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जल संसाधन, नदी विकास और गंगा संरक्षण मंत्रालय

भारत सरकार

Central Ground Water Board

Ministry of Water Resources, River Development and Ganga

Rejuvenation

Government of India

Report on

AQUIFER MAPPING AND MANAGEMENT PLAN

Chitradurga Taluk, Chitradurga District, Karnataka

दक्षिण पश्चिमी क्षेत्र, बेंगलोर

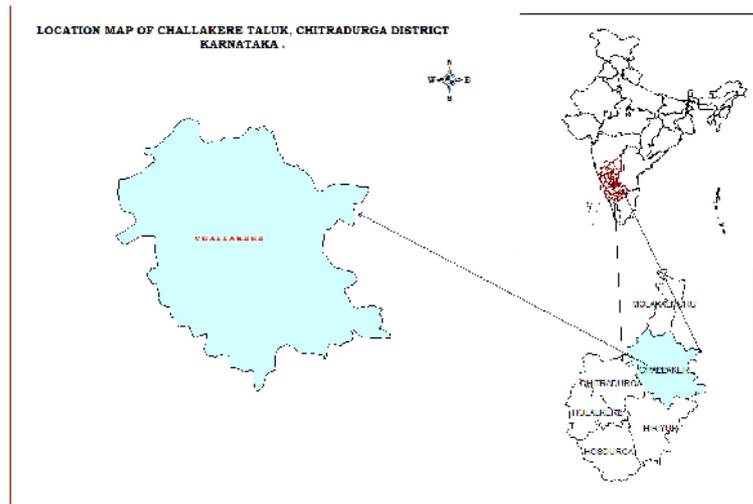
South Western Region, Bengaluru

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Government of India
Ministry of Water Resources, River Development
& Ganga Rejuvenation
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**CHITRADURGA TALUK AQUIFER MAPS AND MANAGEMENT
PLANS, CHITRADURGA DISTRICT,
KARNATAKA STATE**



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**CHITRADURGA TALUK AQUIFER MAPS AND MANAGEMENT
PLANS, CHITRADURGA DISTRICT, KARNATAKA STATE**

1. SALIENT INFORMATION

Name of the taluk	: CHITRADURGA
District	: Chitradurga
State	: Karnataka
Area	: 1,387 sq.km.
Population	: 4,23,879
Annual Normal Rainfall	: 671 mm

1.1 Aquifer management study area

Aquifer mapping studies were carried out in Chitradurga taluk, Chitradurga district of Karnataka, covering an area of 1,387 sq.kms under National Aquifer Mapping Project. Chitradurga taluk of Chitradurga district is located between north latitude $14^{\circ}03'03.2''$ and $14^{\circ}27'29.1''$ & east longitude $76^{\circ}06'39.2''$ and $76^{\circ}35'06''$, and is covered in parts of Survey of India Toposheet Nos. 57B/3, 57B/4, 57B/7, 57B/8, 57B/11 and 57B/12. Chitradurga taluk is bounded by Jagalur taluk on north, Holalkere and Hiriyur taluk on south, Challakere taluk on east and Davanagere and Holalakere on western side. Location map of Chitradurga taluk of Chitradurga district is presented in Fig-1.

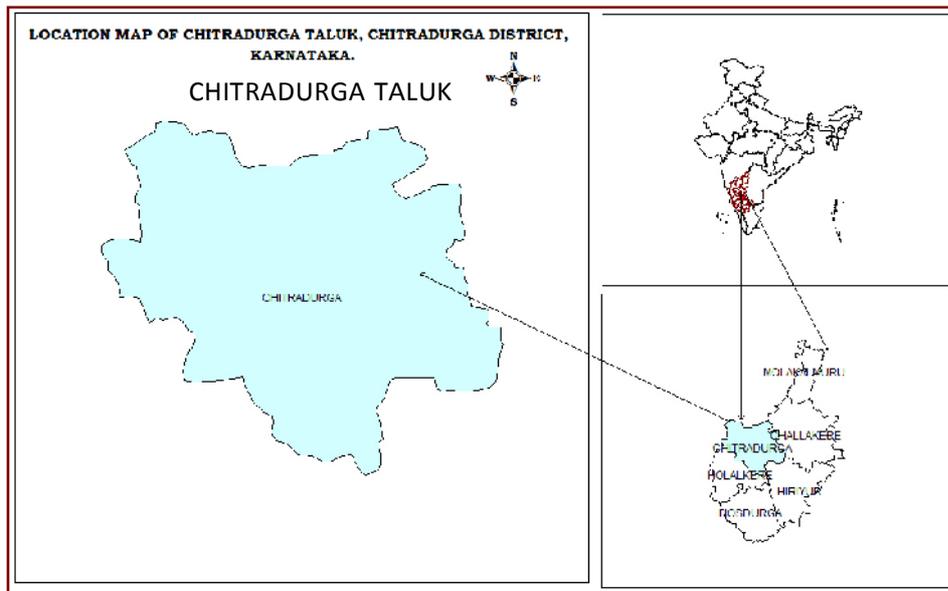


Fig 1: Location Map of Chitradurga taluk, Chitradurga district, Karnataka

Chitradurga with population of about 4.2 lakh is the most populous taluk of Chitradurga district in Karnataka. Taluk administration of Chitradurga taluk is divided into 4 Hoblies and 36 Gram Panchayaths. Chitradurga is the largest city in taluk, which is the taluk and district headquarter also. There are 166 inhabited and 24 uninhabited villages in the taluk. Out of 190 villages in the taluk, Bharamasagara is the most populous village and Attikatte is the least populous village in the taluk. While Dyamavvanahalli is the biggest village in the taluk with an area of 57 km², Kavadijarahatti is the smallest with less than one km² area.

The city of Chitradurga is the district headquarters. Chitradurga gets its name from Chitrakaldurga, an umbrella-shaped lofty hill found there. Tradition dates Chitradurga District to the period of the Ramayana and Mahabharata. The entire taluk lies in the valley of the Vedavati River, with the Tungabhadra River flowing in the northwest.

1.2 Population

According to 2011 census, the population in Chitradurga taluk is 4,23,879 of which rural population is 2,72,142 constituting about 64%, and the urban population is 1,51,737, constituting about 36% of the total population, basically due to Chitradurga City. The taluk has an overall population density of 291 persons per sq.km and showed a decadal increase of about 8.28% during 2001-2011.

1.3 Rainfall

Chitradurga taluk enjoys semi-arid climate. Dryness and hot weather prevails in major part of the year. The area falls under Central Dry agro-climatic zone of Karnataka state and is categorized as drought prone. The climate of the study area 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 Chitradurga taluk for the period 1981 to 2010 is 671 mm. Seasonal rainfall pattern indicates that, major amount of (349 mm) rainfall is received during South-West Monsoon seasons, which contributes to about 53% of the annual normal rainfall, followed by North-East Monsoon season (206 mm) constituting about 27% and remaining (104 mm) 20% during pre-monsoon season (Table-1).

Computations were carried out for the 30 year blocks of 1981- 2010, the mean monthly rainfall in Chitradurga taluk is ranging between 2 mm during January to 134 mm during October. The coefficient of variation percent for pre-monsoon, monsoon and post- monsoon season is 60, 33 and 50 percent respectively. Annual CV at this station works out to be 28 percent (Table-1).

Table-1: Statistical Analysis of Rainfall Data of Chitradurga Taluk, Chitradurga District, Karnataka (1981 to 2010)

Station		JAN	FEB	MAR	APR	MAY	PRE	JUN	JUL	AUG	SEP	SW	OCT	NOV	DEC	NE	Annual
Chitradurga	NORM	2	3	9	35	66	115	69	69	99	113	349	134	59	13	206	671
	STDEV	5	7	21	40	41	69	52	52	56	64	114	83	74	24	104	188
	CV%	253	238	229	113	63	60	76	75	57	57	33	62	125	193	50	28

Based on occurrence and frequency of past drought events, the probability of occurrence of various intensities of drought at each station has been studied. It has been observed that the frequency of occurrence of drought is once in 5 years at Chitradurga taluk.

1.4 Agriculture and Irrigation

Agriculture is the main occupation in Chitradurga taluk. Maize is major crop, grown in almost half of the total crop area followed by pulses, vegetables, oilseeds and Cotton covering about 18%, 12%, 8% and 7% of the total crop area respectively. Ragi, Jowar and Fruits are some other crops grown in the taluk. Due to limited availability of irrigation water, water-intensive crops like Paddy and Sugarcane are not grown in the taluk now.

Table 2: Cropping pattern in Chitradurga taluk 2014-2015 (Ha)

Year	Paddy	Maize	Ragi	Jowar	Pulses	Fruits	Vegetables	Oil seeds	Sugarcane	Cotton
	Area under cultivation (in ha)									
2014-2015	00	44458	2578	1574	17387	1571	11448	7123	00	6547

It is observed that net sown area accounts for about 65% of total geographical area, while area sown more than once is 17% of total geographical area in the taluk (Table-3).

Ground water is the lone source for irrigation in the taluk, as the entire 5015 hectares irrigated area is catered through borewells (Table-4).

Table 3: Details of land use in Chitradurga taluk 2014-2015 (Ha)

Taluk	Total Geographical Area	Area under Forest	Area not available for cultivation	Fallow land	Net sown area	Area sown more than once
Chitradurga	1,23,502	12,049	16,750	2,609	79,990	20,628

Source: District at a glance 2014-15, Govt. of Karnataka

Table 4: Irrigation details in Chitradurga taluk (Ha)

Source of Irrigation	Net area irrigated (Ha)	% of area
Canals	0	0
Tanks	0	0
Wells	0	0
Bore wells	5,015	100%
Lift Irrigation	0	0
Other Sources	0	0
Total	5,015	

Source: District at a Glance 2014-15, Government of Karnataka

1.5 Geomorphology, Physiography and Drainage

The geomorphology of the taluk is characterized by vast stretches of undulated plains interspersed with sporadic ranges or isolated clusters of low ranges of rocky hills dotting the south central and southern parts (Fig-2). The entire taluk lies in the valley of the Vedavati River, with the Tungabhadra River flowing in the northwest. The Citradurga taluk, falls under Krishna River basin. The important river of the taluk is Vedavati, which is a tributary of Tungabhadra. Drainage pattern in the taluk is dendritic to sub-dendritic (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.

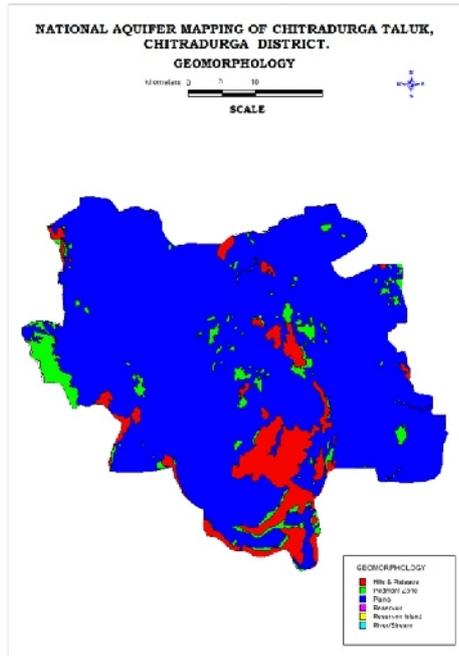


Fig 2: Geomorphology Map

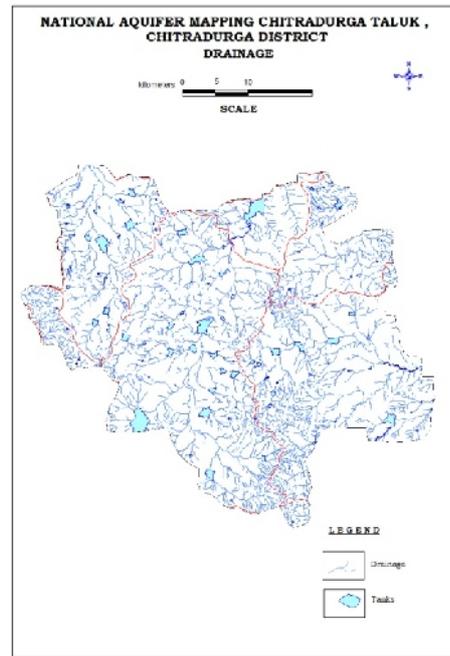


Fig 3: Drainage Map

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 (2013) (Ham)

Taluk	Annual Replenishable GW resources	Fresh In-storage GW resources		Total availability of fresh GW resources
		Phreatic	Fractured (down to 200 m)	
Chitradurga	5,485	00	2,750	Dynamic + Phreatic in-storage + fractured

1.8 Existing and future water demands (as per GEC-2013)

Net ground water availability for future irrigation development : 1.57 MCM

Domestic and Industrial sector demand for next 25 years : 6.62 MCM

1.9 Water level behaviour

(a) Depth to water level

Aquifer - I **

Pre-monsoon: 3.13 - 18.10 m bgl

Post-monsoon: 3.24 - 18.10 m bgl

** This aquifer-I is totally de-saturated due to over-exploitation and has become totally dry. However, isolated patches in topographical lows are seen yielding for very short durations.

Aquifer - II

Pre-monsoon: 3.60 - 27.60 m bgl (Fig-4)

Post-monsoon: 4.30 - 39.80 m bgl (Fig-5)

(b) Water level fluctuation

Aquifer-II

Seasonal Fluctuation: (Fig-6)

Fall, ranges between 0.70 - 12.20 m

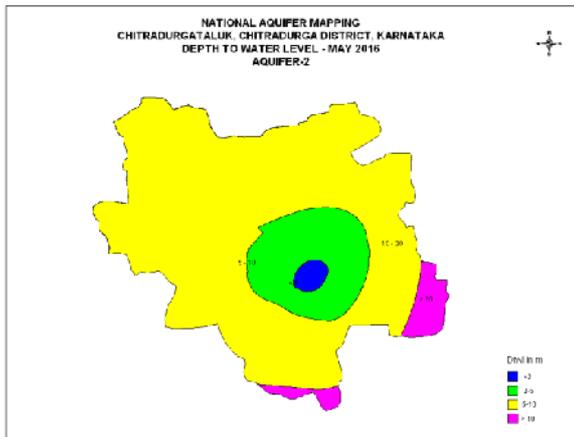


Fig.4: Pre-monsoon Depth to Water Level (Aq-II)

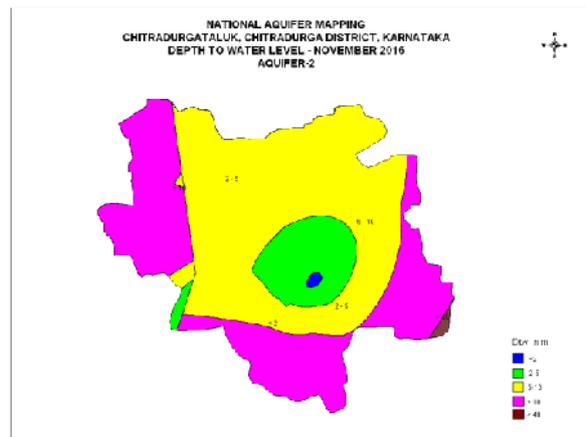


Fig.5: Post-monsoon Depth to Water Level (Aq-II)

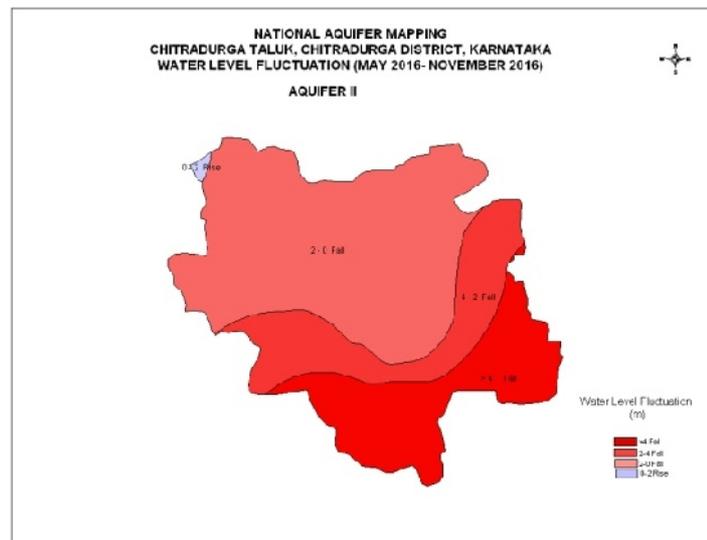


Fig.6: Water Level Fluctuation (Aq-II)

2. AQUIFER DISPOSITION

2.1 Number of aquifers: In Chitradurga 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 Granitic-gneiss, Gneiss and Schist

In Chitradurga taluk, fractured granitic-gneiss, gneisses and hornblende-schist are the main water bearing formations (Fig-7). Ground water occurs within the jointed and fractured granitic-gneisses under semi-confined to confined conditions. In Chitradurga taluk, generally the bore wells are drilled up to a maximum of 200 mbgl (Table-6). Depth of weathered zone (Aquifer-I) ranges from 13.3 mbgl to 25.0 mbgl (Fig-11). This aquifer-I or Phreatic Aquifer is totally de-saturated due to over-exploitation and has become totally dry. However, isolated patches in topographical lows are seen yielding seasonally, that too for very short durations. Ground water exploration reveals that aquifer-II fractured formation was encountered between the depth range of 23 to 192 mbgl. Yield ranges from 0.04 to 5.42 lps. Transmissivity ranges from 2 to 40 m²/day. Specific capacity ranges from 4.5 to 43.9 lpm/m draw down.

The basic characteristics of each aquifer are summarized in Table-7.

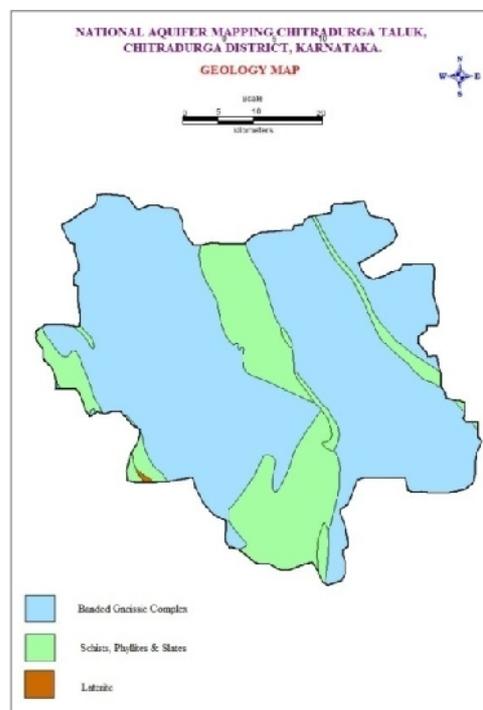


Fig 7: Geology Map

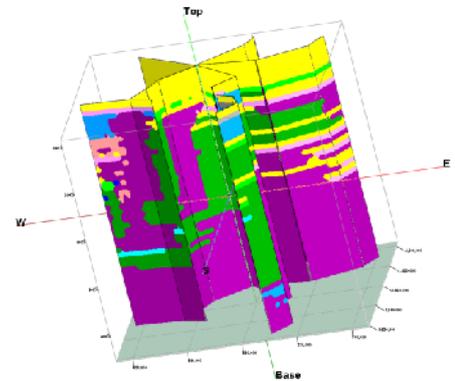
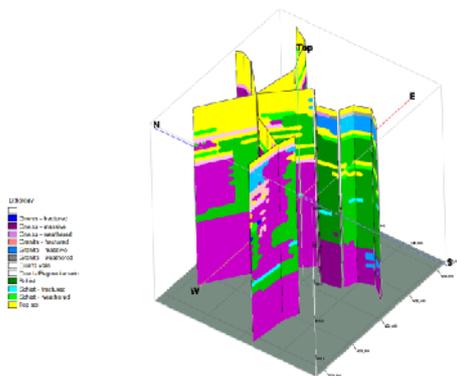
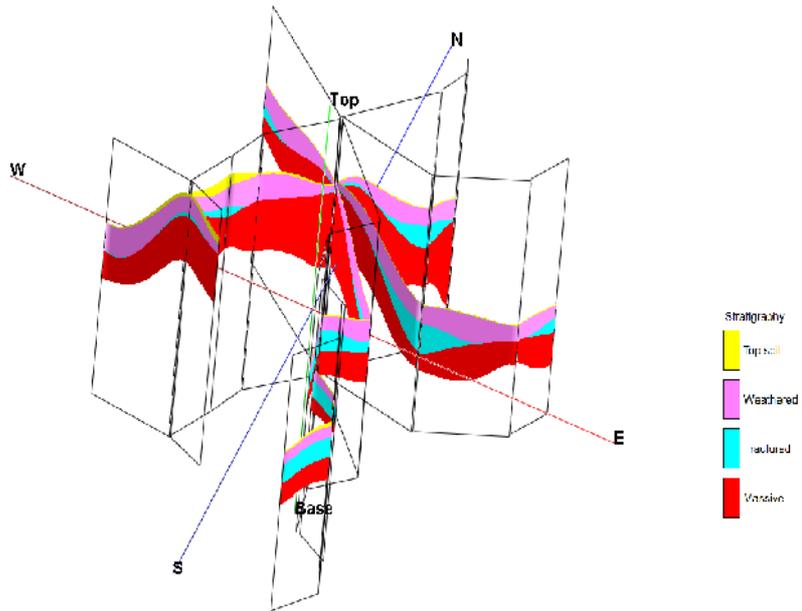
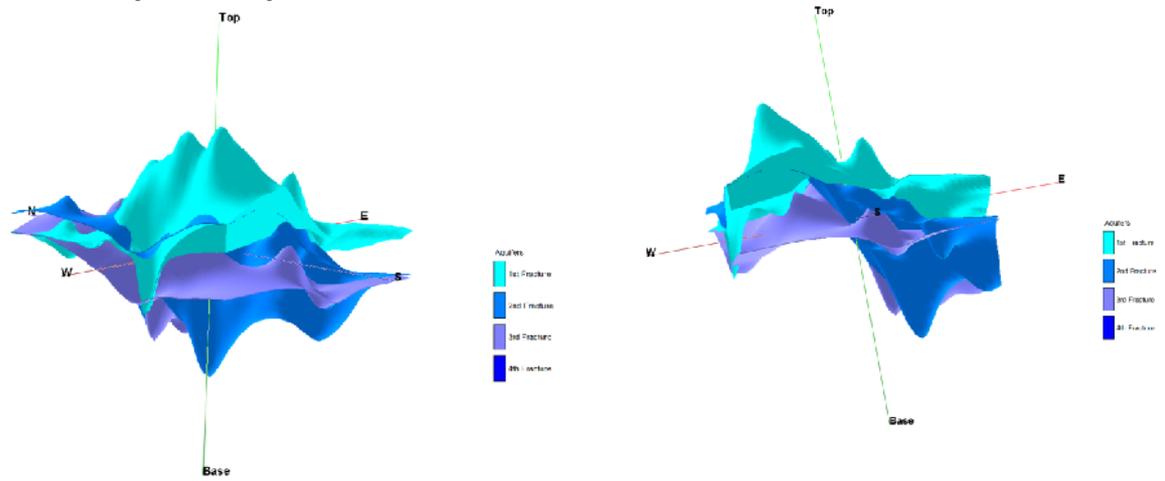
Table 6: Details of Ground water Exploration

Sl. No.	Location	Latitude	Longitude	Depth Drilled (m bgl)	Casing Depth (m bgl)	Fracture Zones (mbgl)	SWL (mbgl)	Q (lps)	DD (m)
1.	Belagatta	14°18'23"	76°27'19"	62.50	2.30	8.0 -10.0, 17.0 -18.0, 22.0-23.0	3.77	1.17	
2.	Doddiganahalli	14°16'33"	76°12'00"	90.00	-		4.90	1.33	6.956
3.	Doddiganahalli	14°16'33"	76°12'00"	60.00	-		4.67	6.73	5.01
4.	Gaurammanahalli	14°17'34"	76°15'28"	38.00	5.50	11.0 - 38.00	12.43	3.00	
5.	Golarahatti	14°17'15"	76°17'30"	90.00	-		15.69	2.17	11.92
6.	Haluvorthy	14°22'35"	76°22'44"	90.00	-		7.35	0.54	12.85
7.	Nellikatte	14°24'00"	76°15'30"	90.00	-		10.40	0.42	13.60
8.	Rangavanahalli	14°22'15"	76°12'20"	200.00	27.61	39.00, 88.00		2.07	
9.	Bharamasagara	14°22'05"	76°12'20"	159.00	27.80	110.00		0.43	
10.	Bevinahalli	14°22'40"	76°10'05"	105.34	11.60	23.00, 52.00, 55.00	24.40	5.42	5.25
11.	Kariyammanahalli	14°25'40"	76°14'05"	132.82	11.50	32.0, 41.0, 103.0, 105.0	29.90	4.30	4.99
12.	Bagenalu	14°16'30"	76°26'30"	187.78	8.75			Neg	
13.	Kurubarahalli	14°10'50"	76°19'40"	200.00	5.52	50.57		0.04	
14.	Haliyur	14°11'60"	76°18'10"	200.00	18.00	192.00		0.31	
15.	Tirumalapura	14°09'50"	76°15'10"	200.00	23.60	29.70		0.04	

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.

2.2. 3 D Aquifer Disposition and Cross-sections



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

a. Aquifer wise resource availability and extraction

(a) Present Dynamic Ground Water Resource (2013)

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
Chitradurga	5485	6226	573	6799	662	157	124	OE

(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
Chitradurga	5485	0	2750	8235

(c) Comparison of Ground Water Availability and Draft Scenario in Chitradurga 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 (Ham)	Stage of GW Development
	2009			2011			2013		
Chitradurga	5593	8067	144	5390	6555	122	5485	6799	124

b. Chemical Quality of Ground Water and Contamination

In general, ground water quality in Chitradurga taluk is good for drinking purpose as per "Indian Standard Drinking Water Specification 2009".

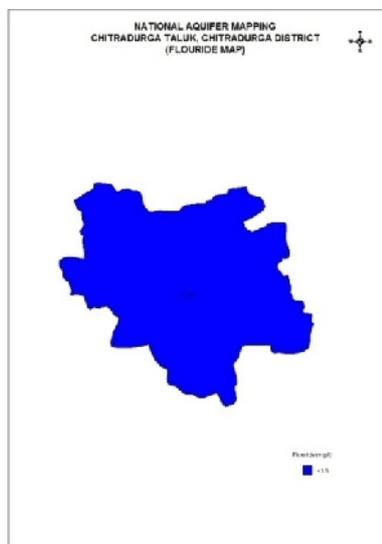


Fig 14: Fluoride Map

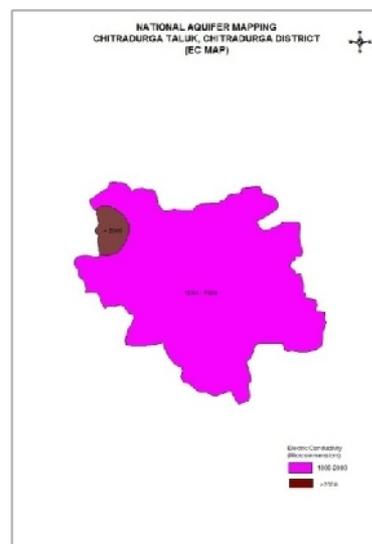


Fig 2: Electrical Conductivity Map

4. GROUND WATER RESOURCE ENHANCEMENT

4.1 Aquifer wise space available for recharge and proposed interventions

Recharge dry phreatic aquifer (Aq-I) in the taluk, through construction of artificial recharge structures, viz., check dams, percolation tanks & point recharge structures (Table-8). The choice of recharge structures should be site specific and such structures need to be constructed in areas already identified as feasible for artificial recharge.

Table 8: Quantity of non-committed surface runoff and expected recharge through AR structures

Artificial Recharge Structures Proposed	Chitradurga Taluk
Non committed monsoon runoff available (Ham)	1290
Number of Check Dams	80
Number of Percolation Tanks	05
Number of Point Recharge structures	09
Tentative total cost of the project (Rs. in lakhs)	311.37
Expected recharge (MCM)	7.317
Expected rise in water level (m)	0.276
Cost Benefit Ratio (Rupees / cu.m. of water harvested)	4.26

4.2 Improvement in GW availability due to Recharge, Chitradurga taluk

Taluk	Net annual ground water availability	Existing gross ground water draft for all uses	Existing stage of ground water development	Expected recharge from proposed Artificial Recharge Structures	Additional potential from proposed irrigation development schemes through inter-basin transfer	Cumulative annual ground water availability	Expected improvement in stage of ground water development after the implementation of the project	Expected improvement in overall stage of ground water development
	HAM	HAM	%	HAM	HAM	HAM		%
Chitradurga	5485	6799	124	732	-	6217	15	109

After implementation of Artificial Recharge structures for GW recharge, the annual ground water availability will increase from 5485 to 6217 ham and the expected improvement in stage of development is 15% i.e., from 124% to 109%

5. DEMAND SIDE INTERVENTIONS

5.1 Advanced irrigation practices

It is observed that presently, ground water through borewells is the lone source for irrigation in the taluk. Water use efficiency measures are need of the hour. Adopting these measures will contribute in ground water resource enhancement in the long run.

Efficient irrigation practices like Drip irrigation and sprinkler need to be adopted by the farmers in the existing 18,053 ha of gross irrigated area. Presently, draft through irrigation is 6799 ham. Efficient irrigation techniques will contribute in saving ground water by 1868 ham and thus, will improve stage of development by 25%, bringing stage of GW development from 109% to 84% (Table-9).

5.2 Change in cropping pattern

In Chitradurga taluk, no Water intensive crop, like Paddy or Sugarcane is being grown, and hence, it may not be of any consequence to apply any modifications in cropping pattern. Hence, change in cropping pattern is not suggested.

Table-9: Improvement in GW availability due to saving by adopting water use efficiency

Taluk	Cumulative annual ground water availability after implementing ar structures & irrigation development schemes	Existing gross ground water draft for all uses	Stage of ground water development after implementing AR structures & Yettinahole project	Saving due to adopting WUE measures	Cumulative annual ground water availability	Expected improvement in stage of ground water development after the implementation of the project	Expected improvement in overall stage of ground water development
	Ham	Ham	%	Ham	Ham	%	%
Chitradurga	6217	6799	109	1868	8085	84	25

5.3 Additional area of irrigation

After adopting various water use efficiency techniques and recharge measures and its resultant savings, the stage of development is expected to be 84% in the taluk, which will bring the taluk to the **semi-critical** category. Hence bringing additional area under irrigation may not be practical with a long-term resource management point of view.

5.4 Regulation and Control

Chitradurga taluk has been categorized as **Over-Exploited**, since the Stage of ground water development has reached **124%** (GE March 2013). Hence, stringent action has to be taken up through Karnataka Ground Water Authority to control ground water exploitation in the taluk.

Ground water recharge component needs to be made mandatory in the taluk to save the situation from deteriorating further.

5.5 Other interventions proposed:

Periodical maintenance of artificial recharge structures should also be incorporated in the Recharge Plan.

5.6 Summary

The summary of Management plan of Chitradurga taluk is given in Table-10.

Table-10: Summary of Management plan of Chitradurga taluk

Chitradurga taluk is 'Over-Exploited' and present stage of GW Development (2013)	124%
Net Annual Ground Water Availability (MCM)	54.85
Existing Gross Ground Water Draft for all uses (MCM)	67.99
Groundwater development feasibility	1.57
Total GW Resources (Dynamic & Static up to the depth of 200 m bgl) (MCM)	82.35
Expected additional recharge from monsoon surplus runoff (MCM)	7.32
Change in Stage of GW development, %	124 to 109
Expected Saving due to adopting WUE measures (MCM)	18.68
Change in Stage of GW development, %	109 to 84

