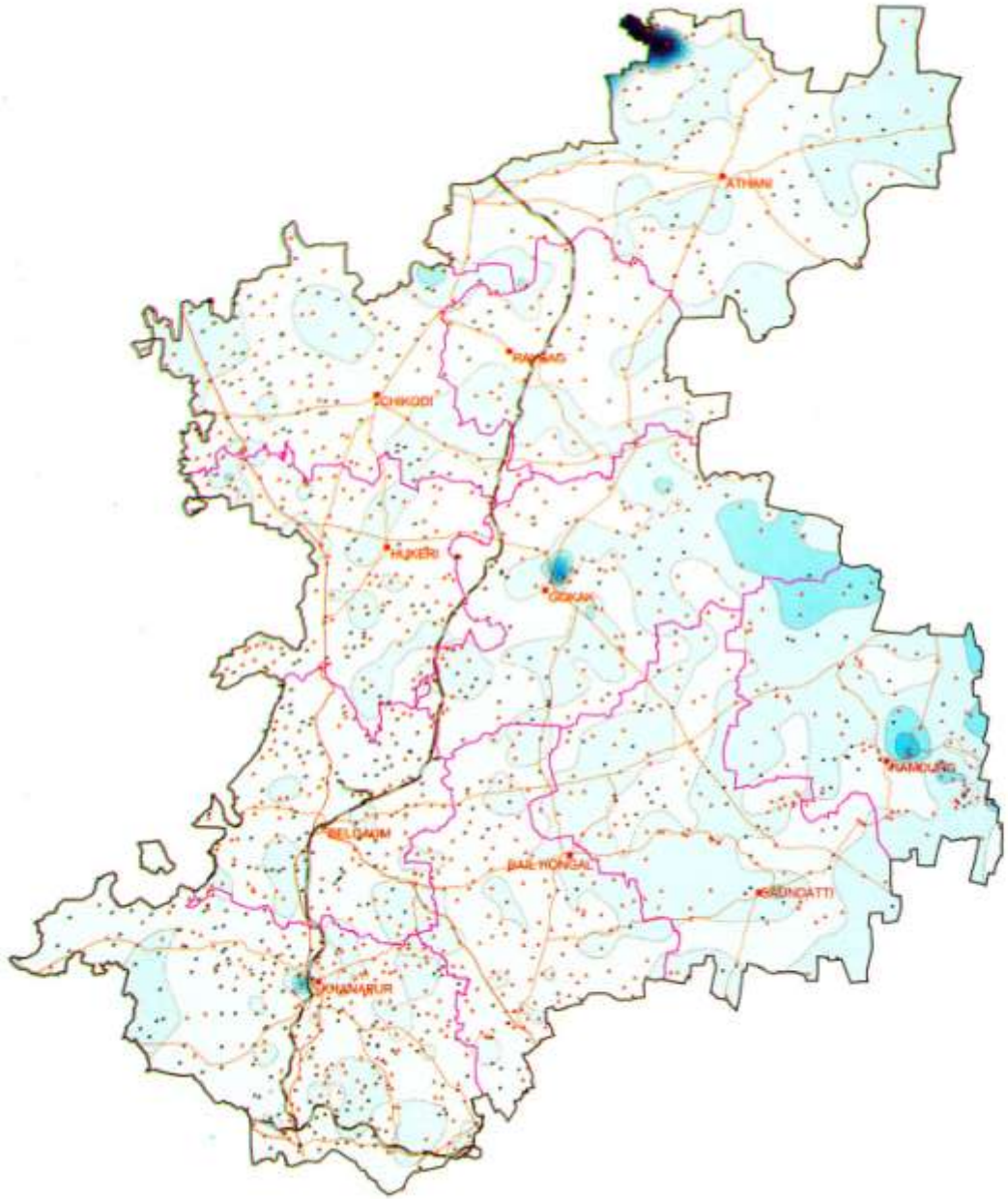
The isoconcentration map of iron (Fig.4D) shows decrease of iron content from southwest to northeast. In the western half of the district abnormal concentration of iron is more pronounced. In the eastern part, apart from few isolated high concentration areas, rest of the area is having more or less uniformly low iron content.

6. Conclusion

The water quality data of Belgaum district has reflected the presence of excess Turbidity, Total Hardness, Calcium Hardness, Iron and the Bacterial incidence. While turbidity can be reduced by simple infiltration, hardness can be reduced by some conventional methods. To overcome from the problem related to excess Iron content, attention is required during the source development such as use of galvanized iron / PVC pipes and proper casing. 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. 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 Belgaum 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	Athani	121	79	580	No. of samples beyond permissible limit	138	84	4	-	13	76	264	70	12	106	36	-	-	89
					No. of Village affected	40	48	4	-	10	36	67	55	8	47	16	-	-	47
					Range	1-12	11-72	27-35	840-8600	8.5-8.6	2084-10008	620-5050	204-1740	1005-2270	412-4580	1.6-21.9	-	-	1.2-3.4
2	Bailhongal	134	133	933	No. of samples beyond permissible limit	203	190	3	-	84	63	325	310	5	17	14	1	1	352
					No. of Village affected	78	79	2	-	38	24	84	89	4	7	9	1	1	94
					Range	1-15	11-126	40-1080	240-6970	0.5-8.8	2008-4650	610-2332	208-768	1010-1320	408-1330	1.6-115	404	623	1.2-1.6
3	Belgaum	179	108	766	No. of samples beyond permissible limit	173	110	78	-	69	4	66	61	1	5	1	-	1	282
					No. of Village affected	53	57	49	-	29	2	25	26	1	5	1	-	1	85
					Range	0.3-20	10.5-101	27-40	120-3650	5-9.62	2365-2767	601-1660	208-533	7171	446-715	10.2	-	1701	1.2-17.1
4	Chikkodi	146	88	622	No. of samples beyond permissible limit	139	38	2	-	17	28	199	181	12	22	36	3	2	109
					No. of Village affected	58	36	2	-	12	8	54	46	5	9	12	3	2	49
					Range	1-12	11-53	28-36	320-7120	4-6.3	2014-4566	610-3350	204-1320	1010-1960	417-1400	1.6-2.6	256-806	661-832	1.2-9
5	Gokak	143	103	849	No. of samples beyond permissible limit	125	124	8	-	16	44	289	205	5	54	83	2	4	137
					No. of Village affected	54	59	5	-	11	24	72	57	4	20	32	1	4	61
					Range	1-12	11-224	30-111	320-8370	4.8-6.3	2004-5520	610-3500	204-1220	1095-1345	410-1600	1.60-18	177-385	608-694	1.2-9
6	Hukkeri	140	115	673	No. of samples beyond permissible limit	126	127	1	-	15	7	116	71	-	12	19	2	1	124
					No. of Village affected	63	57	1	-	14	3	40	29	-	7	11	1	1	62
					Range	1-10	11-49	44	200-4090	4.9-6.3	2027-2601	610-2010	204-528	-	414-672	1.6-2	177-190	1312	1.2-9
7	Khanapur	310	193	898	No. of samples beyond permissible limit	209	170	-	-	192	1	28	29	-	3	6	-	1	405
					No. of Village affected	112	32	-	-	81	1	17	16	-	2	4	-	1	140
					Range	1-20	11-92	-	10-2560	5.5-8.6	7267	632-1400	201-400	-	430-870	2-6.5	-	2014	1.2-4
8	Ramdurg	67	96	360	No. of samples beyond permissible limit	18	40	-	-	-	28	85	33	4	18	48	-	-	44
					No. of Village affected	7	28	-	-	-	13	42	16	4	12	21	-	-	29
					Range	1-12	11-72	-	240-7080	-	2047-5032	610-2830	204-760	1310-1486	406-1330	1.51-1.8	-	-	1.2-8.4
9	Raibagh	110	50	375	No. of samples beyond permissible limit	69	7	-	-	-	20	100	49	3	18	1	-	-	39
					No. of Village affected	34	7	-	-	-	5	32	14	2	7	1	-	-	23
					Range	1-10	13-25	-	310-2840	-	2081-4190	610-3050	208-904	1022-1230	432-1364	1.6	-	-	1.2-5.2
10	Saudatti	123	110	853	No. of samples beyond permissible limit	168	130	8	-	18	10	167	97	-	18	45	3	2	108
					No. of Village affected	75	56	7	-	10	6	56	39	-	7	25	2	2	46
					Range	1-10	11-90	30-120	400-3680	5.9-9	2016-2788	610-2050	204-680	-	414-720	1.6-2	177-214	670-680	1.2-5.2
	Total	1473	1075	6909	No. of samples beyond permissible limit	1368	1020	104	-	424	281	1639	1106	42	273	289	11	12	1689
					No. of villages affected	574	459	70	-	205	122	489	387	28	123	132	8	12	636
					Range	1-20	10.5-224	27-1080	10-8600	0.5-9.62	2004-10008	601-5050	201-1740	1005-7171	406-4580	1.51-115	177-806	608-2014	1.2-17.1



BELGAUM DISTRICT

FIG.4A : FLUORIDE VARIATION

N

SCALE

10 0 10 Kms

LEGEND

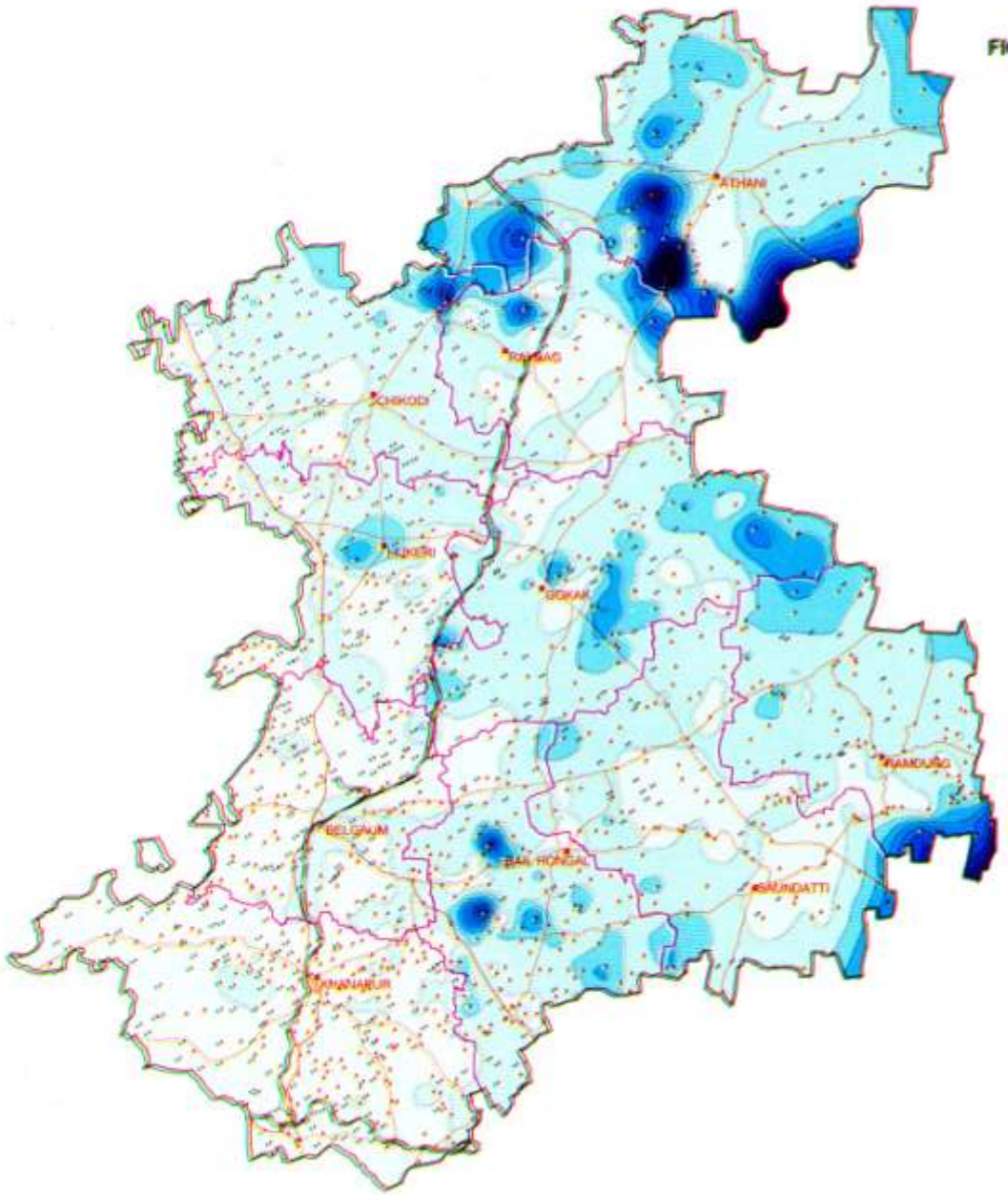
- Village Location
- Village where samples collected / Analysed
- Taluk Head Quarter
- District Head Quarter
- National Highway
- Major Road
- Railway Line

Fluoride in PPM
(Tolerance Limit : 1.5ppm)

- < 0.5
- 0.5 - 1.5
- 1.5 - 2.5
- 2.5 - 3.5
- 3.5 - 4.5
- 4.5 - 5.5
- 5.5 - 6.5
- 6.5 - 7.5
- 7.5 - 8.5
- 8.5 - 9.5
- 9.5 - 10.5
- > 10.5

BELGAUM DISTRICT

FIG.4B : VARIATION OF TOTAL DISSOLVED SALTS (TDS)



N

SCALE

10 0 10 Kms

LEGEND

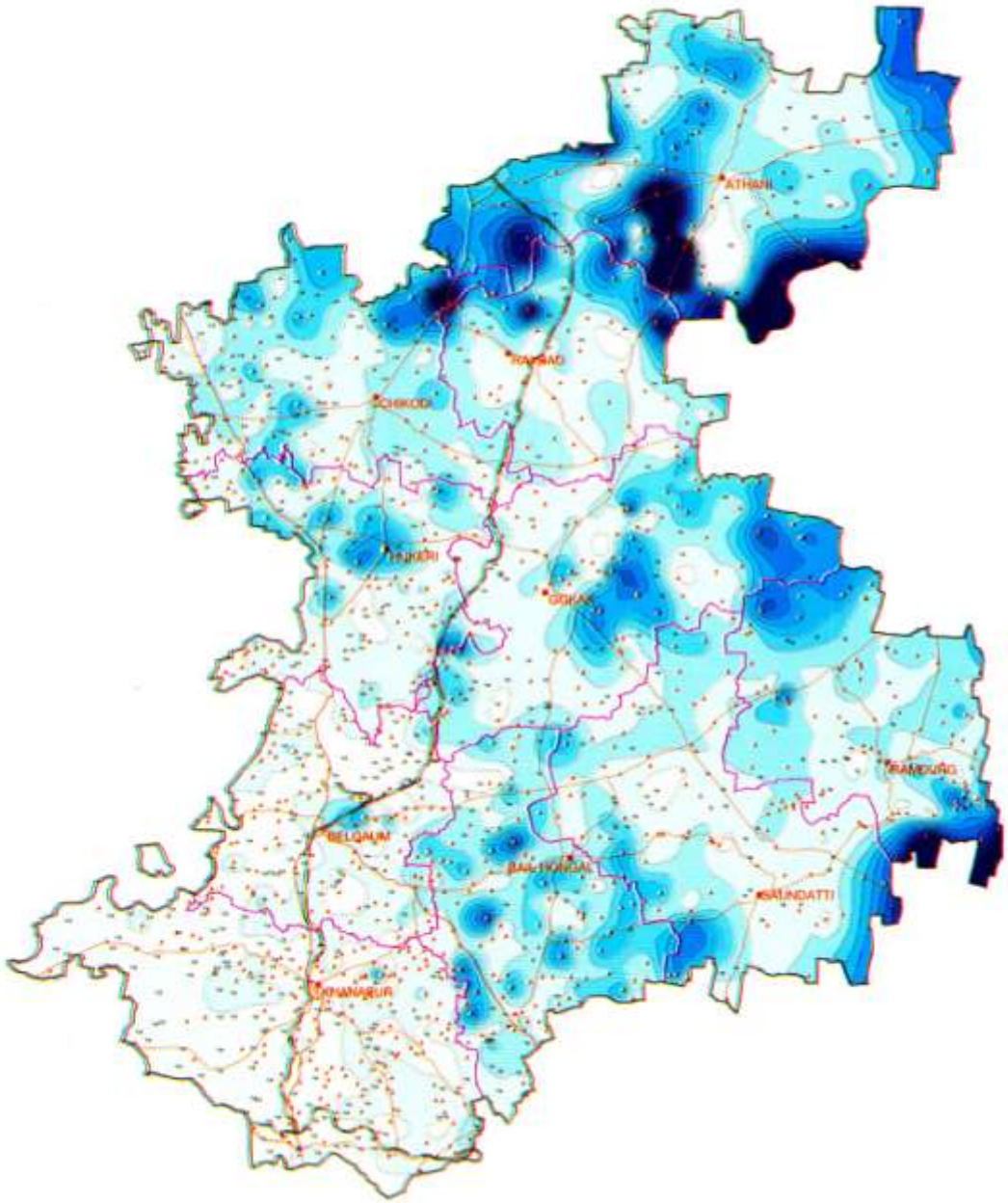
- Village Location
- Village where samples collected / Analysed
- Taluk Head Quarter
- District Head Quarter
- National Highway
- Major Road
- Railway Line

TDS range in PPM
(Tolerane Limit : 2000ppm)

- < 500
- 500 - 1000
- 1000 - 1500
- 1500 - 2000
- 2000 - 2500
- 2500 - 3000
- 3000 - 3500
- 3500 - 4000
- 4000 - 4500
- 4500 - 5000
- > 5000

BELGAUM DISTRICT

FIG.4C : VARIATION OF TOTAL HARDNESS (TH)



N

SCALE

10 0 10 Kms

LEGEND

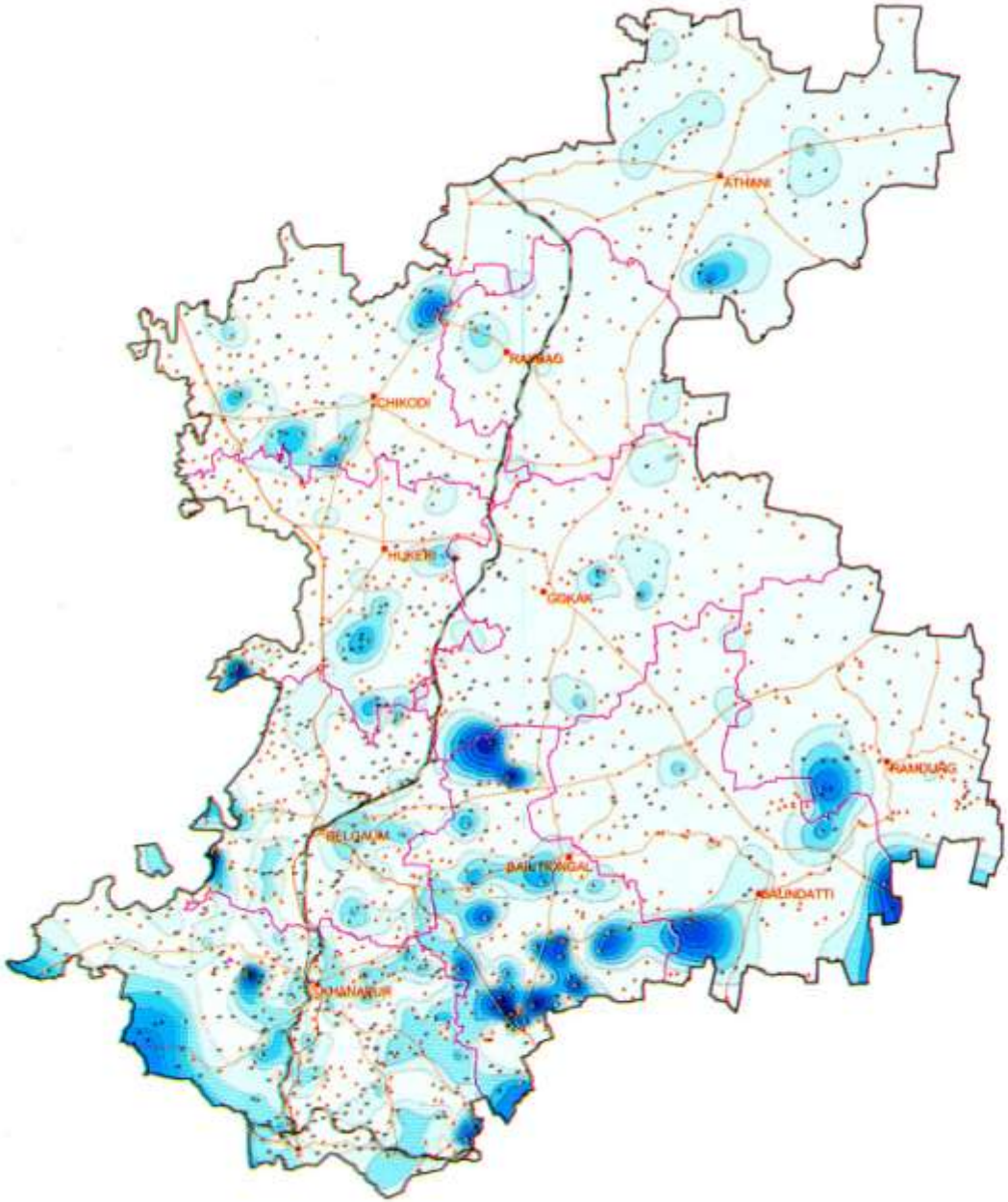
- Village Location
- Village where samples collected / Analysed
- Taluk Head Quarter
- District Head Quarter
- National Highway
- Major Road
- Railway Line

Total Hardness in PPM
(Tolerance Limit : 600ppm)

- < 200
- 200 - 400
- 400 - 600
- 600 - 800
- 800 - 1000
- 1000 - 1200
- 1200 - 1400
- 1400 - 1600
- 1600 - 1800
- 1800 - 2000
- > 2000

BELGAUM DISTRICT

FIG.4D : IRON VARIATION



N

SCALE

10 0 10 Kms

LEGEND

- Village Location
- Village where samples collected / Analysed
- Taluk Head Quarter
- District Head Quarter
- National Highway
- Major Road
- Railway Line

Fe range in PPM
(Tolerance Limt : 1ppm)

- < 1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5
- 5 - 6
- 6 - 7
- 7 - 8
- 8 - 9
- > 9