



केंद्रीय भूमि जल बोर्ड

जल संसाधन, नदी विकास और गंगा संरक्षण

विभाग, जल शक्ति मंत्रालय

भारत सरकार

Central Ground Water Board

Department of Water Resources, River
Development and Ganga Rejuvenation,

Ministry of Jal Shakti

Government of India

AQUIFER MAPPING AND MANAGEMENT OF GROUND WATER RESOURCES

CHIKKODI TALUK,

BELAGAVI DISTRICT, KARNATAKA

दक्षिण पश्चिमी क्षेत्र, बैंगलोर

South Western Region, Bengaluru



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AQUIFER MANAGEMENT PLAN OF CHIKKODI TALUK, BELAGAVI DISTRICT, KARNATAKA STATE

1.0 SALIENT INFORMATION

Name of the Taluk: **Chikkodi**

District: Belagavi; State: Karnataka

Area: 1269 sq.km.

Population: 6,28,800

Annual Normal Rainfall: 716 mm

1.1 Aquifer management study area

Aquifer mapping studies have been carried out in Chikkodi Taluk, Belagavi district of Karnataka, covering an area of 1269 sq.kms under National Aquifer Mapping Project. Chikkodi Taluk of Belagavi district is located between North Latitudes 16°18'46.8" and 16°39'46" and East Longitudes between 74° 15' 00" to 74°47'06" and is falling in Survey of India Toposheets No forms parts of 47L/6, L/7, L/10 &L/11. The study area is bounded on the North and West by Maharastra state, on the East by Athani Taluk, on the South by Hukkeri Taluk of Belagavi district. Location map of Chikkodi Taluk of Belagavi district is presented in **Fig-1**. Chikkodi is Taluk head quarter and there are two other town in this Taluk namely Nippani and Sadalga. There are 132 villages in this Taluk.

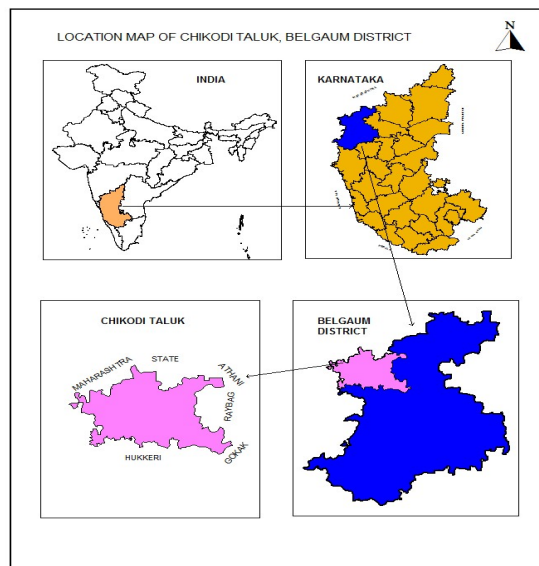


Fig-1: Location map of Chikkodi taluk of Belgaum

1.2 Population

According to 2011 census, the population in Chikkodi Taluk is 6,28,800. Out of which 3,19,797 are males while 3,09,003 are females. The average sex ratio of Chikkodi Taluk is 966. The Chikkodi Taluk has an overall population density of 498 persons per sq.km. The decadal variation in population from 2001-2011 is 10.8% in Chikkodi Taluk.

1.3 Rainfall

Chikkodi Taluk enjoys semi-arid climate. The area falls under Northern transitional agro-climatic zone of Karnataka state. The normal annual rainfall in Chikkodi Taluk for the period 1981 to 2010 is 716 mm. Seasonal rainfall pattern indicates that, major amount of (507 mm) rainfall was recorded during South-West Monsoon seasons, which contributes about 71% of the annual normal rainfall, followed by North-East Monsoon season (125 mm) constituting 17% and remaining (84 mm) 12% in Pre-Monsoon season (**Table-1**).

On Computations were carried out for the 30 year blocks of 1981-2010, the mean monthly rainfall at Chikkodi Taluk is ranging between 1 mm during January to 139 mm during June. The coefficient of variation percent for pre-monsoon, monsoon and post-monsoon season is 59, 33 & 70 percent respectively. Annual CV at this station works out to be 25 percent (Table-1).

Table-1: Statistical Analysis of Rainfall Data of Chikkodi Taluk, Belagavi district (1981 to 2010)

STATION		JAN	FEB	MAR	APR	MAY	PRE	JUN	JUL	AUG	SEP	SW	OCT	NOV	DEC	NE	Annual
CHIKKODI	NRM	1	3	6	22	52	84	139	136	122	111	507	97	23	4	125	716
	STDEV	3	12	11	22	45	50	80	68	52	85	170	79	30	12	87	177
	CV%	250	397	188	102	87	59	58	50	42	76	33	81	130	273	70	25

1.4 Agriculture & Irrigation

Agriculture is the main occupation in Chikkodi Taluk. Major Kharif crops are Maize, Bajra, Jowar, Tur and Vegetables. Main crops of Rabi season are Maize, Bajra, Jowar and Sunflower (Table-2). Water intensive crops like sugarcane and paddy are grown in 36% of total crop area. Maize is grown in 18% and oil seeds in 19% of total crop area of Taluk. Bajra & jowar account 10% of total crop area.

Table-2: Cropping pattern in Chikkodi Taluk 2016-2017 (Ha)

Year	Wheat	Maize	Paddy	Jowar	Pulses	Fruits	Vegetables	Oil seeds	Sugarcane	Cotton
Area under cultivation (in ha)										
2016-2017	4093	22407	821	10797	5287	703	1056	24285	44442	725

It is observed that net sown area accounts 81% and area sown more than once is 22% of total geographical area in Chikkodi Taluk (**Table-3**). Area not available for cultivation and Fallow land cover 8% &5% of total geographical area respectively. 14% of net area irrigated is only from bore wells and 1% from lift irrigation (**Table-4**).

Table-3: Details of land use in Chikkodi Taluk 2016-2017 (Ha)

Taluk	Total Geographical Area	Area under Forest	Area not available for cultivation	Fallow land	Net sown area	Area sown more than once
CHIKKODI	126949	547	12399	6060	103254	28487

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

Table-4: Irrigation details in Chikkodi Taluk

Source of Irrigation	Net area irrigated (Ha.)	% of area
Canals	8200	6%
Tanks	0	0
Wells	25488	20%
Bore wells	17240	14%
Lift Irrigation	711	1%
Other Sources	13543	11%
Total	65182	

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

1.5 Geomorphology, Physiography & Drainage

Chikkodi Taluk is a plateau region formed by basaltic lava flows, which represents “Deccan penneplain”. The central and southern parts exhibit moderate to gently “undulating terrain” having sparsely distributed knolls and tors. The remaining part of the Taluk is in general a “plateau area”. The elevation in the plains varies from 600 m in the North western part to 540m amsl in the Northeastern part of the Taluk. This has its bearing on the regional slope which is towards northeast. The differential altitude is significant because, it is likely to cause irregular ground water flow patterns on the micro scale (**Fig.-2**). Topography is dominantly controlled by geological structures.

The entire Chikkodi Taluk falls in Krishna river basin. Vediganga and Doudhganga Rivers drain in the northwestern and eastern parts of the Taluk. Hirehalla river drain in the Southeastern part of the Taluk. The Drainage pattern is dendritic to subdendritic (**Fig.-3**).

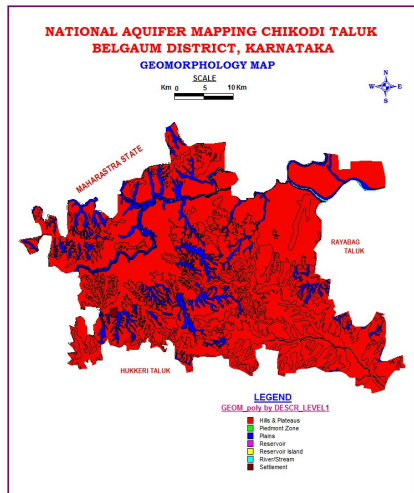


Fig-2: Geomorphology Map

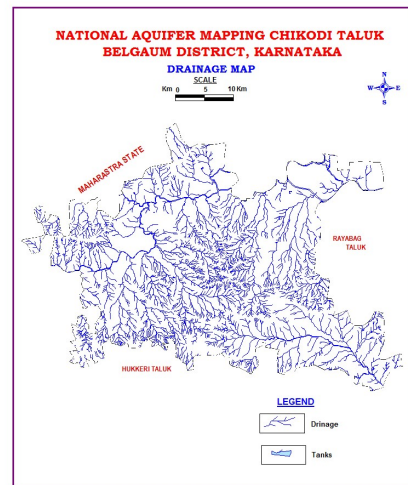


Fig-3: Drainage Map

1.6 Soil

The soils of Chikodi Taluk can broadly be classified into Black cotton soils and Red soils. These soils vary in depth and texture, depending on the parent rock type, physiographic settings and climatic conditions. Black cotton soils are mature soils with high humus and are mildly alkaline in nature. Along the Krishna river these soils are overlapped by alluvial clayey materials. Black cotton soils are the product of highly weathered and decomposed basaltic rocks. Red soils are sandy in nature and derived from weathering of vesicular basalt.

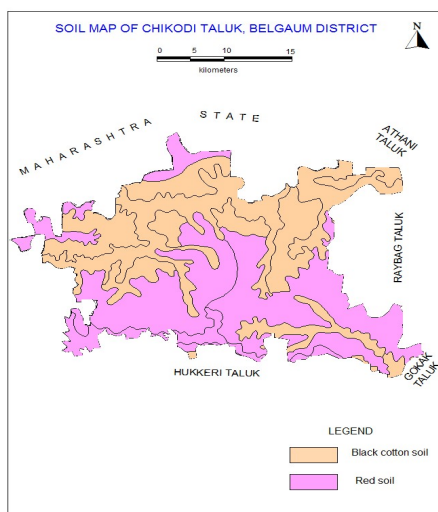


Fig 4: Soil Map

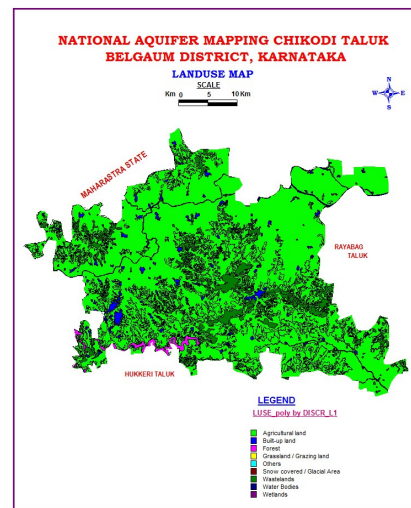


Fig 5: Landuse Map

1.7 Ground water resource availability and extraction

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

Table-5: Total Ground Water Resources (2017) (Ham)

Taluk	Annual replenishable GW resources	Fresh In-storage GW resources		Total availability of fresh GW resources
		Phreatic	Fractured (Down to 200m)	
CHIKKODI	19603			Dynamic + phreatic in-storage + fractured
		1229	3078	23910

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

- Net ground water availability for future irrigation development : 61.75 MCM
- Domestic (Industrial sector) demand for next 25 years : 22.90 MCM

1.9 Water level behavior

(a) Depth to water level

Aquifer - I

- Pre-monsoon: 4.02 – 14.01 mbgl (**Fig.-6**)
- Post-monsoon: 3.14 – 10.34 mbgl (**Fig.-7**)

Aquifer - II

- Pre-monsoon: 9.58 -12.97 mbgl (**Fig.-8**)
- Post-monsoon: 9.43 – 11.93 mbgl (**Fig.-9**)

(b) Water level fluctuation

Aquifer-I (Fig.-10)

- Seasonal Fluctuation: Rise ranges 1.053 – 4.13 m; Fall ranges 0.16 – 0.91 m

Aquifer-II (Fig.-11)

- Seasonal Fluctuation: Rise shows 0.09-1.04 m; Fall ranges 0.0 – 0 .0 m

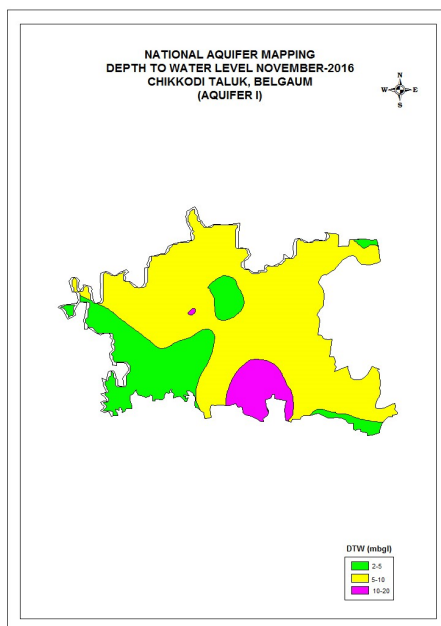


Fig-6: Pre-monsoon Depth to Water Level (Aq-

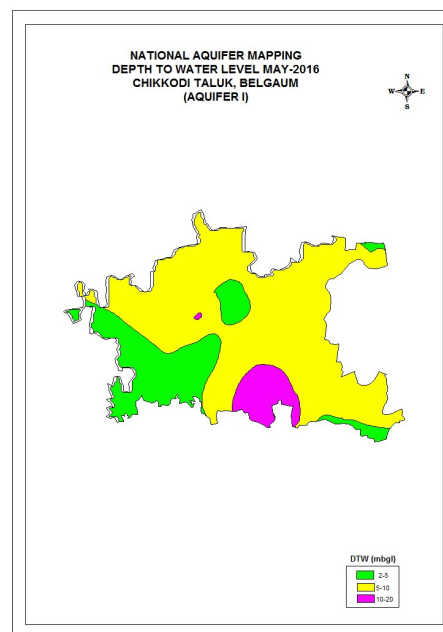


Fig-7: Post-monsoon Depth to Water Level (Aq-I)

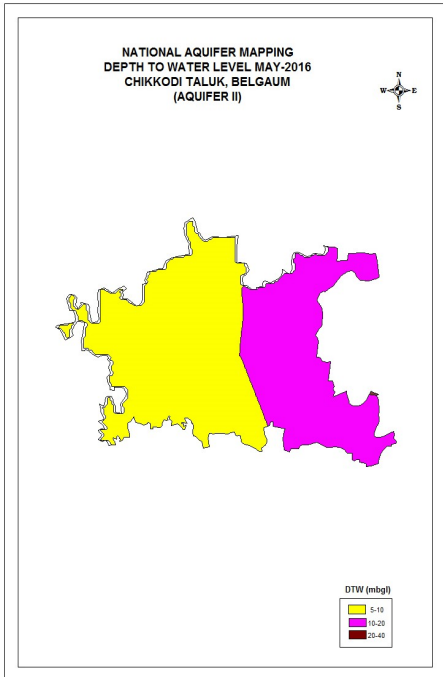


Fig-8 Pre-Monsoon Depth to Water Level (Aq-II)

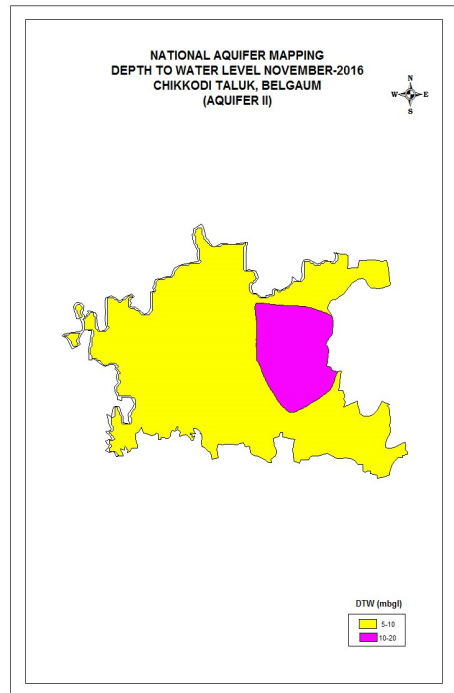


Fig-9 Post-Monsoon Depth to Water Level (Aq-II)

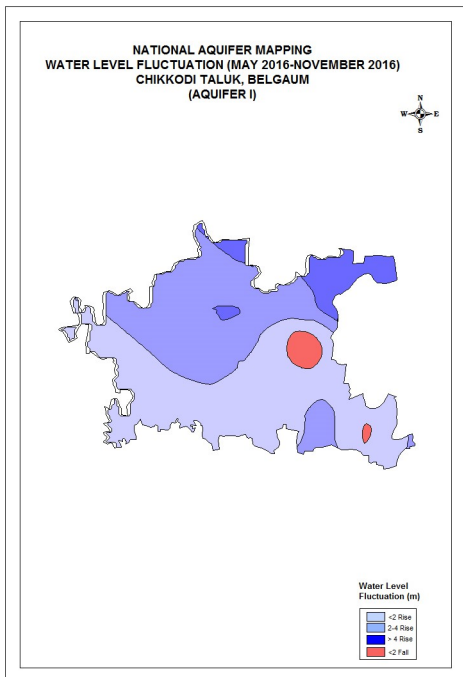


Fig-10: Water Level Fluctuation (Aq-I)

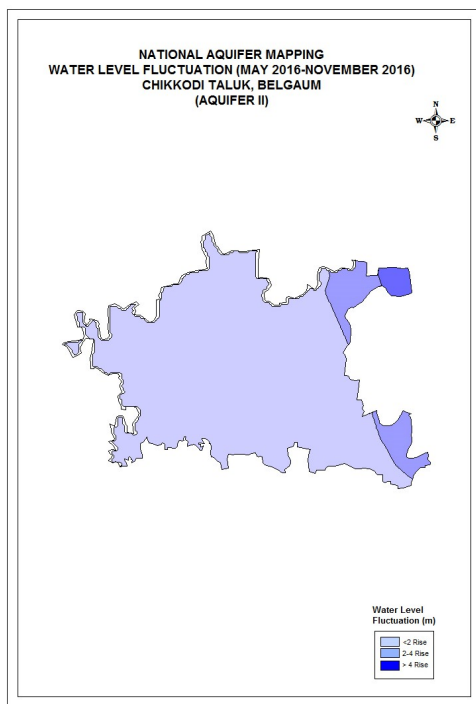


Fig-11: Water Level Fluctuation (Aq-II)

2.0 AQUIFER DISPOSITION

2.1 Number of aquifers: In Chikkodi Taluk, there are mainly two types of aquifer systems;

- i. Aquifer-I (Phreatic aquifer) Weathered Basalt
- ii. Aquifer-II (Fractured aquifer) Fractured Basalt and Vesicular Basalt

In Chikkodi Taluk, Basalt is the main water bearing formations (**Fig-12**). Ground water occurs within the weathered and fractured Basalt under water table condition and semi-confined condition. In the Taluk, bore wells were drilled from a minimum depth of 80 mbgl to a maximum of 200 mbgl. Depth of weathered zone ranges from 3 mbgl to 20 mbgl (**Fig-13**). Ground water exploration reveals that aquifer-II fractured formation was encountered between the depth of 40 to 200 mbgl. Yield ranges from 0.20 to 4.82 lps. The basic characteristics of each aquifer are summarized in Table-7.

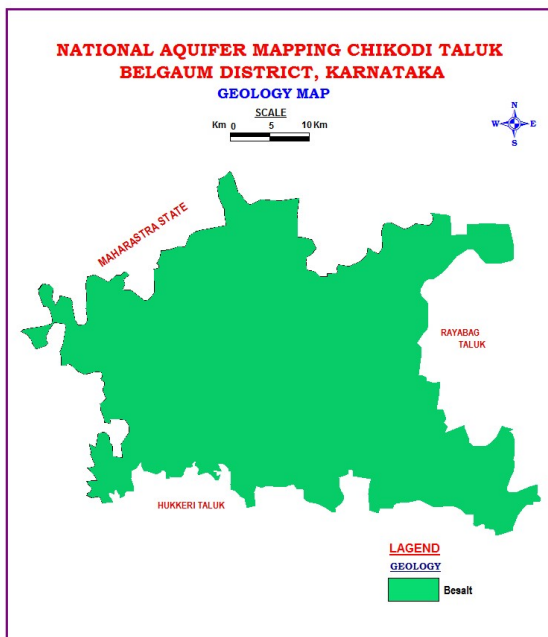


Fig-10: Geology Map

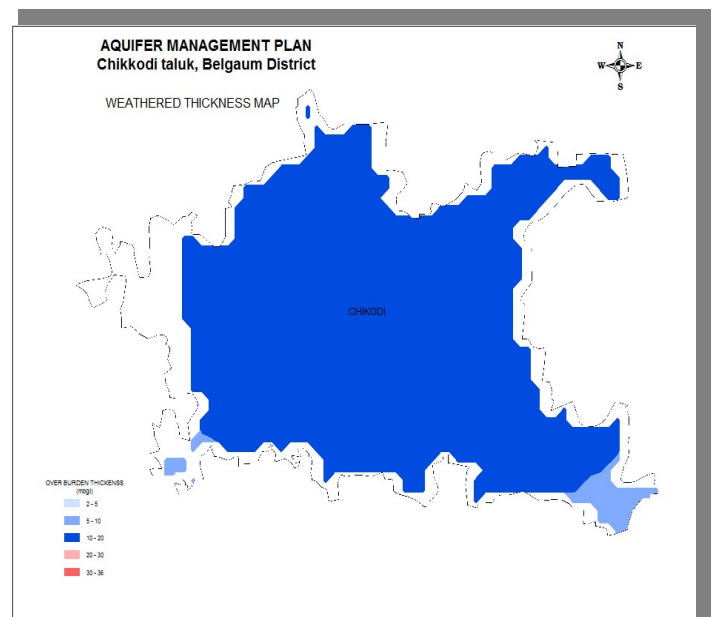


Fig-11: Weathered Thickness Map (Aq.-I)

Table-6: Details of Ground Water Exploration

Sl. No	Location	Lat & Long	Depth m bgl	Casing (m)	Lithology	SWL (mbgl)	Q (lps)	DD (m)	T (m ² /day)
1	Hirekundi	16° 28' 03" 74° 35' 22"	80.00	3.0	Basalt	6.53	Negl	-	-
2	Nagarmunali	16° 22' 00" 74° 41' 00"	80.00	3.0	Basalt	16.32	1.30	0.34	294
3	Nippani	16° 23' 42" 74° 22' 48"	80.00	3.0	Basalt	4.17	0.11	28.26	0.69
4	Yadgud	16° 19' 12" 74° 36' 22"	80.00	-	Basalt	29.15	0.26	13.22	1.0

Table-7: Basic characteristics of each aquifer

Aquifers	Weathered Zone (Aq.-I)	Fractured Zone (Aq.-II)
Prominent Lithology	Weathered Basalt	Fractured / Jointed Basalt
Thickness range (mbgl)	20	Fractures upto 200 mbgl
Depth range of occurrence of fractures (mbgl)	7-15	47-196
Range of yield potential (lps)	Poor yield	1 - 5
Specific Yield	2%	0.2%
T (m ² /day)	-	1 – 294
Quality Suitability for Domestic & Irrigation	Suitable	Suitable

3.0 Ground water resource, extraction, contamination and other issues

3.1 Aquifer wise resource availability and extraction

(a) Present Dynamic Ground Water Resource (2017)

Taluk	NET ANNUAL GROUND WATER AVAILABILITY	EXISTING GROSS GROUND WATER DRAFT FOR IRRIGATION	EXISTING GROSS GROUND WATER DRAFT FOR DOMESTIC AND INDUSTRIAL WATER SUPPLY	EXISTING GROSS GROUND WATER DRAFT FOR ALL USES	ALLOCATION FOR DOMESTIC AND INDUSTRIAL USE FOR NEXT 25 YEARS	NET GROUND WATER AVAILABILITY FOR FUTURE IRRIGATION DEVELOPMENT	EXISTING STAGE OF GROUND WATER DEVELOPMENT	Category
CHIKKODI	19603	11166	1867	13033	2290	6175	66	SAFE

(b) Present total Ground Water Resource (Ham)

Taluk	Annual replenishable GW resources (in ham)	Fresh In-storage GW resources (in ham)		Total availability of GW resource (in ham)
		Phreatic	Fractured	Dynamic + phreatic in-storage + fractured in-storage
CHIKKODI	19603	1229	3078	23910

(c) Comparison of ground water availability and draft scenario in Chikkodi Taluk

Taluk	GW availability (in ham)	GW draft (in ham)	Stage of GW development	GW availability (in ham)	GW draft (in ham)	Stage of GW development	GW availability (in ham)	GW draft (in ham)	Stage of GW development	GW availability (in ham)	GW draft (in ham)	Stage of GW development
	2009			2011			2013			2017		
CHIKKODI	15299	17669	115	13584	12279	90	13517	12542	93	19603	13033	66

3.2 Chemical quality of ground water and contamination

Interpretation from Chemical Analysis results in Chikkodi Taluk is mentioned as under:

ELECTRICAL CONDUCTIVITY: In general, EC values range from 434 to 3920 μ /mhos/cm in the aquifer-I at 25°C. The highest value of 3920 μ /mhos/cm at 25°C is recorded in Belakud.

FLUORIDE: Fluoride concentration in ground water ranges between 0.53 – 1.8 mg/l in the aquifer-I. The value of fluoride above permissible limit of 45 mg/l as per IS: 10500, 2012 is observed in Belakud and Kabbur.

NITRATE: Nitrate value ranges from 4 and 137 mg/l in the Aquifer –I. The permissible limit of nitrate above the standard drinking water as per IS: 10500, 2012 is observed in Belakud, Eksamba, Rupnal and Saundalaga.

Table-8: Quality of ground water (Aquifer-I) in Chikkodi Taluk of Belagavi district

SI.NO	LOCATION	PH	EC	TH	CA	MG	NA	K	CO3	HCO3	CL	SO4	NO3	F
1	BELAKUD	7.81	3920	1310	336	114	299	6	0	67	773	672	137	1.70
2	GALATGA	8.40	1023	420	88	49	45	1	6	49	213	58	35	0.53
3	EKSAMBA	8.50	2500	480	76	70	357	17	18	110	432	432	137	0.98
4	KABBUR	8.10	729	150	24	22	92	4	0	275	60	29	35	1.80
5	NIPPANI	8.80	998	150	4	34	156	2	48	183	142	27	4	1.00
6	RUPNAL	8.80	638	190	4	44	46	20	36	140	64	38	137	0.85
7	SADALGA	8.99	434	130	40	7	41	1	12	73	43	62	35	0.68
8	SAUNDALAGA	8.70	479	130	28	15	46	1	12	73	71	34	137	0.98

3.3 Ground Water Resource Enhancement

3.3.1 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-9**). 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 (**Fig 12**).

Table-9: Quantity of non-committed surface runoff & expected recharge through AR structures (As per Master Plan of Artificial Recharge in Karnataka and Goa,2020)

Artificial Recharge Structures Proposed	Chikkodi Taluk
Non committed monsoon runoff available (MCM)	254.368
Number of Check Dams	1317
Number of Percolation Tanks	229
Number of Subsurface dykes	7
Tentative total cost of the project (Rs. in lakhs)	17880.548
Excepted recharge (MCM)	190.776
Cost Benefit Ratio (Rupees/ cu.m. of water harvested)	9.37

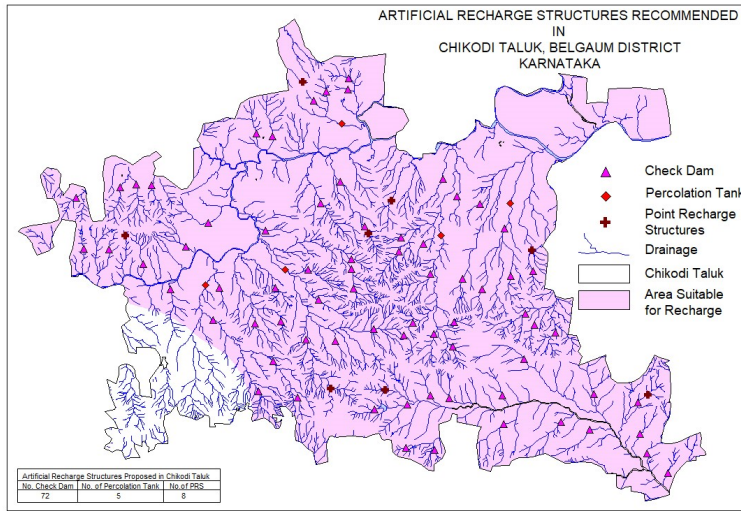


Fig 12 -: Feasible area for AR Structures

Table-10 Improvement in GW availability due to Recharge, Chikkodi 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	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	%	%
Chikkodi	19603	13033	66	19077.6	33.69	32.31

3.3.2 Regulation and Control

- Chikkodi Taluk has been categorized as **Safe**, since the Stage of ground water development is **66%** (GEC March 2017). So proper action has to be taken up through Karnataka Ground Water Authority to manage/control further ground water exploitation in the Taluk.
- Ground water recharge component needs to be made mandatory in the non-command area of the Taluk for further development of ground water.

3.3.4 Other interventions proposed

- Periodical maintenance of artificial recharge structures should also be incorporated in the Recharge Plan.
- Excess nitrate & fluoride concentration is found in ground water samples require remedial measures viz.
 - Dilution of nitrate rich ground water through artificial recharge & water conservation.
 - Roof top rain water harvesting.

4 Summary

The summary of Management plan of Chikkodi Taluk is given in **Table-10**.

Table-10: Summary of Management plan of Chikkodi Taluk

Chikkodi Taluk is safe & present stage of GW Development (2017)	66%
Net Annual Ground Water Availability (MCM)	196.03
Existing Gross Ground Water Draft for all uses	130.33
Total GW Resources (Dynamic & Static upto the depth of 200 mbgl) (MCM)	239.10
Expected additional recharge from monsoon surplus runoff (MCM)	190.776
Change in Stage of GW development, %	66 to 33.69
Excess nitrate & fluoride concentration	<ul style="list-style-type: none">• Dilution of nitrate rich ground water through artificial recharge & water conservation.• Roof top rain water harvesting.

