



## केंद्रीय भूमि जल बोर्ड

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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**

**KALGHATGI TALUK, DHARWAD  
DISTRICT, KARNATAKA**

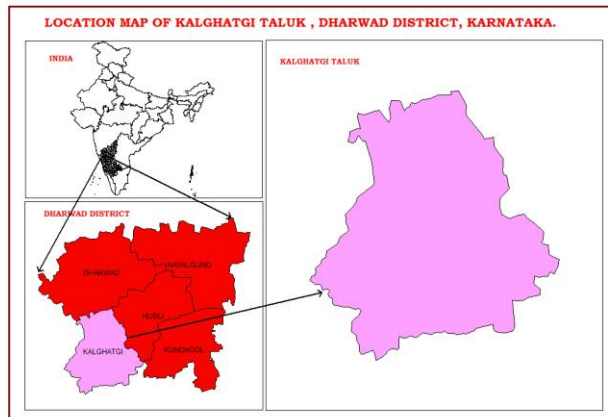
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**GOVERNMENT OF INDIA  
MINISTRY OF JAL SHAKTI  
DEPT. OF WATER RESOURCES, RD & GR  
CENTRAL GROUND WATER BOARD**

## **AQUIFER MANAGEMENT PLAN OF KALGHATGI TALUK, DHARWAD DISTRICT, KARNATAKA STATE**



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# **AQUIFER MANAGEMENT PLAN OF KALGHATGI TALUK, DHARWAD DISTRICT, KARNATAKA STATE**

## **1.0 SALIENT INFORMATION**

Name of the taluk: Kalghatgi

District: Dharwad

State: Karnataka

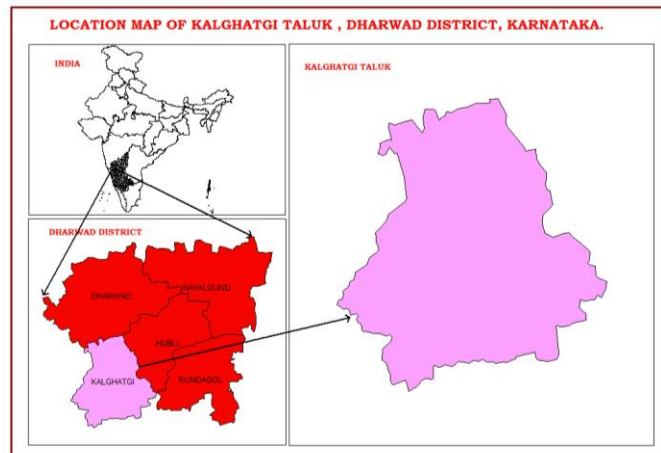
Area: 691 sq.km.

Population: 3,96,166

Annual Normal Rainfall: 889 mm

### **1.1 Aquifer management study area**

Aquifer mapping studies was carried out in Kalghatgi Taluk, Dharwad District of Karnataka, covering an area of 691 sq.kms under National Aquifer Mapping Project. Kalghatgi Taluk of Dharwad district is located between north latitude 15° 02' 15.66" and 15° 21' 38.70" & east longitude 74° 49' 43.53" and 75° 08' 19.69" and is covered in parts of Survey of India Topo sheet Nos. 48L/15, 48 L/16, 48 M/3& 48 M/4. Kalghatgi Taluk is bounded by Dharwad, Haliyal, Hubli, Yellapur and Mundgod taluks. Location map of Kalghatgi Taluk of Dharwad district is presented in **Fig. 1**.



**Fig.1: Location Map of Kalghatgi Taluk, Dharwad District**

Taluk administration of Kalghatgi Taluk is divided into 5 Hoblies namely Kasba, Kattaya, Salegama, Shantigrama and Dudda. Kalghatgi town is also the taluk head quarter for Dharwad district. There are 368 inhabited and 26 uninhabited villages in the taluk.

## 1.2 Population

According to 2011 census, the population in the taluk is 3,96,166, in which 2,18,682 constitute the rural population and 1,77,484 urban population, which works out to 55% (rural) and 45% (urban) of the total population of taluk. The study area has an overall population density of 573 persons per sq.km. The decadal variation in population from 2001-2011 is 9.7%.

## 1.3 Rainfall

Kalghatgi taluk enjoys semi-arid climate. Dryness and hot weather prevails in major part of the year. The area falls under Southern dry agro-climatic zone of Karnataka state and is categorized as drought prone. The normal annual rainfall in Kalghatgi taluk for the period 1981 to 2010 is 889 mm. Seasonal rainfall pattern indicates that, major amount of (490 mm) rainfall was recorded during South-West Monsoon seasons, which contributes about 55% of the annual normal rainfall, followed by North-East Monsoon season (221 mm) constituting 25% and remaining (178 mm) 20% in Pre-Monsoon season (**Table 1**).

On Computations were carried out for the 30 year blocks of 1981-2010, the mean monthly rainfall at Kalghatgi taluk is ranging between 2 mm during January to 168 mm during October. The coefficient of variation percent for pre-monsoon, monsoon and post-monsoon season is 177, 264 & 202 percent respectively. Annual CV at this station works out to be 318 percent (**Table 1**).

**Table 1: Statistical Analysis of Rainfall Data of Kalghatgi Taluk, Dharwad district (1981 to 2010)**

STATION		JAN	FEB	MAR	APR	MAY	PRE	JUN	JUL	AUG	SEP	SW	OCT	NOV	DEC	NE	Annual
Kalghatgi	NRM	2	3	22	59	92	178	112	128	118	133	490	168	44	8	221	889
	ST DEV	4	11	45	49	55	100	67	73	68	84	186	99	55	14	109	280
	CV%	38	29	50	120	168	177	167	175	175	158	264	171	82	55	202	318

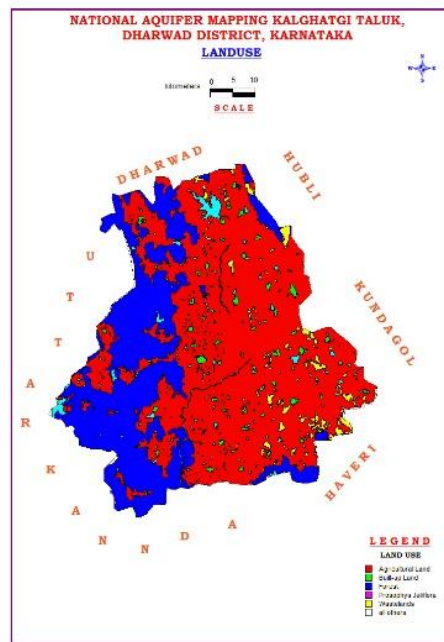
## 1.4 Agriculture & Irrigation

Agriculture is the main occupation in Kalghatgi taluk. Major Kharif crops are paddy, maize, ragi, tur and vegetables. Main crops of Rabi season are maize, ragi, horse gram, vegetables, groundnut, and sunflower (**Table 2**). Water intensive crops paddy and sugarcane are grown in 4% of total crop area. Maize is grown in 45%, ragi in 14%, vegetables in 29% and pulses in 4% of total crop area of taluk.

**Table 2: Cropping pattern in Kalghatgi Taluk 2014-2015 (Ha)**

Year	Paddy	Maize	Ragi	Jowar	Pulses	Fruits	Vegetables	Oil seeds	Sugarcane	Cotton
	Area under cultivation (in ha)									
2014 -15	1936	23420	7583	20	1943	1253	15460	532	316	2

It is observed that the net sown area accounts 52% and area sown more than once is 17% of total geographical area in Kalghatgi Taluk (**Table 3**). Area not available for cultivation and Forest cover 32% & 4% of total geographical area respectively. 79% of net area irrigated is only from bore wells and 21% from tank irrigation (**Table 4**). Land use Land cover Map at **Fig.2**.



**Fig. 2: Land use & Land cover Map of Kalghatgi Taluk, Dharwad district**

**Table-3: Details of land use in Kalghatgi 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
Kalghatgi	91818	3677	29117	91881	48187	15839

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

**Table-4: Irrigation details in Kalghatgi Taluk (in ha)**

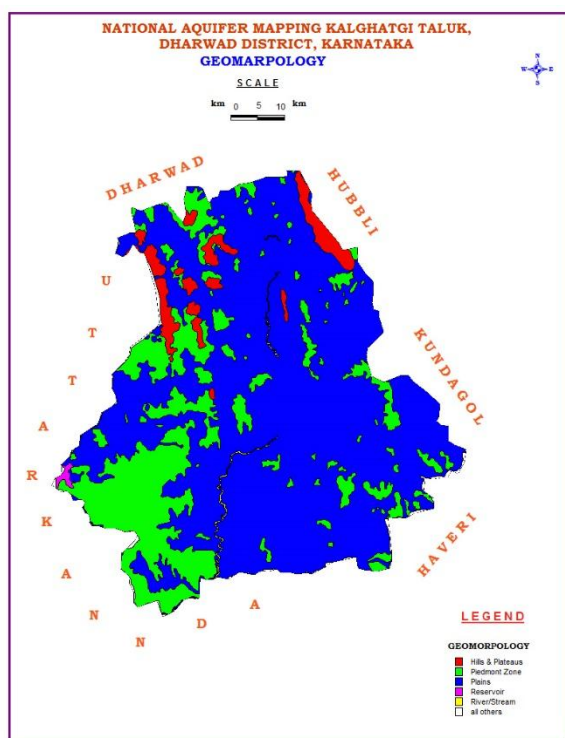
Source of Irrigation	Net area irrigated (Ha.)	% of area
Canals	11012	50
Tanks	6989	32
Wells	308	2
Bore wells	3597	16
Lift Irrigation	0	0
Other Sources	0	0
<b>Total</b>	<b>21906</b>	<b>100</b>

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

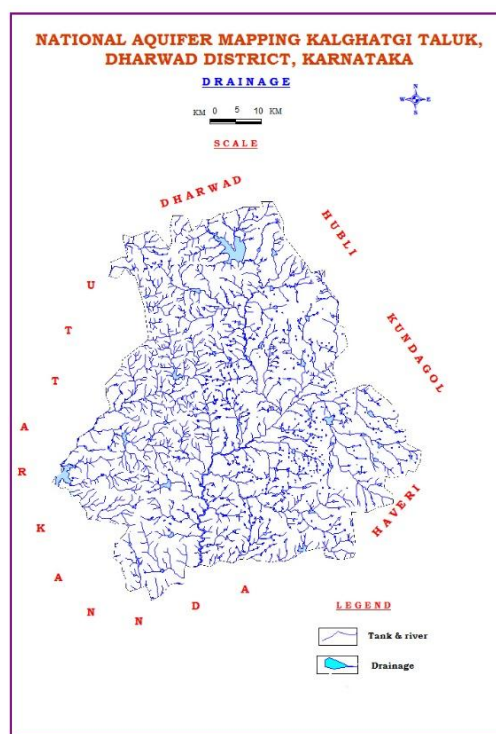
### 1.5 Geomorphology, Physiography & Drainage

The general land elevation on the southern side of the taluk is about 860 m amsl and increases to 1000 m amsl in the north. The general slope is mostly towards NW to SE. Isolated hillock at Sigegudda has an elevation of 1285 m amsl (**Fig. 3**).

The taluk is drained by 1<sup>st</sup> to 4<sup>th</sup> order streams which flow towards south and west wards. The southern boundary of the taluk is coinciding with the Hemavathi River. The tank system is well developed in the taluk. The general drainage pattern is dendritic to sub-dendritic in nature and mostly joins Hemavathi River (**Fig.4**).



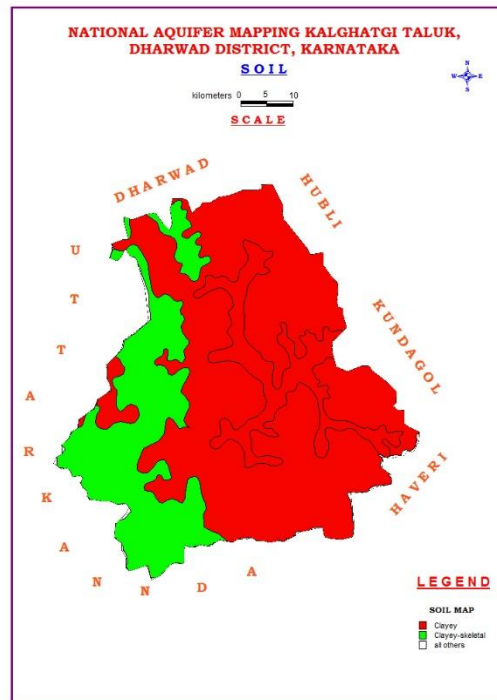
**Fig. 3: Geomorphology Map**



**Fig. 4: Drainage Map**

## 1.6 Soil

In general the taluk is covered by red soil. Patches of black cotton soil are also found at places. The red soil in general derives from granite gneisses. Black cotton soil are derived from schist and alluvial soil found in limited extent and confined to river/nala courses. Soil Map is given as **Fig. 5**.



**Fig. 5: Soil Map of Kalghatgi Taluk**

## 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 Ground Water Resources (2013) (Ham)**

Taluk	Annual replenishable GW resources	Fresh In-storage GW resources		Total availability of fresh GW resources
		Phreatic	Fractured (Down to 200m)	Dynamic + phreatic in-storage + fractured
Kalghatgi	16372	18725	1863	36960

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

- Net ground water availability for future irrigation development : 99.62 MCM
- Domestic (Industrial sector) demand for next 25 years : 10.74 MCM



## 1.9 Water level behavior

### (a) Depth to water level

#### Aquifer - I

- Pre-monsoon: 1.60 – 17.16 mbgl (Fig.-6)
- Post-monsoon: 1.88 – 11.45 mbgl (Fig.-7)

#### Aquifer - II

- Pre-monsoon: 5.96 – 21.81 mbgl
- Post-monsoon: 4.40 – 21.56 mbgl

### (b) Water level fluctuation

#### Aquifer-I

- Seasonal Fluctuation: Rise ranges 0.28 – 3.25 m;  
Fall ranges 0.89 – 12.82 m

#### Aquifer-II

- Seasonal Fluctuation: Rise shows 1.18 m;

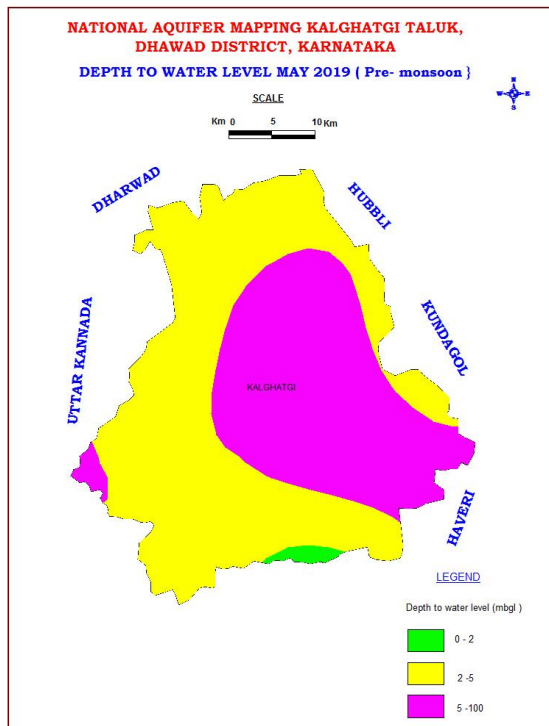


Fig. 6: Pre monsoon DWL(Aquifer 1)

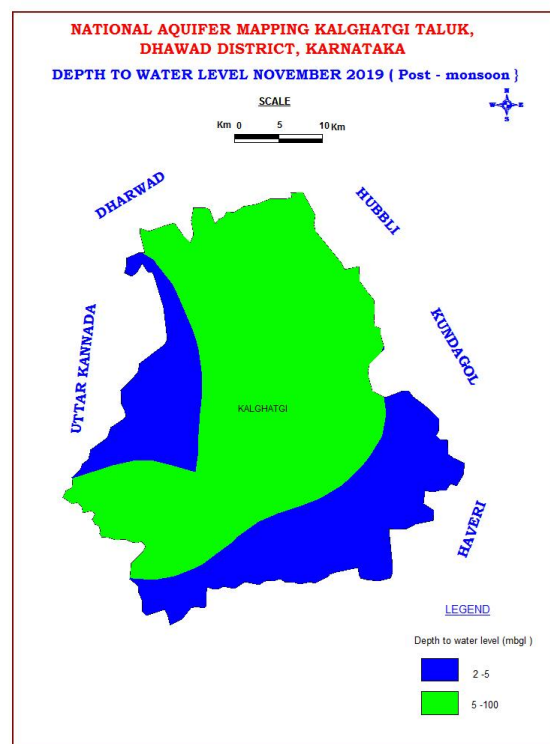


Fig. 7: Post monsoon DWL(Aquifer 1)

## 2.0 AQUIFER DISPOSITION

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

i. **Aquifer-I (Phreatic aquifer)** comprising Weathered Graine Gneiss / Schist

ii. **Aquifer-II (Fractured aquifer)** comprising Fractured Graine Gneiss / Schist

In Kalghatgi Taluk, granitic-gneisses & schist are the main water bearing formations (**Figure 8**). Ground water occurs within the weathered and fractured granitic-gneisses & schist under water table condition and semi-confined condition. In Kalghatgi Taluk bore wells were drilled to a minimum depth of 124 mbgl to a maximum of 200 mbgl (**Table-6**). Depth of weathered zone (Aquifer-I) ranges from 22.5 mbgl to 49.5 mbgl (Figure-9).

Ground water exploration reveals that aquifer-II fractured formation was encountered between the depths of 30 to 200 mbgl. Yield ranges from 0.08 to 16.0 lps. Transmissivity ranges from 11 to 577 m<sup>2</sup>/day. The basic characteristics of each aquifer are summarized in **Table-7**.

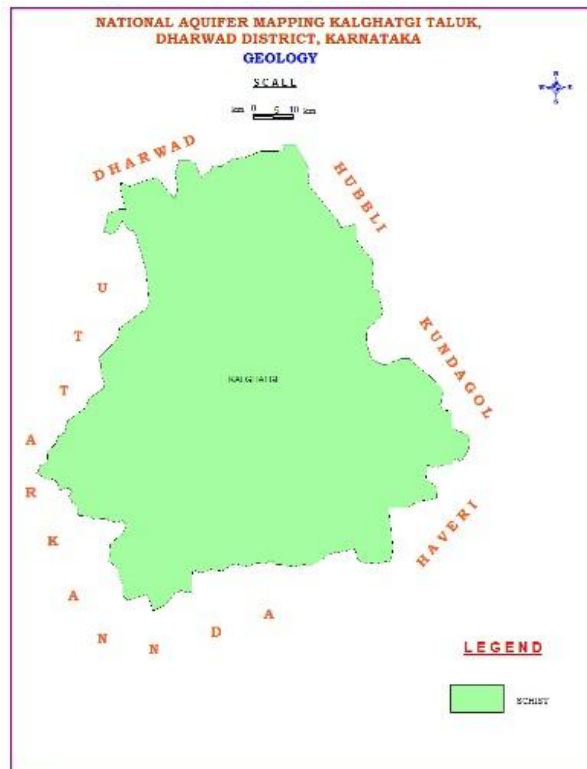


Fig-12: Geology Map

**Table 6: Details of Ground Water Exploration**

S. No	Location	Latitude	Longitude	Depth Drilled (mbgl)	Casing Depth (m)	Fracture Zones	SWL (mbgl)	Q (lps)	DD (m)	T (m <sup>2</sup> /day)
1	Anugavalli	13°6'40"	76°11'40"	124	33.5	53 - 54, 62 - 63, 70 - 71, 85 - 86	5.96	16	2.54	262.0
2	Anugavalli OW	13°6'40"	76°11'41"	124	30	32 - 33, 68 - 69, 104 - 105, 122 - 123	7.87	13.8	2.28	154.0
3	Bailahalli	13°3'4"	75°59'20"	166	25.8	90 - 91, 114 - 115, 136 - 137, 145 - 146	14.78	2.73	15.18	29.0
4	Bailahalli OW	13°3'4"	75°59'21"	126	22.5	37 - 38, 107 - 108, 120 - 121	8.47	8.82	17.55	19.0
5	Kalghatgi	13°0'45"	76°7'20"	162	26	27 - 28, 59 - 60, 68 - 69	10.08	13.8	1.13	577.0
6	Kalghatgi OW	13°0'46"	76°7'21"	200	31.5	93 - 94	8.81	0.08	-	14.0
7	Sommanahalli	13°5'23"	76°7'22"	178	49.5	72 - 73, 99 - 100, 106 - 107, 125 - 126	18.91	9.9	9.14	21.1
8	Sommanahalli OW	13°5'24"	76°7'22"	200	44.76	83 - 84, 87 - 88, 100 - 101, 137 - 138, 199 - 200	19.52	3.28	7.32	44.2
9	Duddanayakanahalli	12°54'45"	76°2'50"	200.2	31.5	80 - 81, 160 - 161, 199 - 200	4.4	0.21	-	11.0
10	Karakere EW	12°58'25"	76°15'35"	200		66, 158, 160	16.7			
11	Karakere OW	12°58'25"	76°15'35"	200		23, 27, 47, 120, 129, 180	15.82			

**Table 7: Basic characteristics of each aquifer**

Aquifers	Weathered Zone (Aq.-I)	Fractured Zone (Aq.-II)
Prominent Lithology	Weathered Gneiss / Schist	Fractured / Jointed Gneiss / Schist
Thickness range (mbgl)	30	Fractures up to 200 mbgl
Depth range of occurrence of fractures (mbgl)	-	32 - 200 80% between 50 - 200
Range of yield potential (lps)	Poor yield	1 - 10
Specific Yield	2%	0.2%
T (m <sup>2</sup> /day)	-	11 – 262
Quality Suitability for Irrigation	Suitable	Suitable
Suitability for Domestic purposes	Suitable	Suitable
Remarks	Safe	Ground water potential fractures, 1 to 3 sets likely up to the depth of 200 m bgl.

### 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
	ham	ham	ham	ham	ham	ham	%	
Kalghatgi	3212	2290	120	2410	129	793	75	SEMICRITICAL

##### (b) Present total Ground Water Resource (in ham) 2017

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
Kalghatgi	3212	25952	2328	31492

##### (c) Comparison of ground water availability and draft scenario in Kalghatgi 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
	2011			2013			2017		
Kalghatgi	16808	6730	40%	16372	6862	42%	3212	2410	75%

### 3.2 Chemical quality of ground water and contamination

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

**Electrical conductivity:** In general, EC values in Aq-I range from 330 to 1700  $\mu$ /mhos/cm at 25°C which are within the permissible limit in both the aquifers. In Aquifer-II, EC value ranges from 580 to 730  $\mu$ /mhos/cm at 25°C. The map showing the Electrical conductivity in Kalghatgi Taluk is shown in **Fig.13 a**.

**Fluoride:** Fluoride concentration in ground water is of geogenic origin in areas underlain by younger granites/ gneisses containing minerals like Fluorspar & fluoroapatite. F value ranges between 0.23 - 1.011mg/l which are within the permissible limit of 1.5 mg/l.

**Nitrate:** Of the 15 samples analyzed, 6 samples are collected from phreatic aquifers and remaining 9 are from fractured aquifers. The two dug wells belonging to phreatic aquifers shows Nitrate contamination above permissible limit of 45 mg/l (i.e. 49 mg/l – Haragowdanahalli and 60 mg/l – Shantigrama) and the remaining dug wells Nitrate value ranges between 27 to 41 mg/l. In the fractured aquifer out of 9 samples analyzed one sample indicate nitrate greater than the permissible limit of 45 mg/l (Anachialli – 51 mg/l) remaining 8 samples nitrate value ranges between 3 -7 mg/l. The map showing the nitrate concentration in Kalghatgi Taluk is shown in **Figure.13 b**.

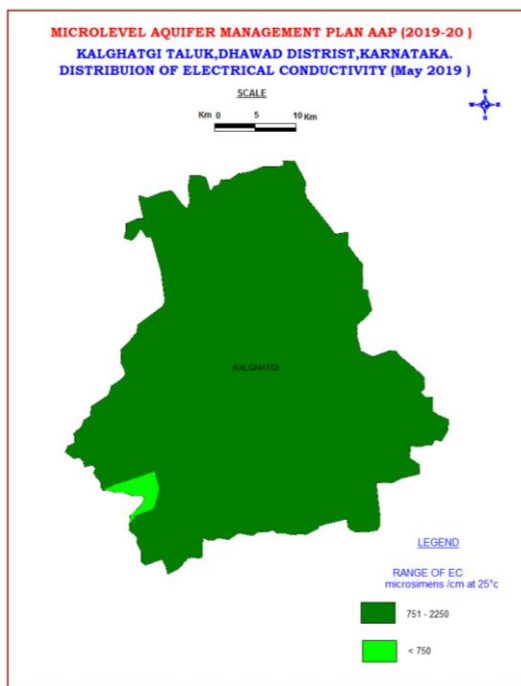


Fig.13 a. Distribution of EC

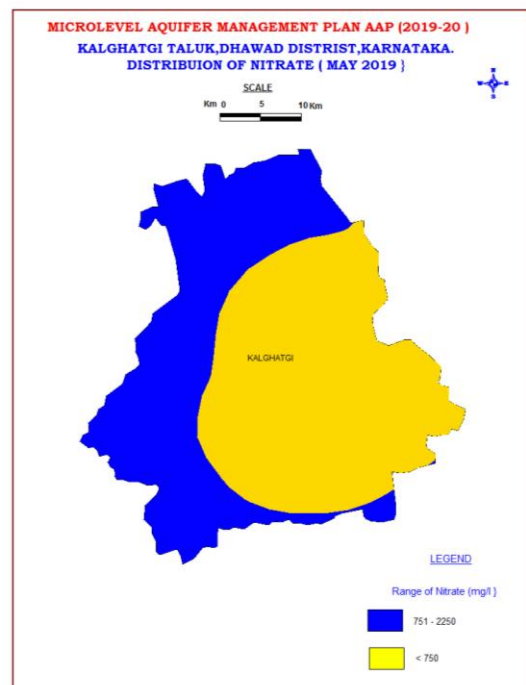


Fig.13 b. Distribution of Nitrate

In general ground water quality in Kalghatgi Taluk is good for drinking purpose except in some areas, where nitrate is found to be greater than the permissible limit as per “Indian Standard Drinking Water Specification 2009”. Ground water samples have also been tested and found suitable for agriculture & irrigation purposes.

#### 4.0 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 & expected recharge through AR structures**

Artificial Recharge Structures Proposed	Kalghatgi Taluk
Non committed monsoon runoff available (MCM)	21.40
Number of Check Dams	132
Number of Percolation Tanks	9
Number of Point Recharge structures	14
Tentative total cost of the project (Rs. in lakhs)	514.98
Expected recharge (MCM)	12.10
Expected rise in water level (m)	0.65
Cost Benefit Ratio (Rupees/ cu.m. of water harvested)	4.26

##### 4.2 Improvement in GW availability due to Recharge, Kalghatgi 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	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	%	%
KALGHATGI	3212	2410	75	1210	4422	54	20

#### 5.0 DEMAND SIDE INTERVENTIONS

##### 5.1 Advanced irrigation practices

It is observed that ground water through wells & bore wells contribute only 18% of the source for irrigation in Kalghatgi Taluk. Balance 82% irrigation is from surface water from canals & tanks. Also, water intensive crops paddy and sugarcane are grown in less than

5% of total crop area from surface water source. Present stage of ground water development is 75% (GEC 2017). Thus, efficient irrigation practices are not suggested in the taluk. Further, change in cropping pattern is also not recommended.

## 5.2 Water Logging and additional area of irrigation

Area prone for water logging (2-5 m pre-monsoon water level contour) is estimated (Table-9). In these areas, quantum of withdrawal of ground water is calculated considering specific yield of 2% and water column to be reduced to 5 mbgl. The volume of ground water withdrawn in Kalghatgi taluk is 756 ham (0.267 TMC). Additional area of crop can be irrigated using 75% of irrigation efficiency is calculated on the basis of recommendation of University of Agriculture Science, Bangalore. Accordingly, since maize and vegetables are grown in 73% of total crop area of taluk, it is suggested that additional area of 1134 ha can be irrigated for Maize or Vegetables or 1890 ha for Jowar crops (Table-9).

**Table-9: Withdrawal of Ground Water and Increase in area of Irrigation in Kalghatgi Taluk**

Water Level Range (mbgl)	Water Level to be reduced to (mbgl)	Water Column (m)	Area (Ha)	Specific Yield	Volume of Ground Water to be withdrawn		Area of crop can be irrigated using 75% of Irrigation Efficiency (Ha)		
					(Ham)	(TMC)	Maize	Jowar	Vegetables
0 - 2	5	4	0	0.02	0	0.000	0	0	0
2 - 5	5	3	12600	0.02	756	0.267	1134	1890	1134
<b>Total</b>					<b>756</b>	<b>0.267</b>	<b>1134</b>	<b>1890</b>	<b>1134</b>

## 5.3 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.
  - Micro irrigation.