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Government of India

AQUIFER MAPPING AND MANAGEMENT OF GROUND WATER RESOURCES

GANGAVATHI TALUK,

KOPPAL DISTRICT, KARNATAKA

दक्षिण पश्चिमी क्षेत्र, बैंगलोर

South Western Region, Bengaluru

AQUIFER MANAGEMENT PLAN OF GANGAVATHI TALUK, KOPPAL DISTRICT, KARNATAKA STATE

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1. SALIENT INFORMATION

Name of the taluk : Gangavathi

District : Koppal

State : Karnataka

Area : 1,321 sq.km.

Population : 4,59,905

Annual Normal Rainfall : 579 mm

1.1 Aquifer management study area

Aquifer mapping studies were carried out in Gangavathi taluk, Koppal district of Karnataka, covering an area of 1,321 sq.kms under National Aquifer Mapping Project. Gangavathi taluk of Koppal district is located between north latitude 15^{O}20'12" &15^{O}42'56" and east longitude 76^{O}18'00" & 76^{O}48'50", and is covered in parts of Survey of India Toposheet Nos. 57A/6, 57A/7, 57A/10, 57A/11 and 57A/14. Gangavathi Taluk is bounded by by Hospet taluk towards South, Koppal taluk towards west, Sindhanur Taluk towards North, Siruguppa Taluk towards East. Location map of Gangavathi taluk of Koppal district is presented in **Fig-1**.

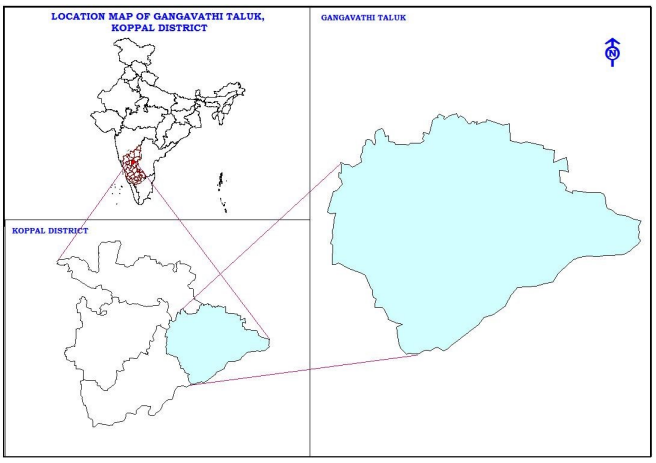

Fig 1: Location Map of Gangavathi Taluk, Koppal District

Gangavathi taluk has a population of about 4,06,334 (Census 2011). Taluk administration of Gngavathi taluk is divided into 8 Hoblies and 42 gram panchayats. Gangavathi is the second largest town in the taluk, which is the taluk headquarter also. There

are 148 inhabited and 9 uninhabited villages in the taluk. Out of 157 villages in the taluk, Karatgi is the largest and most populous village with a population of 29,991 and Rajapur is the smallest and the least populous village with a population of 4. There are three Urban Local Bodies in the taluk, one CMC, one TMC and one TP. Gangavathi City Municipal Committee is the main urban body.

Koppal district was carved out of Raichur district on 1st April 1998. Gangavathi taluk is a part of Koppal district. Gangavathi is the largest city of Koppal district in terms of area and population. It is a commercial centre and a major focal point for the Rice Milling Industry of Karnataka, with its rural areas being important for Paddy cultivation, it is considered the 'Rice Bowl' of Karnataka. The taluk hosts hundreds of Rice Mills and exports rice to tip and corner of the State and Country. Sugar production is also very prominent in the taluk. Gangavathi Sugar Limited, now closed, was once considered the second biggest Sugar Plant in Asia. Kannika Parameshwari, Pampapathi, Muddaneshware and Neelakanteshwara are some of the famous temples located in Gangavathi. Tungabhadra dam is located close to the city and channels the water to many villages of the taluk.

1.2 Population

According to 2011 census, the population in Gangavathi taluk is 4,59,905 of which rural population is 3,45,263 constituting about 75%, and the urban population is 1,14,642 constituting about 25% of the total population, basically due to Gangavathi town. The taluk has an overall population density of 287 persons per sq.km and showed a decadal increase of about 21% during 2001-2011.

1.3 Climate and Rainfall

Gangavathi taluk enjoys arid climate. Dryness and hot weather prevails during major part of the year. The area falls under Northern Dry agro-climatic zone of Karnataka state and is categorized as drought prone. The climate of the taluk is quite agreeable and free from extremes. The year is usually divided into four seasons: summer from March to May; rainy season or south-west monsoon season from June to September; post- monsoon season covering the months of October and November and dry or winter Season from December to February.

The normal annual rainfall in Gangavathi taluk for the period 1981 to 2010 is 591 mm. Seasonal rainfall pattern indicates that, major amount of (376 mm) rainfall is

received during South-West Monsoon seasons, which contributes to about 63% of the annual normal rainfall, followed by North-East Monsoon season (153 mm) constituting about 26% and remaining (62 mm) 11% during pre-monsoon season **(Table-1).**

Computations were carried out for the 30 year blocks of 1981 - 2010, the mean monthly rainfall in Gangavathi taluk is ranging between 1 mm during February to 142 mm during September. The coefficient of variation percent for pre-monsoon, monsoon and post- monsoon season is 113, 212 and 135 percent respectively. Annual CV at this station works out to be 254 percent **(Table-1).**

Table-1: Statistical Analysis of Rainfall Data of Gangavathi Taluk (1981 to 2010)

Station		Jan	Feb	Mar	Apr	May	Pre	Jun	Jul	Aug	Sep	SW	Oct	Nov	Dec	NE	Annual
Gangavathi	Normal Rainfall	1	1	7	12	42	63	76	75	83	142	376	113	33	6	153	591
	STDEV	3	3	23	20	47	56	62	57	72	100	177	96	60	11	113	233
	CV%	35	32	29	60	90	113	123	131	114	142	212	119	56	51	135	254

Based on occurrence and frequency of past drought events, the probability of occurrence of various intensities of drought at Gangavathi station has been studied. It has been observed that the frequency of occurrence of drought is once in 3 years in Gangavathi taluk.

1.4 Agriculture and Irrigation

Agriculture is the main occupation in Gangavathi taluk. The taluk is well known for its paddy cultivation due to availability of canal water and the taluk is also called as Rice Bowl city of Karnataka. Pulses, Maize, Bajra and Oil Seeds and Jowar are other main crops, in the taluk. Fruits, Sugarcane and cotton are also grown in limited area in the taluk **(Table 2).**

Table 2: Cropping pattern in Gangavathi taluk 2016-17 (Ha)

Year	Paddy	Maize	Bajra	Jowar	Pulses	Fruits	Vegetables	Oil seeds	Sugarcane	Cotton
	Area under cultivation (in ha)									
2016-17	37497	7834	7170	3052	10650	2194	2239	8259	378	190

It is observed that net sown area accounts for about 43% of total geographical area, while area sown more than once is about 8% of total geographical area in the taluk **(Table-3).** Surface water is the major source for irrigation in the taluk, as about 64%

of the net Irrigated area is catered through canal system. Only one third of the net irrigated area in the taluk (14,315 hectates) is catered through ground water **(Table-4).**

Table 3: Details of land use in Gangavathi taluk 2016-17 (Ha)

Taluk	Total Geographical Area	Area under Forest	Area not available for cultivation	Fallow land	Net sown area	Area sown more than once
Gangavathi	1,32,131	14,482	19,180	32,772	57,003	23,894

Source: District at a glance 2016-17, Govt. of Karnataka

Table 4: Irrigation details in Gangavathi taluk (Ha)

Source of Irrigation	Net area irrigated (Ha)	% of area
Canals	28,489	66.4
Tanks	0	0
Wells	0	0
Bore wells	14,315	33.36
Lift Irrigation	100	0.24
Other Sources	0	0
Total	**42,904**	

Source: District at a Glance 2016-17, Government of Karnataka

1.5 Geomorphology, Physiography and Drainage

Geomorphologically, the taluk forms a part of Maidan Region, its relief features are slightly different from other areas, are characterized by vast stretches of undulated plains interspersed with sporadic ranges or isolated clusters of low ranges of rocky hills. Kanakagiri hill with 688 m amsl represents the highest elevation point in the taluk **(Fig 2).** The taluk is drained by only one major river system, Tungabhadra which is the tributary of Krishna. Tungabhadra a perennial river flowing through the Gangavathi leaves the taluk at Nandihalli village, it has a large number of rivulets and streams as tributaries, all of these generally go dry during the summer. The Hirehalla and Sulekahalla are the two important non-perennial streams draining the taluk. Drainage map of the taluk is presented as **Fig 3.**

1.6 Soil

The taluk is having predominantly fertile black soil with varying clayey and sandy mixtures. Red loamy soil cover is also seen in some parts of the taluk.

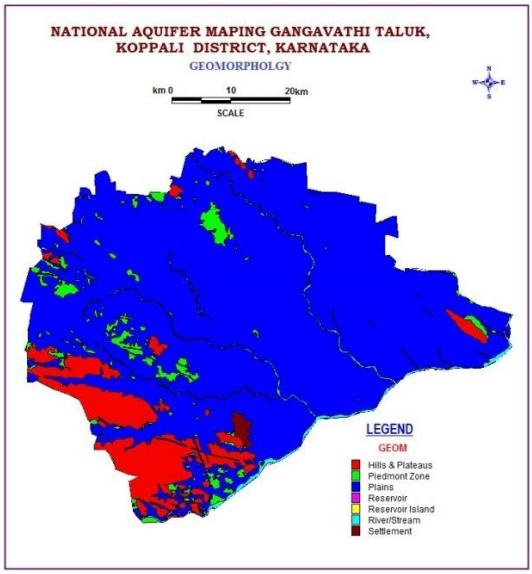

Fig 2: Geomorphology Map

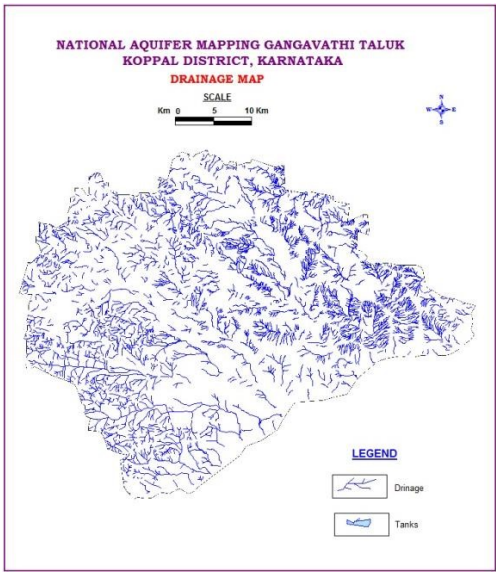

Fig 3: Drainage Map

1.7 Ground water resource availability and extraction

Aquifer wise total ground water resources up to 200 m depth is given in **Table-5** below.

Table 5: Total GW Resources (2017) (Ham)

Taluk	Annual Replenishable GW resources	Fresh In-storage GW resources		Total availability of fresh GW Resources
		Phreatic	Fractured (down to 200 m)	Dynamic + Phreatic in-storage + fractured
Gangavathi	23348	12055	3185	38588

1.8 Existing and future water demands (as per GEC-2017)

Net ground water availability for future irrigation development : 153.98 MCM

Domestic and Industrial sector demand for next 25 year : 10.61 MCM

1.9 Water level behaviour

(a) Depth to water level

Aquifer I

Pre-monsoon: 3.60 – 13.40 m bgl
Post-monsoon: 0.95 – 5.25 m bgl

Aquifer - II

Pre-monsoon: 7.85 – 11.57 m bgl
Post-monsoon: 6.43 – 10.34 m bgl

The Depth to water level maps of Pre and post monsoon seasons in different Aquifers are given in **Fig. 4 to 6** and the Fluctuation map of Aquifer I is shown in **Fig.7**.

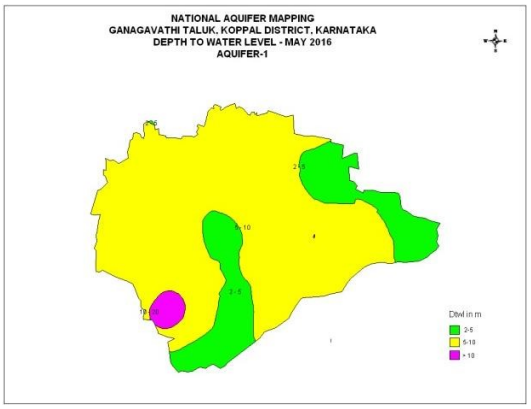

Fig.4: Pre-monsoon Depth to Water Level (Aq-I)

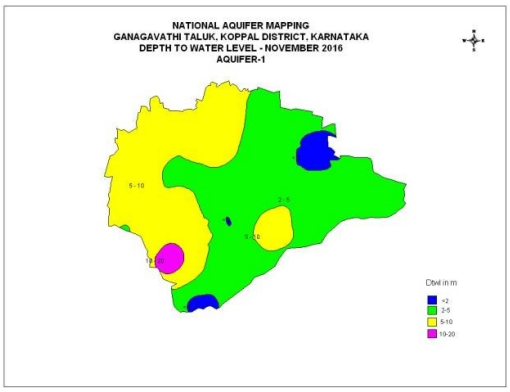

Fig.5: Post-monsoon Depth to Water Level (Aq-I)

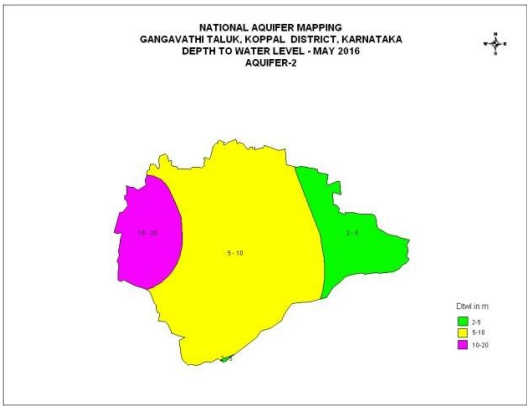

Fig.6: Pre-monsoon Depth to Water Level (Aq-II)

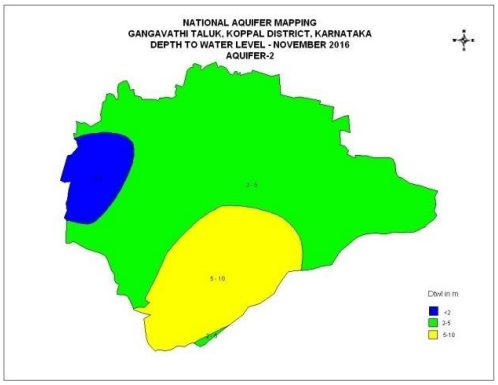

Fig.7: Post-monsoon Depth to Water Level (Aq-II)

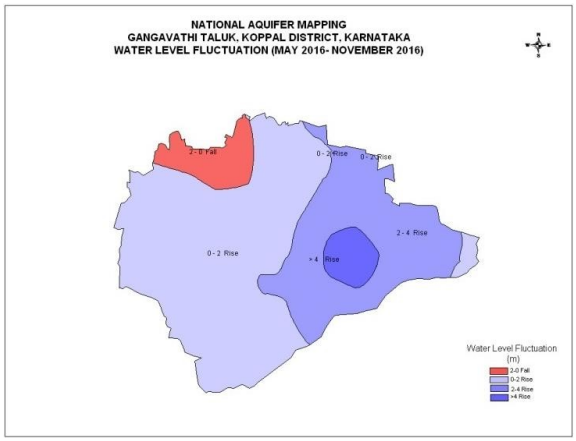

Fig.8: Water Level Fluctuation

2. AQUIFER DISPOSITION

2.1 Number of aquifers: In Gangavathi taluk, there are mainly two types of aquifer systems;

i. **Aquifer-I (Phreatic aquifer)** comprising Weathered Granite Gneiss

ii. **Aquifer-II (Fractured aquifer)** comprising Fractured Granite Gneiss

In Gangavathi taluk, granite gneiss of Peninsular Gneissic Complex is the main water bearing formation. Ground water under phreatic conditions occurs in the weathered and decomposed mantle (Aquifer-I) and under semi-confined to confined conditions within in the deeper fractures of these formations (Aquifer-II) **(Fig.9).**

Depth of weathered zone (Aquifer-I) ranges from 6.0 to 22.0 m bgl, it is predominantly exploited through dug wells. Aquifer-II is exploited through shallow borewells, these bore wells are generally drilled up to a maximum of 200 m bgl **(Table-6).** Ground water exploration reveals that Aquifer-II fractured formation was encountered between the depth range of 25 to 200 m bgl and 80 percent of the fractures are encountered within 135 m bgl depth. Yield ranges from 0.14 to 19.44 m^3/hour. Transmissivity ranges from 2 to 100 m^2/day. The basic characteristics of each aquifer are summarized in **Table-7**.

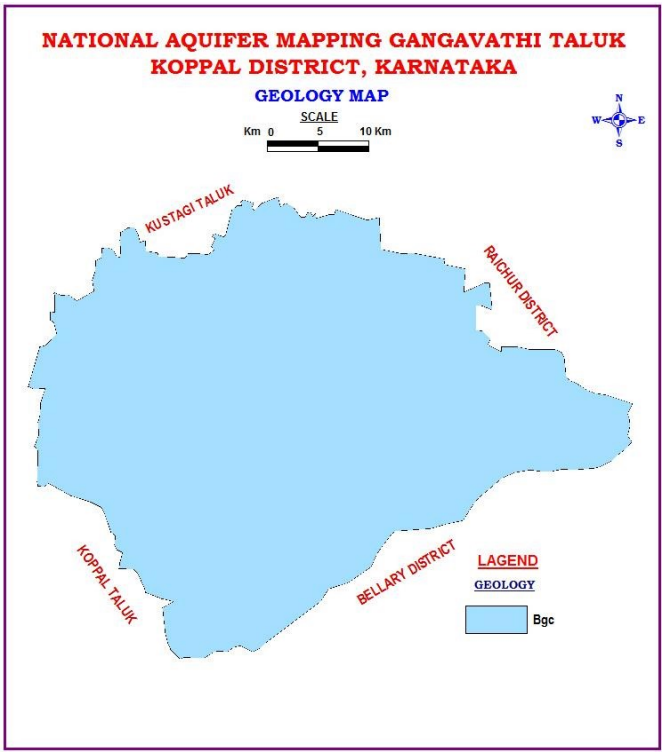

Fig 9: Geology Map

Table 6: Details of Ground water Exploration

Sl. No.	Location	Latitude	Longitude	Depth Drilled (m bgl)	Casing Depth (m bgl)	Fracture Zones (mbgl)	SWL (mbgl)	Q (lps)	Formation
1.	Hullihaider	15°39'41"	76°23'33"	200.00	16.30	56.0 – 57.0	9.74	0.01	Granite gneiss
2.	Kanakagiri	15°34'30"	76°24'51"	200.00	15.66	24.0 – 25.0, 34.8 – 35.5, 150.8 – 151.8	10.98	4.26	Granite gneiss
3.	Gaddi	15°28'45"	76°25'45"	200.00	18.55	Dry			Granite gneiss
4.	Budagumpa	15°34'08"	76°41'25"	200.00	22.22	27.36 – 28.50	2.94	0.01	Granite gneiss
5.	Kartagi	15°38'29"	76°39'27"	200.00	11.63	174.0 – 175.0	5.51	0.21	Granite gneiss
6.	Kuntoji	15°28'50"	76°39'49"	200.00	9.28	79.0 – 80.0, 92.0 – 93.0, 105.0 – 106.0	1.60	13.78	Granite gneiss
7.	Inchnal	15°41'43"	76°30'51"	200.00	6.62	23.2 – 24.0	5.02	0.43	Granite gneiss
8.	Nandihalli	15°31'52"	76°47'57"	200.00	18.70	28.5 – 29.0, 50.0 – 51.0, 130.0 – 130.5	2.98	1.74	Granite gneiss
9.	Gangavathi	15°36'02"	76°39'23"	200.00	11.48	18.0 – 18.5	11.48	0.43	Phyllite

Table 7: Basic characteristics of each aquifer

Aquifers	**Weathered Zone (Aq.-I)**	**Fractured Zone (Aq.-II)**
Prominent Lithology	Weathered Gneiss / Granite	Jointed /Fractured Granite, Gneiss
Thickness range (m bgl)	25.00	Fractures down to 200 mbgl depth
Depth range of occurrence of fractures (mbgl)	12.00 - 25.00	23 - 200 80% between 25.00 - 135.00
Range of yield potential (lps)	De-saturated, almost Dry now	0.04 - 5.4
Specific Yield	-	0.2%
T (m^2 /day)	-	2 – 100
Quality, Suitability for Irrigation	-	Suitable
Suitability for Domestic purposes	-	Suitable
Remarks	Over-Exploited	Ground water potential fractures, 1 to 3 sets likely up to the depth of 200 m bgl.

3. GROUND WATER RESOURCE, EXTRACTION, CONTAMINATION AND OTHER ISSUES

a. Aquifer wise resource availability and extraction

(a) Present Dynamic Ground Water Resource (2017)

Taluk	Net Annual Ground Water Availability (Ham)	Existing Gross Ground Water Draft for Irrigation (Ham)	Existing Gross Ground Water Draft For Domestic and Industrial Water Supply (Ham)	Existing Gross Ground Water Draft for all Uses (Ham)	Allocation For Domestic and Industrial Use for Next 25 Years (Ham)	Net Ground Water Availability for Future Irrigation Development (Ham)	Existing Stage Of Ground Water Development (%)	Category
Gangavathi	23348	7470	725	8195	1061	15398	35	SAFE

(b) Present total Ground Water Resource (in ham)

Taluk	Annual Replenishable GW Resources	Fresh In-storage GW Resources		Total availability of GW Resource
		Phreatic	Fractured	Dynamic + phreatic in-storage + fractured in-storage
Gangavathi	23348	12055	3185	38588

(c) Comparison of Ground Water Availability and Draft Scenario in Gangavathi taluk

Taluk	GW Availability (Ham)	GW Draft (Ham)	Stage of GW Development	GW Availability (Ham)	GW Draft (Ham)	Stage of GW Development	GW Availability (Ham)	GW Draft	Stage of GW Development	GW Availability (Ham)	GW Draft	Stage of GW Development
	2009			**2011**			**2013**			**2017**		
Gangavathi	32442	6752	21	32469	6705	21	32449	7045	22	23348	8195	35

b. Chemical Quality of Ground Water and Contamination

In general, ground water quality in Gangavathi taluk is good for drinking purpose as per "Indian Standard Drinking Water Specification 2009" except at some places showing higher concentrations of Nitrate and Fluoride and EC (**Fig 10, 11 & 12).**

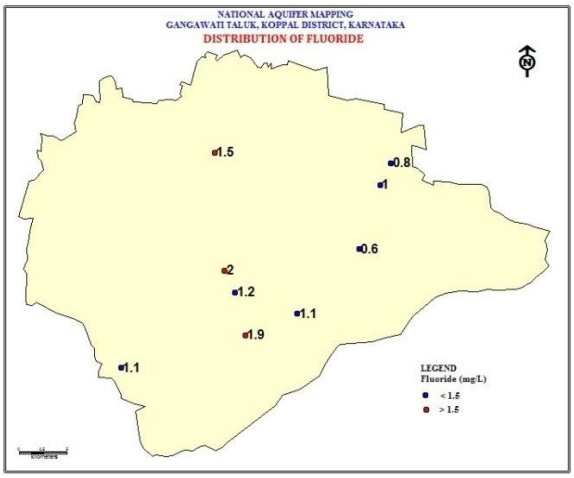

Fig 10: Fluoride Map

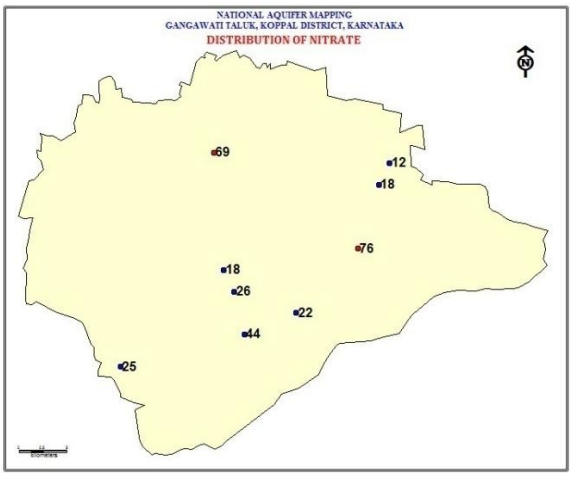

Fig 11: Nitrate Map

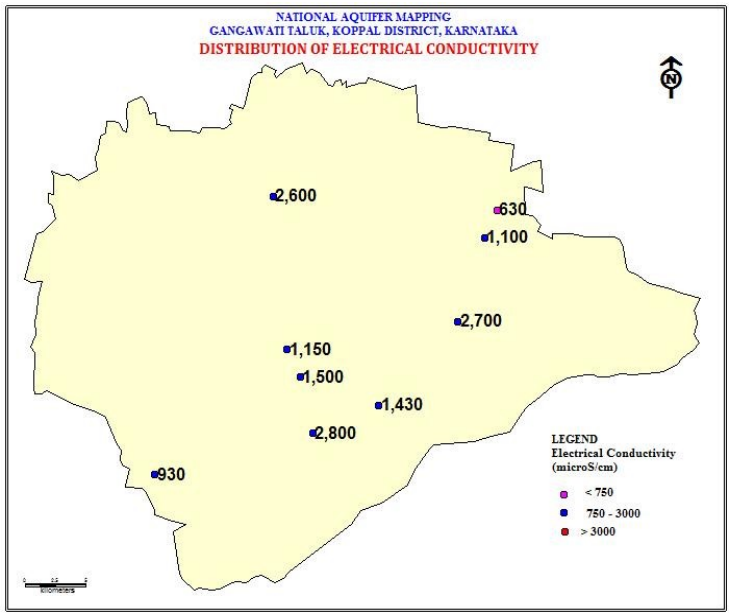

Fig 12: EC Map

4. GROUND WATER RESOURCE ENHANCEMENT

As such the available ground water resources have been development to the tune of 35 percent only i.e., the entire taluk is under 'SAFE' category. There is ample scope for development of ground water resources, and hence no need to adopt ground water resource enhancement measures at present. However, occurrence of over-exploited clusters in safe taluks of hard rock crystalline terrain is a very common phenomenon. In such a scenario, judicious development of the resource is very much required. So efforts are to be made for augmentation of the resource in these over-exploited clusters to keep the development sustainable for long durations.

5. DEMAND SIDE INTERVENTIONS

Bringing additional area under irrigation coupled with relevant scientific input may be the priority with a long-term resource management point of view. Further, curtsey canal irrigation, the taluk now has a vast water-logged area (5300 hectares: DTW 0– 2.0 m bgl) and water-logging prone area (71900 hectares: DTW 2.0 – 5.0 m bgl). Theoretically, withdrawal of ground water to the tune of about 1544 ha m from these water-logged and water-logging prone areas, is possible. Such withdrawal will help in improving the ground water resource position, increase in the area of irrigation as well improvement in soil and water quality too. But such withdrawal should be optimally utilised for expanding the net irrigated area in the taluk. In a nutshell, a proper conjunctive use plan has to be made and practiced in the taluk.