केन्द्रीय भूमिजल बोर्ड

जल शक्ति मंत्रालय, जल संसाधन, नदी विकास और गंगा संरक्षण विभाग

भारत सरकार

Central Ground Water Board

Ministry of Jal Shakti,
Department of Water Resources, River Development
and Ganga Rejuvenation
Government of India

Report on

AQUIFER MAPPING AND MANAGEMENT PLAN

Heggadadevanakote Taluk, Mysore District, Karnataka

दक्षिण पश्चिमी क्षेत्र, बेंगलुरु

South Western Region, Bengaluru

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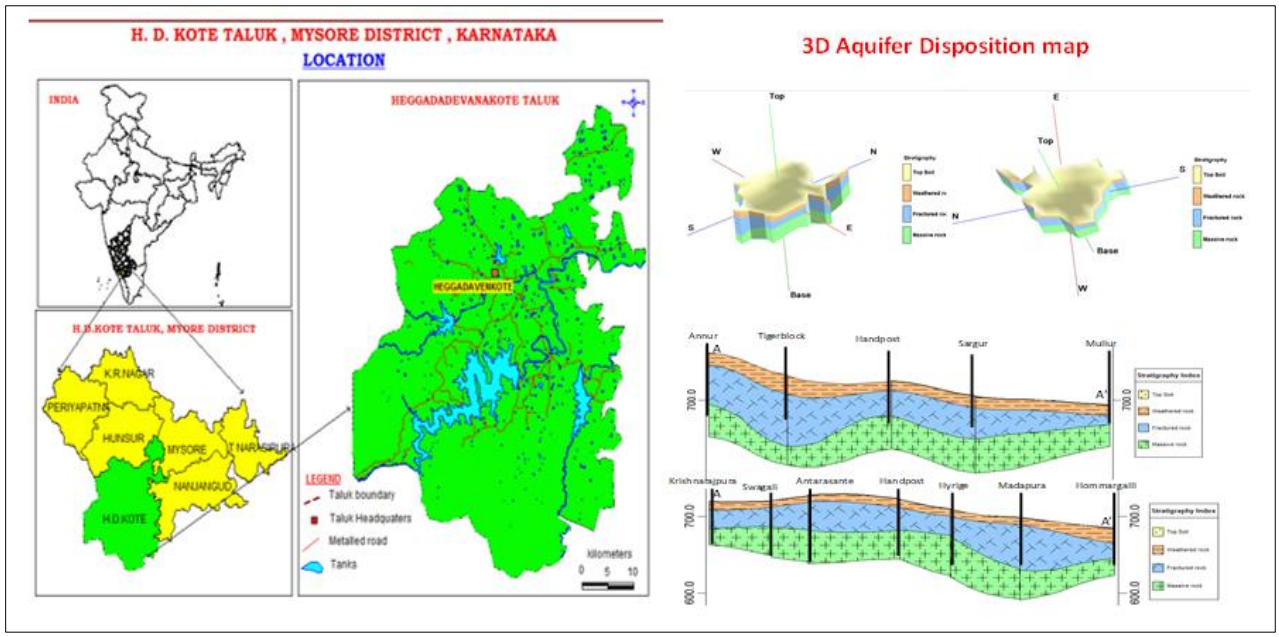
Bengaluru

AQUIFER MAPS AND MANAGEMENT PLAN, HEGGADADEVANAKOTE TALUK, MYSORE DISTRICT, KARNATAKA STATE

(AAP – 2021-2022)



By

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AUGUST-2022

AQUIFER MAPS AND MANAGEMENT PLAN, HEGGADADEVANAKOTE TALUK, MYSORE DISTRICT, KARNATAKA STATE

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AQUIFER MAPS AND MANAGEMENT PLAN, **HEGGADADEVANAKOTE** TALUK, **MYSORE** DISTRICT, KARNATAKA STATE

1 SALIENT INFORMATION

Name of the taluk	: Heggadadevanakote
District	: Mysore
State	: Karnataka
Area	: 981 sq.km.
Population (Census 2011)	: 2,82,963
Normal annual Rainfall	: 853 mm

1.1 Study Area

Aquifer Mapping Studies have been carried out in Heggadadevanakote taluk, Mysore district of Karnataka, covering an area of 1618 sq.kms under National Aquifer Mapping Project. The Heggadadevanakote taluk is located between North Latitudes 12°10'52.27'' and 11°44'14.43" and East Longitudes between 76° 29' 11.8" to 76°6'50.29". The taluk is covered in parts of Survey of India Toposheet Nos 49M/13, 58A/1,58A/5, 58A/6, 57D/4 and 57D/8. The study area is bounded on the East by Nanjangud taluk, on the North by Hunsur Taluk of Mysore district, on the South by Chamarajanagar district and Kerala state, on the West by Kodagu district. Heggadadevanakote is taluk headquarter. Taluk administration of Heggadedevankote is divided into 5 Hoblies and 39 grampanchayats. There are 281 villages present in this taluk. Location map of Heggadadevanakote taluk of Mysore district is presented in **Fig-1.**

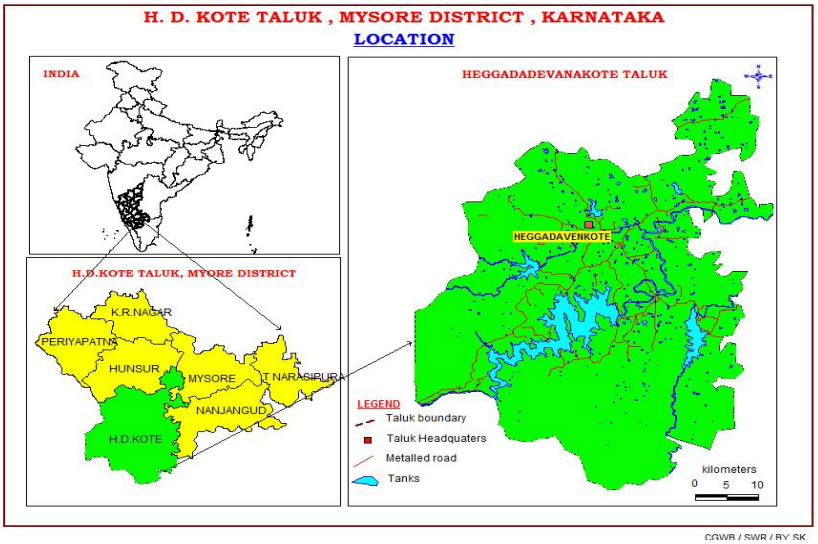


Fig-1: Location map of Heggadadevanakote taluk of Mysore district

1.2 Population

According to 2011 census, the population in Heggadadevanakote taluk is 2,63,706, in which 2,37,968 constitute the rural population and 25,738 is the urban population. The taluk has an overall population density of 163 persons per sq.km. The decadal variation in population from 2001-2011 is 7.22% in Heggadadevankote taluk. The Population details are given in **table-1.**

Table-1: Population details

Total	Male	Female	%Share of the district Population	Rural Population	Urban Population	Decadal change in Population	Decadal change in rural Population	Decadal change in urban Population
263706	132748	130958	8.79	237968	25738	7.22	1.74	113.68

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

1.3 Rainfall and Climate

Heggadadevanakote taluk enjoys semi-arid climate. The area falls under Southern Dry Agro-climatic zone of Karnataka state.The normal annual rainfall in Heggadadevanakote taluk for the period **1990 to 2019** is 853 mm. Seasonal rainfall pattern indicates that, major amount of (427mm) rainfall was recorded during South-West Monsoon seasons, which contributes about 50.05% of the annual normal rainfall, followed by Pre-Monsoon Monsoon season (223 mm) constituting 26.14% and remaining (203mm) 23.79% in North-East Monsoon season . The coefficient of variation percent for pre-monsoon, monsoon and post-monsoon season is 41, 36&42 percent respectively. Annual Co-efficient Variation at this station works out to be 26percent **(Table-2A).**

Table-2A: Statistical Analysis of Rainfall Data Heggadadevanakote taluk, (1990 to 2019)

Stataion Heggadadevanakote	JAN	FEB	MAR	APR	MAY	PRE	JUN	JUL	AUG	SEP	SW	OCT	NOV	DEC	NE	ANNUAL
NRM	3	6	18	85	110	223	97	123	110	96	427	136	55	12	203	853
STDEV	8	12	26	60	55	91	54	63	99	58	152	82	52	22	86	223
CV%	246	190	144	70	50	41	56	51	90	61	36	60	95	178	42	26

Source: Directorate of Economic and Statistics

The annual rainfall data from 2009 to 2019 of the Heggadadevanakote taluk is given in **Table 2B** and Monthly rainfall data of Heggadadevanakote taluk is in **Table 2C**. The Monthly rainfall analysis for the period from 2009 to 2019 is shown in **Fig. 2**

Table-2B Actual Annual Rainfall of Heggadadevanakote taluk from 2009 to 2019

Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Rainfall(mm)	981	1110	1119	624	479	962.6	849	414	866	1137	1262

Table 2C : Monthly rainfall data ofHeggadadevanakotetaluk

Year	JAN	FEB	MAR	APR	MAY	PRE	JUN	JUL	AUG	SEPT	SWM	OCT	NOV	DEC	NEM	ANNUAL
2009	0	0	85	91	97	273	56	258	88	145	547	23	108	30	161	981
2010	21	14	0	255	107	397	117	126	92	59	394	186	133	0.0	319	1110
2011	0	2	47	182	125	356	78	96	68	88	330	280	153	0	433	1119
2012	0	0	0	150	123	273	33	42	67	93	235	81	35	0	116	624
2013	0	6	14	108	0	128	33	42	67	93	235	81	35	0	116	479
2014	3.4	0	20	68.2	181	272.6	57	154	132	131	474	149	0	67	216	962.6
2015	0	0	17	61	118	196	222	27	113	96	458	50	145	0	195	849
2016	0	0	12	31	70	113	133	101	19	12	265	17	3	16	36	414
2017	0	0	0	60	195	255	50	54	116	257	477	81	5	48	134	866
2018	0	7	70	65	200	342	153	163	191	58	565	216	14	0	230	1137
2019	0	38	10	51.6	129.4	229	47	133	565	117	862	106	52	13	171	1262

(**Source:** Directorate of Economic and Statistics)

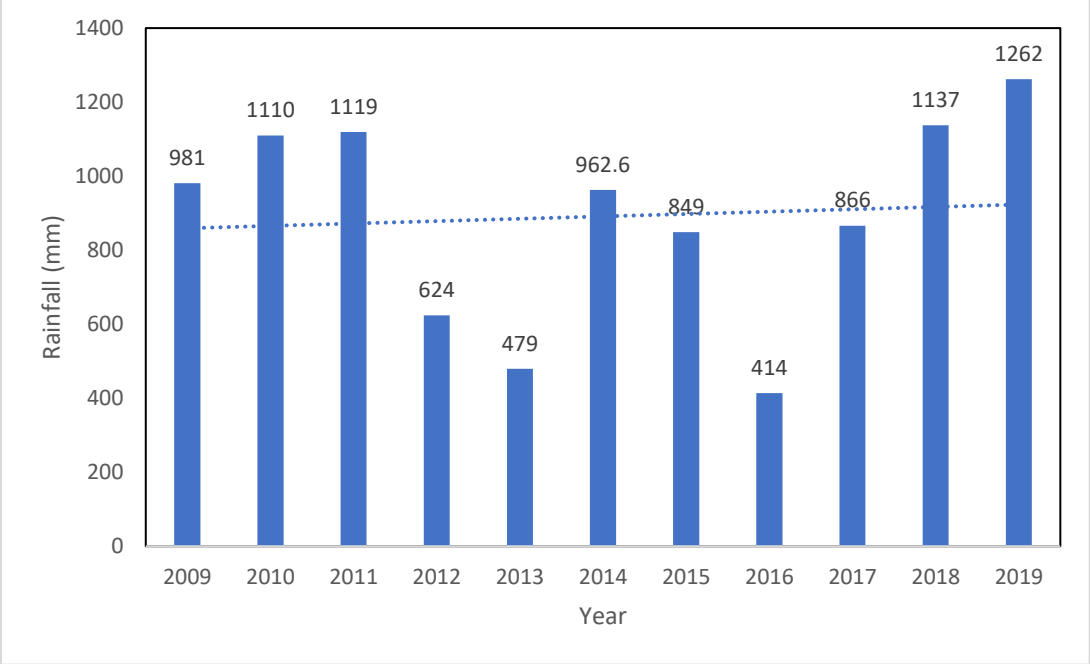


Fig. 2: Rainfall Trend Analysis

1.4 Agriculture & Irrigation

Agriculture is the main occupation in Heggadadevanakote taluk. Major Kharif crops are Paddy, Maize, ragi and Vegetables. Important crops of Rabi season are maize, vegetable and oilseeds. Water intensive crops like Paddy, Sugar cane and Tobacco are grown in Heggadadevanakote Taluk **Table -3A.**

Table-3A: Cropping pattern in HEGGADADEVANAKOTE taluk 2016-2017 (Ha)

Crop	Paddy	Ragi	Maize	Pulses	Sugarcane	Tobacco	Oil seeds	Cotton	Fruits	Vegetables
Area(ha)	1067	3141	12515	10070	1157	3150	745	26910	2250	865

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

About 17 % of the Geographical area is covered by forest. It is observed that net sown area accounts 30 % and area sown more than once is 5% of total geographical area in Heggadadevanakote taluk . Area not available for cultivation, the other uncultivable land and Fallow land cover 19 %, 23% and 25% respectively of total geographical area. About 26% of net area irrigated is only from Groundwater (wells and Bore wells). About 74 % of net area is irrigated from Surface water (Canals and Tanks). The major source of irrigation is surface water. The details of land use and details of irrigation are given in **(Table-3B)** and **(Table-3C)** respectively. The land use pattern is given in **(Fig-4).**

Table-3B: Details of land use in HEGGADADEVANAKOTE taluk 2016-2017 (Ha)

Taluk	Total Geographical Area	Area under Forest	Area not available for cultivation	Other Uncultivable land	Fallow land	Net sown area	Area sown more than once	Gross sown area
HEGGADADEVANAKOTE	194138	33031	37370	45251	49198	57822	9937	67759
% of the area	-	17	19	23	25	30	5	35

Source: District at a glance 2016-2017

Table-3C: Irrigation details in Heggadadevanakote taluk (in ha)

Source of Irrigation	Length in Km/No of structures	Gross area Irrigated (Ha)	Net area Irrigated (Ha.)	% of area
Canals	188.8	1150	1100	67
Tanks	59	110	110	7
Wells	2	240	230	14
Bore wells/ Tube wells	3560	239	190	10
Lift Irrigation	-	0	0	-
Other Sources	-	0	0	-
Total			1630	100

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

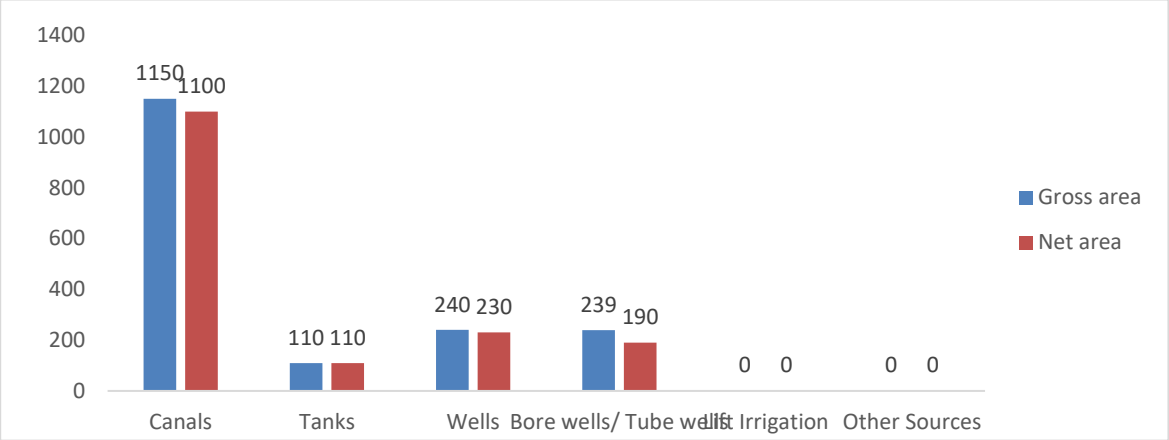


Fig. 3: Sources of Irrigation

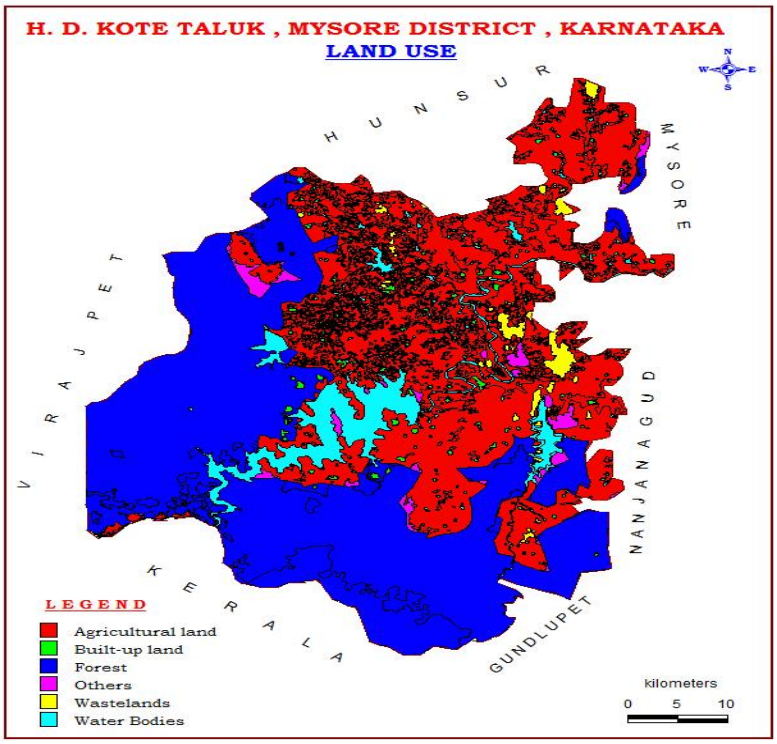


Fig 4: Land use Map

1.5 Geomorphology, Physiography & Drainage

The geomorphology of the Heggadadevanakote taluk is formed by hilly area in Southern part and plain region in central and northern parts of the taluk. The elevation in the taluk varies from 973 m in the Southern part to 721m amsl in the Northern part of the taluk. The differential altitude is significant because, it is likely to cause irregular ground water flow patterns on the micro scale **(Fig.-5).** Topography is dominantly controlled by geological structures. The entire Heggadadevanakote taluk falls in cauvery Krishna river basin. The drainage system is well developed in the taluk. The Drainage pattern is dendritic to subdendritic **(Fig.-6).**

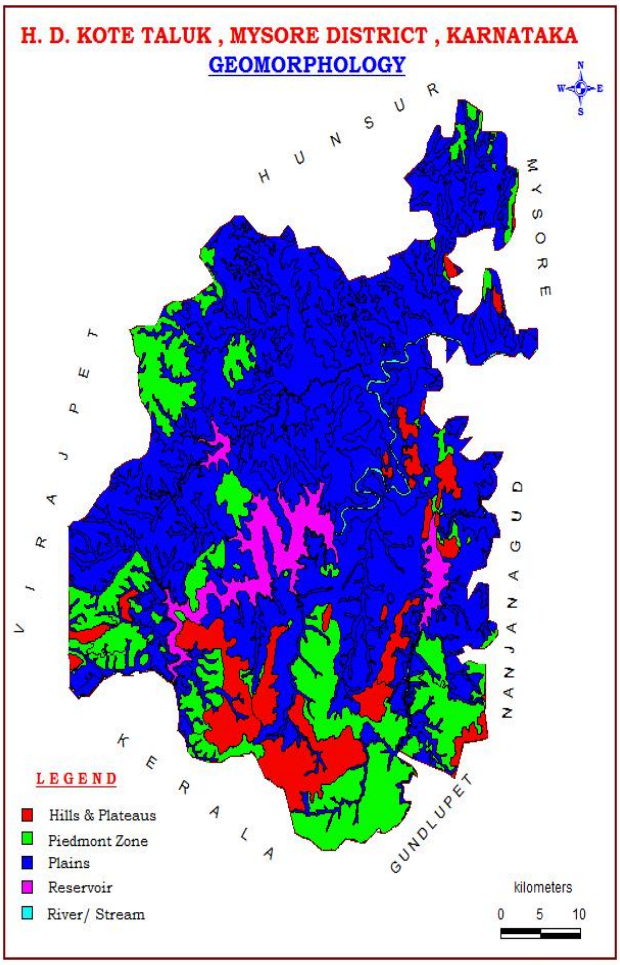


Fig-5: GeoMorphology Map

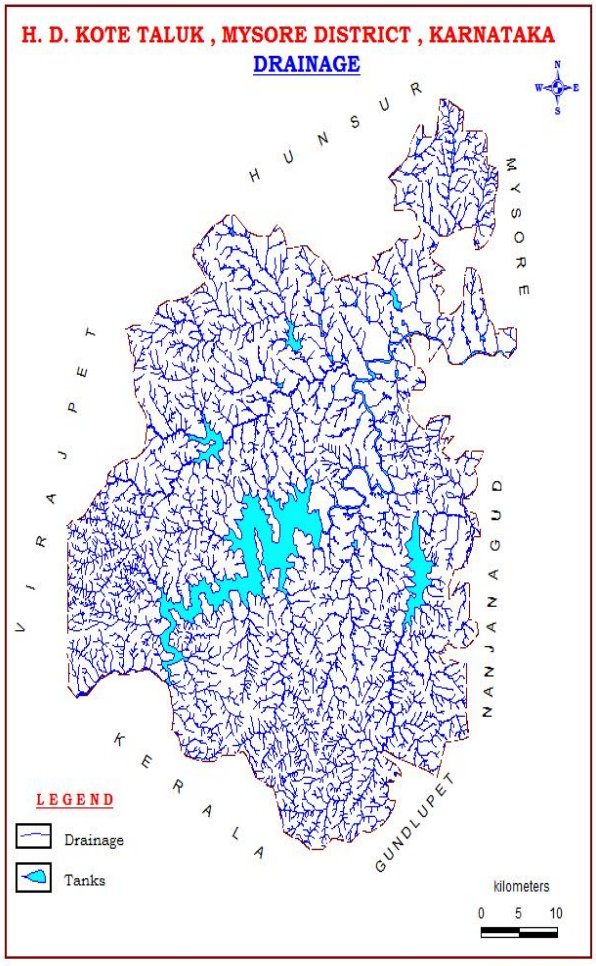


Fig-6: Drainage Map

1.6 Soil

The soils of Heggadadevanakote taluk can broadly be classified into Clayey soils, Clayey Skeletal soils, Clayey mixed and Rocky soils. These soils vary in depth and texture, depending on the parent rock type, physiographic settings and climatic conditions **(Fig-7).**

Geologically, the taluk is mainly composed of metamorphic rocks of Pre-Cambrian age either exposed at the surface or covered with a thin mantle of residual and transported soils. The rock formation

in the taluk falls into two groups, gneissic complex and schistose formation **(Fig-8).** The identification of stream pattern in the taluk is helpful in identification and interpretation of many geological features

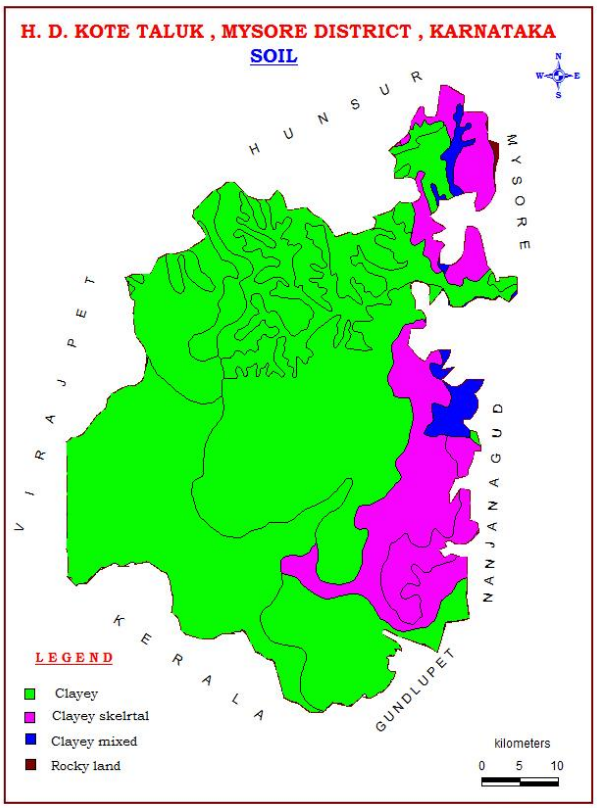


Fig-7: Soil Map

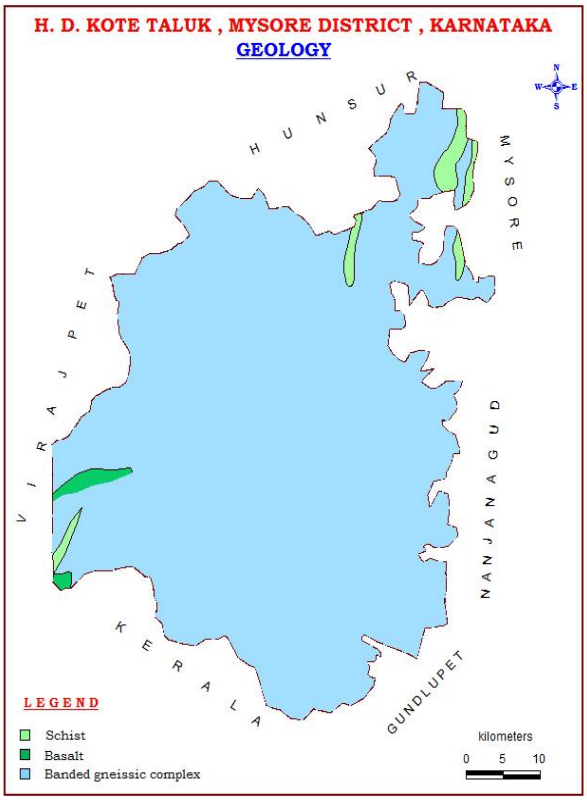


Fig-8: Geology Map

1.7 Ground water resource availability and extraction

As per Groundwater resource estimation 2020 Table 6, the data on Groundwater resources shows that the net groundwater availability is 8165.75 Ham. The existing gross groundwater for irrigation is 3914.13 Ham. The stage of Groundwater development is 47.93 % and falling under 'Safe' category (**Table-4A).**

Table-4A: Dynamic Ground Water Resources (2020) (Ham)

Net Annual Ground Water Availability	Existing Gross Ground Water Draft for Irrigation	Existing Gross GW 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
8165.75	3261.89	652.24	3914.13	976.94	3926.92	47.93	Safe

Aquifer wise total ground water resources up to 150 m depth is given in **Table-4B** below as per 2020 estimation.

Table-4B: Total Ground Water Resources (2020) (Ham)

Taluk	Annual replenishable GW resources	Fresh In-storage GW resources		Total availability of fresh GW resources
		Phreatic	Fractured (Down to 150m)	Dynamic + phreatic in-storage + fractured
HEGGADADEVANAKOTE	8165.75	6403	2341	16909.75

1.8 Existing and Future Water Demands (as per GWRA-2017 and 2020)

The details of dynamic (Phreatic) ground water resources for Heggadadevanakote taluk as on 2017 and 2020 is shown in **Table.5A** and **Table.5B**. It is observed that the stage of ground water extraction is 56 % to 48% from 2017 to 2020.

Table.5A Dynamic Ground Water Resource, (2017 Figures in Ham)

Net Annual Ground Water Availability	Existing Gross Ground Water Draft for Irrigation	Existing Gross GW 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
11633	4359	2116	6476	2489	5016	56	SAFE

Table-5 B: Present Dynamic Ground Water Resource (2020)

Net Annual Ground Water Availability	Existing Gross Ground Water Draft for Irrigation	Existing Gross GW 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
8165.75	3261.89	652.24	3914.13	976.94	3926.92	47.93	Safe

1.9 Water level behavior

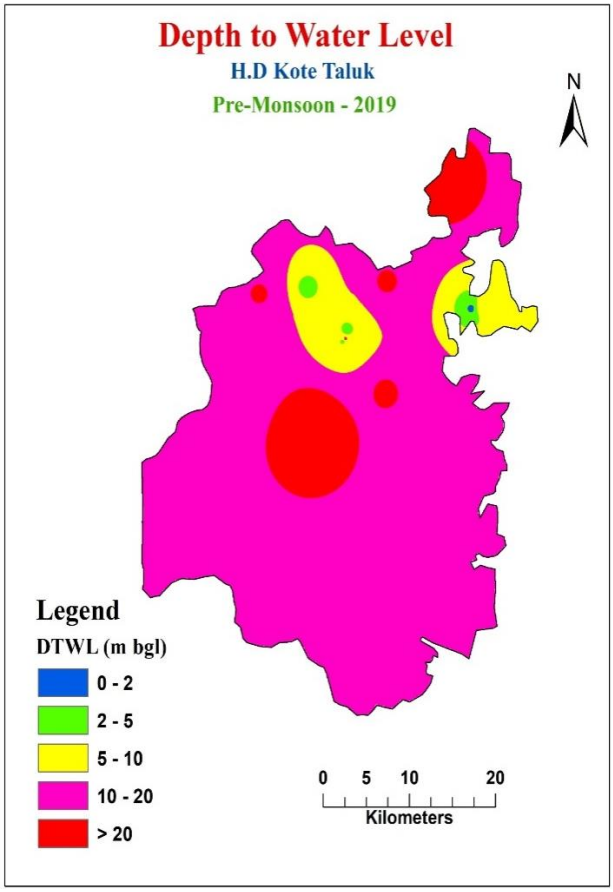
The water level data have been monitored from the representative dug wells and borewells under NHS monitoring programme for both pre and post monsoon seasons during 2019 in Aquifer I and Aquifer II **(Table 6A).** During premonsoon season water level ranges from 1.85 to 3.54 mbgl, whereas in postmonsoon it varies from 0.77 to 4.73 mbgl. Whereas in Aquifer II, the water level ranges from 6.6 to 38.11 mbgl in premonsoon and 1.31 to 20.0 mbgl during post monsoon as per Ground water Department, Govt of Karnataka data **(Table 6B)** and the maps shown in **Fig 9, 10**

Table 6A: Depth to water level of Pre and Post-monsoon (2019), CGWB

Sl No.	Site_type	Location name	May-19	Nov-19
1	Dug well	Heggadadevankote-A	1.85	3.53
2	Dug well	Nanjanayakanahalli	2.36	2.36
3	Dug well	Hampur	3.0	3.65
4	Dug well	Saragur	1.41	4.73
5	Dug well	Hanagodu	3.54	0.77
6	Bore well	Heggadadevankote	12.78	9.06
7	Bore well	Mullur	18.97	11.41

Table 6B: Depth to water level of Pre and Post-monsoon (2019) (Ground Water Dept., Govt. of Karnataka)

Sl No	Site_type	Location name	May-19	Nov-19
1	Bore well	Antarasanthe	38.11	20.0
2	Bore well	Bheemanahalli	20.97	8.86
3	Bore well	Chikkeriyur B	21.74	13.42
4	Bore well	Devalapura	22.25	13.28
5	Bore well	Doddbayranakupe	12.02	6.85
6	Bore well	Gangadahosahalli	27.44	13.32
7	Bore well	Hamapura B	7.13	1.31
8	Bore well	Heggadadevanakote	6.60	3.83



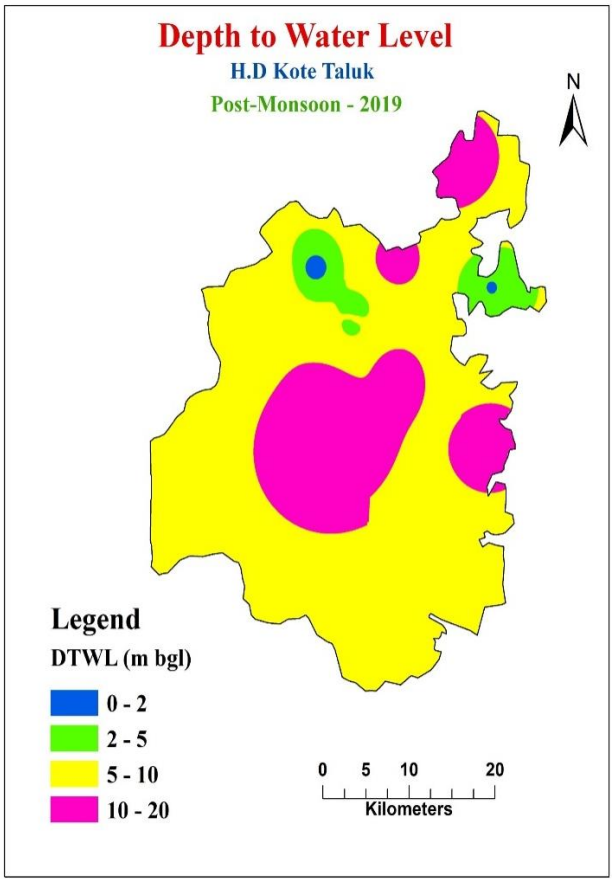


Fig-9: Pre-monsoon Depth to Water Level

Fig-10: Post-monsoon Depth to Water Level

2 AQUIFER DISPOSITION

The occurrence and movement of water in the subsurface is broadly governed by geological Frame works i.e., nature of rock formations including their porosity (primary and secondary) and Permeability. The principal aquifers in the area are Gneisses and Schist and the occurrence and movement of ground water in these rocks is controlled by various factors and it primarily depends on the degree of interconnection of secondary pores/voids developed by fracturing and weathering in the hard rock.

2.1 Aquifer Types

In Heggadadevanakote taluk, there are mainly two types of aquifer systems

i. Aquifer-I (Phreatic aquifer): Weathered

ii. Aquifer-II (Fractured aquifer) Fractured Granitic gneiss.

In Heggadadevanakote taluk, Schist and Granitic gneiss are the main water bearing formations. Ground water occurs within the weathered and fractured Schist, Granite and Granitic gneiss under water table condition and semi-confined condition. In Heggadadevanakote taluk bore wells were drilled from a minimum depth of 35 mbgl to a maximum of 200.00 mbgl. Depth of weathered zone ranges from 3.0 mbgl to 30.5 mbgl. Ground water exploration reveals that aquifer-II fractured formation was encountered

between the depth of 10 to 120.0 mbgl. Yield ranges from Negligible to 5.88 lps. The basic characteristics of each aquifer are summarized in Table-7A,7B.

The 3D aquifer disposition models, 2D aquifer sections and 3D aquifer fence diagrams have been prepared based on Exploration data and borewell inventory data and it presented in **Fig-11a to c.**

Table-7A: Details of Groundwater Exploration

S.No	Location	Depth m bgl	Casing (m)	Lithology	SWL (mbgl)	Q (lps)	T (m^2/day)
1	Antarasante EW	200	24.5	Granite Gneiss	11.33	5.88	31.01
2	Antarasante-OW	200	30.5	Granite Gneiss	16.19	3.76	148.72
3	Alanahalli EW	200	18.3	Granite Gneiss	13.645	< 1	32.1
4	Madapura-EW	200	6.1	Granite Gneiss	13.66	< 1	0.168

Table-7B: Details of Groundwater Exploration

S.No	Location	Depth (m bgl)	Casing (m)	Lithology	Fracture (m)	Q (lps)
1	Mullur	41	12	Granite Gneiss	18	1.41
2	K R Pura	45	12	Granite Gneiss	37	0.8
3	Swagali	53	5	Granite Gneiss	10	2.22
4	Antarasante	85	12	Granite Gneiss	34	1.41
5	Handpost	55	12	Granite Gneiss	37	0.39
6	Tigerblock	110	30	Granite Gneiss	103	0.8
7	Annur	116	12	Granite Gneiss	76	0.14
8	Narale	107	18	Granite Gneiss	85	0.8
9	Sargur	30	12	Granite Gneiss	15	0.8
10	Hyrige	91	6	Granite Gneiss	7	1.41
11	Madapura	125	6	Granite Gneiss	91	0.39
12	Hommargalli	46	24	Granite Gneiss	30	0.8
13	Alanahalli	76	12	Granite Gneiss	27	2.22
14	Devalapura	52	12	Granite Gneiss	45	1.41

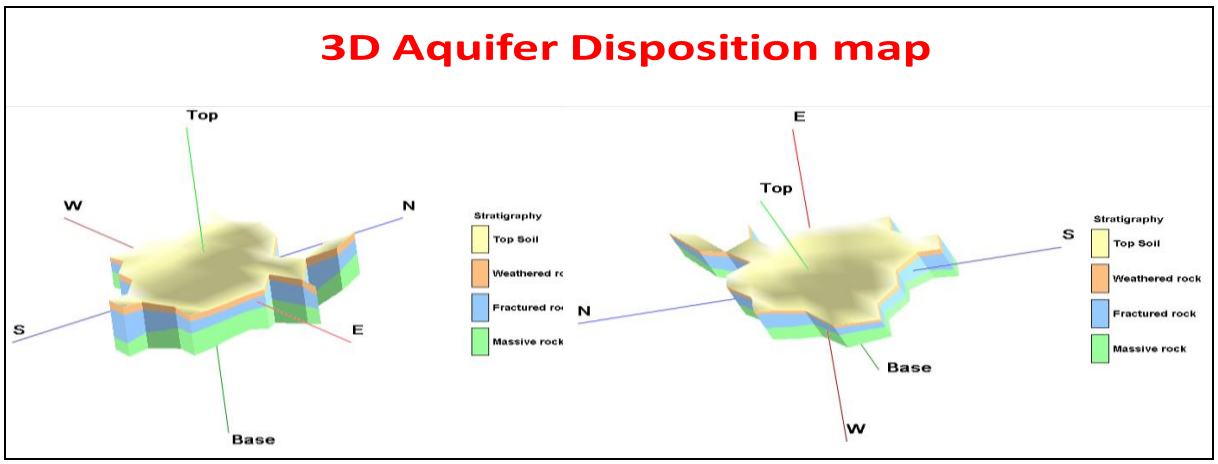


Fig. 11a: 3D Aquifer model

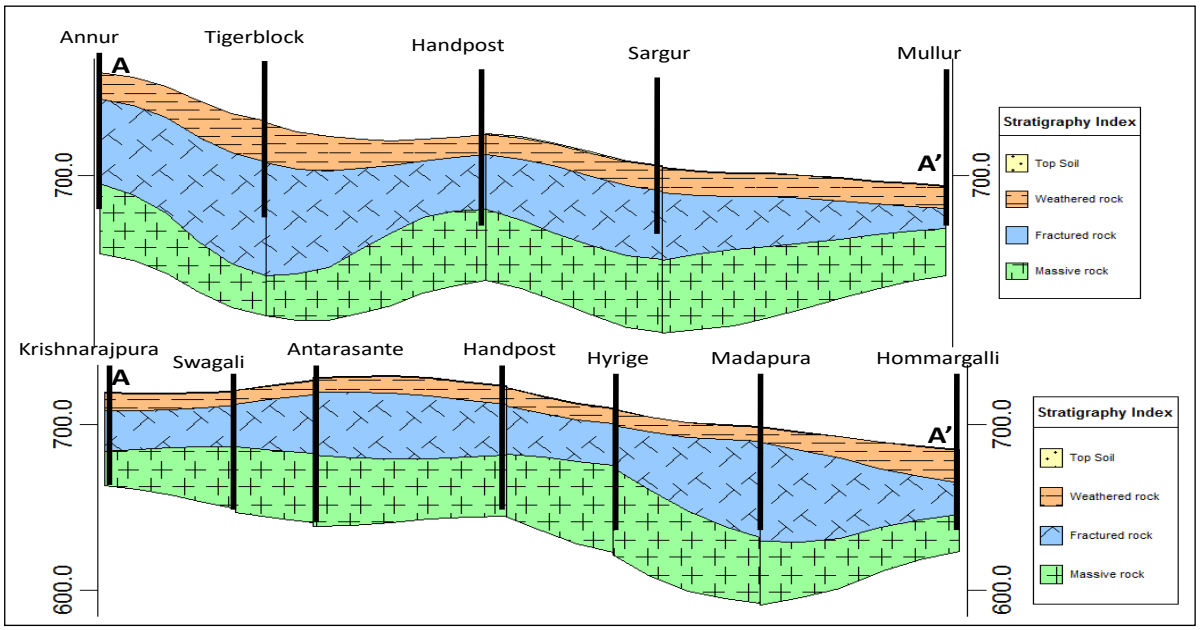


Fig. 11b: 2D Aquifer section

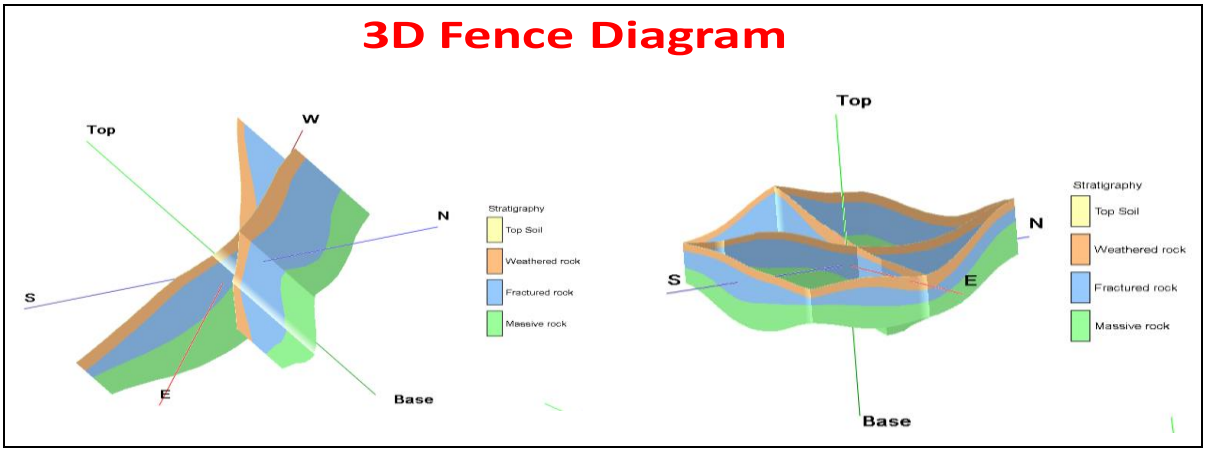


Fig. 11 C: 3D Aquifer fence diagram

3 GROUND WATER RESOURCE, EXTRACTION, CONTAMINATION AND OTHER ISSUES

The main ground water issues are Limited Ground Water Potential / Limited Aquifer Thickness / Sustainability, declining water level trend which are all inter-related or inter dependent.

3.1 Comparison of Ground Water Resource and Extraction

The Dynamic Ground Water Resource 2017 and as on 2020 have summarized and presented in **Table-8.** It is observed that the ground water availability in 2020 is less compare to 2017. Groundwater draft in 2020 is less compare to 2017, so stage of Groundwater development is improved (47.93%). As Heggadadevanakote taluk is 'safe' category, there is scope to develop the Groundwater resources in this taluk through additional wells. In view of the prevailing practice of abstraction structures, bore wells are the preferred structures in the area.

Table 8: Comparison of groundwater availability and draft scenario (in ham)

Taluk	March 2017			March 2020		
HEGGADADEVANAKOTE	GW Availability (in ham)	GW Extraction (in ham)	Stage of GW Development %	GW Availability (in ham)	GW Extraction (in ham)	Stage of GW Development%
	11633	6476	56	8165.75	3914.13	47.93

3.2 Chemical Quality of Ground Water and Contamination

The water samples were collected in different parts of Heggadadevanakote taluk and analysed in CGWB, Bangalore laboratory. Interpretation from Chemical Analysis results in Heggadadevanakote taluk is mentioned in **Table 9.**

- **ELECTRICAL CONDUCTIVITY:** In general, EC values range from 1100 to 1270 µ/mhos/cm in the aquifer-Iat 25°C and ranges from 440 to 1950 µ/mhos/cm in the aquifer-II. **Fig. 12A**
- **NITRATE:** Nitrate concentration inground water ranges from 36.71 and 39.29 mg/l in the Aquifer –I and ranges from 9.25 and 42.99 mg/l in the Aquifer –II. **Fig. 12B**
- **FLUORIDE:** Fluoride concentration in ground water ranges between 0.68 and 1.14 mg/l in the aquifer-I and ranges between 0.73 and 1.19 mg/l in the aquifer-II. **Fig. 12C**

Table 9: Water quality parameters

SL. No	Location	EC	F (mg/l)	NO3 (mg/l)
1	Sargur(DW)	1100	0.68	39.29
2	Mullur(DW)	1270	1.14	36.71
3	Mullur(BW)	890	1.03	22.35
4	K.R. Pura(BW)	1394	0.73	42.84
5	Swagali(BW)	440	1	11.84
6	Antrasante(BW)	1080	1.01	12.69
7	Handpost(BW)	980	0.97	30.03
8	Tiger block(BW)	1840	1.15	11.24
9	Annur(BW)	1410	1.19	42.99
10	Narale	1170	1.06	40.59
11	Hyrige(hand pump)	1950	1.18	32.41
12	Madapura (Kolagala)(BW)	950	1.01	17.83
13	Hommaragally(BW)	1850	1.18	9.25
14	Alanahalli(BW)	1270	1.04	32.42
15	Sargur(DW)	1100	0.68	39.29
16	Mullur(DW)	1270	1.14	36.71
17	Mullur(BW)	890	1.03	22.35
18	K.R. Pura(BW)	1394	0.73	42.84
19	Swagali(BW)	440	1	11.84

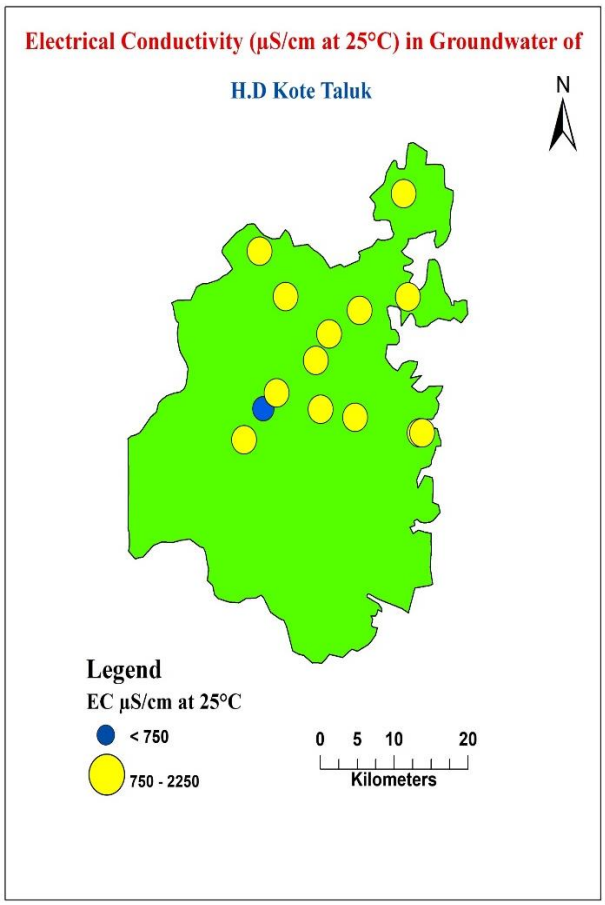


Fig. 12 A: EC distribution map

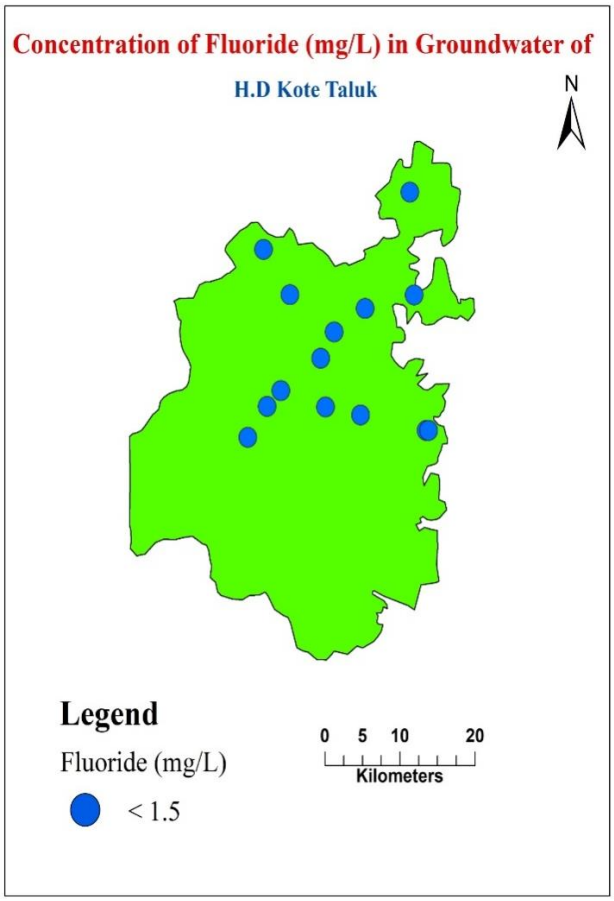


Fig. 12 C: Fluoride distribution map

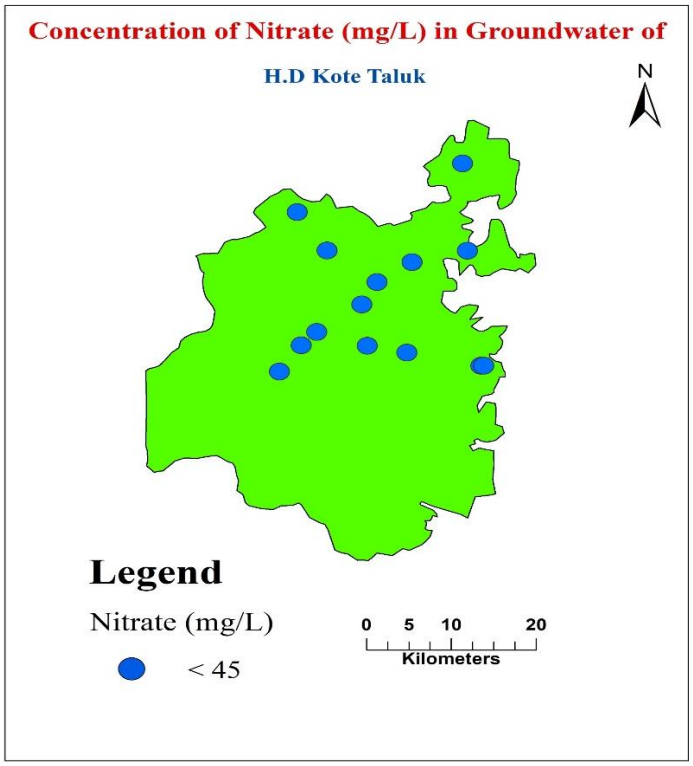


Fig. 12B: Nitrate distribution map

4 GROUND WATER RESOURCE ENHANCEMENT AND PROPOSED MANAGEMENT STRATEGY

4.1 Resource Enhancement by Supply Side Interventions

Recharge dry phreatic aquifer (Aq-I) in the taluk, through construction of artificial recharge structures, viz; check dams, percolation tanks & Sub surface dyke **(Table-10A).** The choice of recharge structures should be site specific and such structures need to be constructed in areas as feasible for artificial recharge.

Table-10A: Quantity of non-committed surface runoff & expected recharge through AR structures

Artificial Recharge Structures Proposed	Heggadadevanakote taluk
Non committed monsoon runoff available (MCM)	130.777
Total no. of existing Artificial Recharge Structures	800
Number of Check Dams	683
Number of Percolation Tanks	114
Number of Sub surface dyke	3
Number of Filter beds	20
Tentative total cost of the project (Rs. in lakhs)	9209.103 Lakhs
Excepted recharge (MCM)	98.083
Additional Irrigation Potential (Lakh hectares)	0.118

Table 10B: Improvement in GW availability due to Recharge as per GWRA 2020

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 groundwater development
	HAM	HAM	%	HAM	%	%
Heggadadevanakote	8165.75	3914.13	47.93	9808.3	26.16	21.77

After implementation of Artificial Recharge structures for GW recharge, the annual groundwater availability will increase from 8165.75 to 17974.05 ham and the expected improvement in stage of development is 26.16% from 47.93% to 21.77% **(Table-10B).**

4.1.1 Strategic Action Plan

The provision for minimum protective irrigation can only improve the agricultural growth in the taluk which is dependent on rain. This objective can be achieved by utilizing the rain water more efficiently by harvesting structures like farm ponds, check-dams, barrages and other surface structures. The Strategic Action Plan, prepared for the taluk has included the irrigation infrastructure for major irrigation, minor irrigation, ground water recharge, harvesting of rain water, improvement of irrigation efficiency and strengthening the adoption of micro-irrigation. Considering the existing infrastructure in the taluk and considering the irrigation potential required to be created to meet the gap between demand and supply of all the sectors of water use, the Strategic Action Plans are developed under PMKSY project and the same is given below.

4.1.2 Benefits of Artificial recharge scheme

Artificial recharge structures namely check dams and Nala bunds can be taken up on large scale in the over-exploited areas as a management plan to tackle falling ground water levels.

- These structures have proved in building-up of ground water levels and sustainability of ground water abstraction structures, mainly in bore wells.
- An increase in the area irrigated by ground water source is also observed in the area of influence.
- Such activities help in providing sustainable drinking water to the rural population. The qualitative result from farmer's perception indicate that, there is rising trend in ground water levels in the area of influence, productivity of crops enhanced and improvement in yield is observed in bore wells.

The cropping pattern has shown that farm households have resumed growing crops such as grapes which were not previously grown in the area.

4.2 Resource Savings by Demand Side Interventions

4.2.1 Water Use Efficiency by Micro Irrigation Practices

As per resources estimation-2020, Heggadadevanakote Taluk falls under **Safe** category with the stage of groundwater extraction of 47.93 %. However, Water Use Efficiency (WUE) practices like Drip irrigation needs to be strengthened to save irrigation water by way of precision farming mechanism. This ultimately enhances the area under irrigation potential.

4.3 Ground Water Development Plan

Heggadadevanakote taluk has been categorized as **Safe**. However mandatory guideline issued by Government of Karnataka like rain water harvesting and Artificial recharge structures should be constructed. Groundwater recharge component needs to be made mandatory in the non-command area of the taluk for further development of ground water.

4.4 Other interventions proposed

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

5 SUMMARY AND RECOMMENDATIONS

The main ground water issues are Low Ground Water Development, Limited Ground Water Potential / Limited Aquifer Thickness / Sustainability, which are all inter-related or inter dependent. The summary of ground water management plan of Heggadadevanakote taluk is given in **Table- 11.**

Table-11: Summary of Management plan of Heggadadevanakote taluk

Heggadadevanakote taluk is Safe & present stage of Ground water extraction (2020)	47.93%
Net Annual Ground Water Availability (MCM)	81.6575
Existing Gross Ground Water extraction for all uses (MCM)	39.1413
Total GW Resources (Dynamic & Static up tothe depth of 200 mbgl) (MCM)	169.09
Expected additional recharge from monsoon surplus runoff (MCM)	98.083
Change in Stage of GW development, %	47.93 to 21.77
Water Use efficiency measures	• Government to take initiative to encourage at least 70% farmers to adopt water use efficiency irrigations practices like dip & sprinkler irrigation

As per the resource estimation – 2020, Heggadadevanakote taluk falls under Safe category with the stage of groundwater extraction is 47.93 %. However, there is need to formulate management strategy to tackle the water scarcity related issues in the taluk in the coming days to avoid water crisis in

the future. It is suggested to adopt a scientific and multi-pronged ground water management strategy covering supply side interventions, demand side interventions, ground water development interventions and groundwater quality protection aspects as mentioned in the management plan suggested above

- **Ground water resource enhancement by supply side interventions**: Quantity of surface water available through non-committed surface run-off is estimated to be 13077.7ham. This can be used to recharge the aquifer mainly through percolation tanks (114), check dams (683) and sub surface dyke structures (3). The volume of water expected to be conserved/recharged is 9808.3 ham through these AR structures. The approximate cost estimate for construction of these AR structures is Rs. 92.09 Cr. The additional area which can be brought under assured ground water irrigation will be about 11800 hectares. However, the figures given are tentative and pre-field studies / DPR are recommended prior to implementation of these recharge structures.
- **Ground water resource enhancement by demand side interventions:** At present about 26 % of irrigation is by wells and bore wells (ground water). The micro irrigation practices like drip and sprinkler irrigation are comparatively less practiced in comparison with traditional surface flooding mode of irrigation. The micro irrigation water efficient methodology needs to be adopted for growing water intensive crop like Paddy, Sugarcane and Tobacco which is grown in the cropped area largely and groundwater dependent. Implementation of efficient irrigation techniques will contribute in saving Groundwater.
- **Change in cropping pattern:** Farmers are facing inadequacy of groundwater for agriculture during summer. Water intensive crops like Paddy, Sugarcane and Tobbaco are grown in 5373 ha of the cropped area. However, oil seeds grown during kharif and rabi period. At present (2020), the stage of ground water extraction is 47.23% and taluk has been categorized as Safe, thus change in cropping pattern has not been suggested.

By adopting the supply side and demand side management plan itself, the stage of groundwater extraction decreases to 21.77 % from 47.93 % and the taluk falls under safe category.