



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

Gubbi Taluk, Tumkur District, Karnataka

दक्षिण पश्चिमी क्षेत्र, बेंगलुरु

South Western Region, Bengaluru

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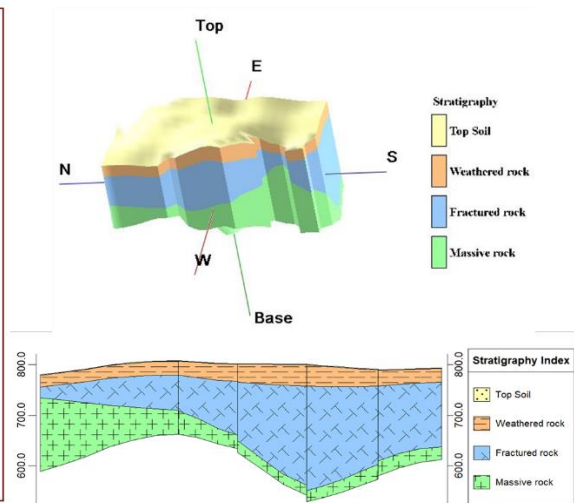
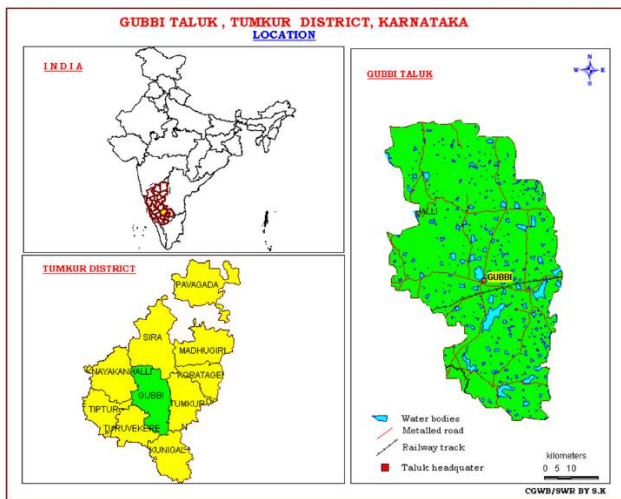
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AQUIFER MAPS AND MANAGEMENT PLAN, GUBBI TALUK, TUMKUR DISTRICT, KARNATAKA STATE

(AAP – 2021-2022)



By

Naresh Chandra Sahoo, Assistant Hydrogeologist, CGWB, SWR, Bengaluru

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1 SALIENT FEATURES

Name of the taluk	: GUBBI
District	: Tumkur
State	: Karnataka
Area	: 1225 sq.km
Population	: 2,62,518
Annual Normal Rainfall	: 803 mm (2020)

1.1 Study area

Aquifer Mapping Studies have been carried out in Gubbi taluk, Tumkur district of Karnataka, covering an area of 1225sq.kms under National Aquifer Mapping Project. The Gubbi taluk is located between North Latitudes $13^{\circ}19'10.41''$ and $13^{\circ}22'27.06''$ and East Longitudes between $76^{\circ}42'38.60''$ to $76^{\circ}59'45.46''$. The study area is bounded on the East by Tumkur taluk, north by Sira Taluk, south by Kunigal & Turuvekere taluks and on the west by C.N Halli & Tiptur taluks of Tumkur district. Gubbi is taluk head quarter. There are 346 villages and 34 Gram panchayats and 6 hoblies in this taluk. Location map of Gubbi taluk of Tumkur district is given in Fig-1.

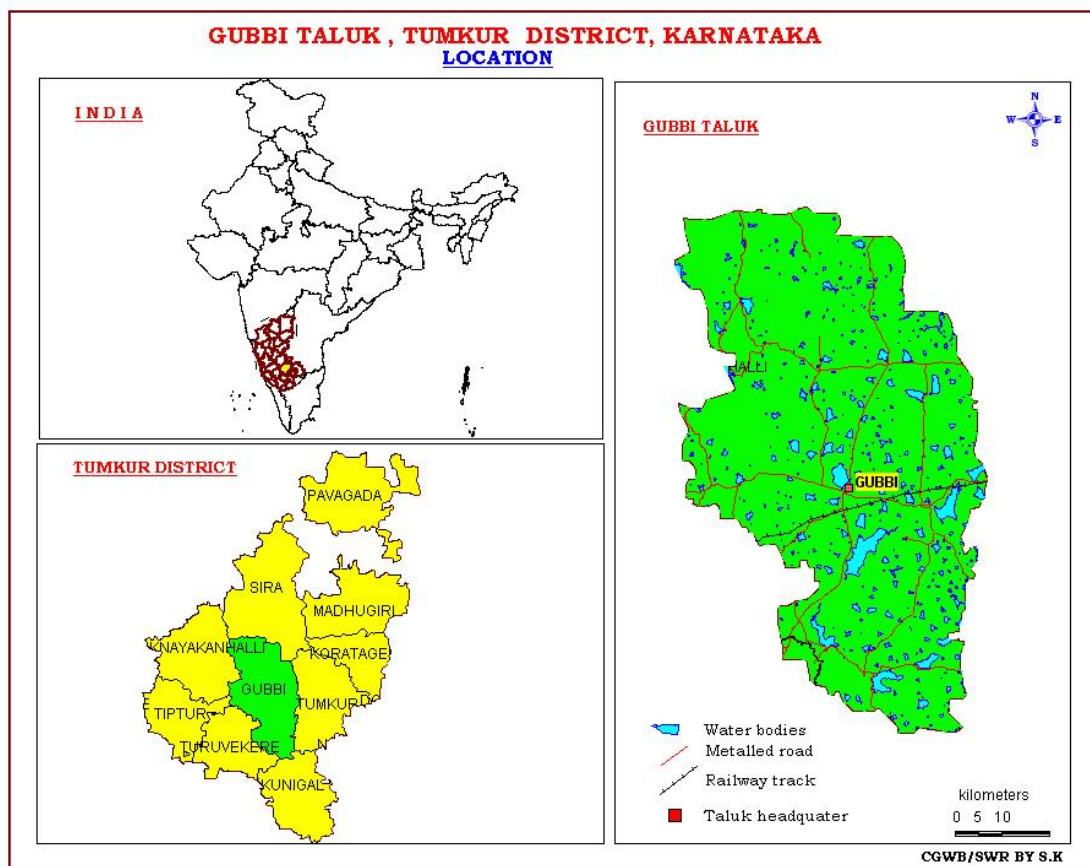


Fig 1: Location map

1.2 Population

According to 2011 census, the population in Gubbi taluk is 2,62,518, out of which 1,32,102 is male and 1,30,416 is female. The taluk has an overall population density of 214 persons per sq.km. The decadal variation in population from 2001-2011 is 2.4% in Gubbi taluk. The population details are given in Table-1.

Table-1: Population details (2011) of Gubbi taluk

Total Population	262518
Number of Male	132102
Number of Female	130416
Share of the district population (%)	9.79
Total Number of Rural populations	244072
Total Number of Urban populations	18446
Decadal change in population (2001-2011) (%)	2.4
Decadal change in rural population (%)	1.89
Decadal change in urban population (%)	9.8

Source: As Per 2011 Census at District at a glance 2016-17, Govt. of Karnataka

1.3 Rainfall and Climate

Gubbi 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 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 annual rainfall data from 2006 to 2016 of the Gubbi taluk is collected from the District at Glance, Tumkur District report and is given in Table - 2.

Table-2: Actual Annual Rainfall of Gubbi taluk from 2006 to 2016

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Rainfall (mm)	326	501	640	586	750	489	382	561	703	836	372.4

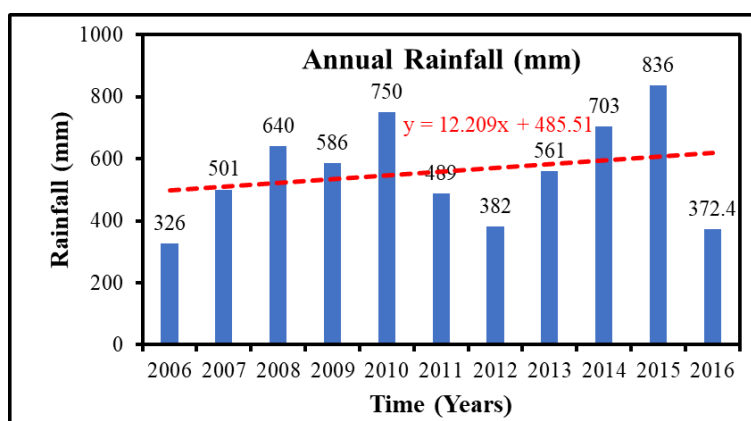


Fig 2: Annual Rainfall trend map of Gubbi taluk of Tumkur district

1.4 Agriculture & Irrigation

Agriculture is the main occupation in Gubbi taluk. The major crops cultivated in the taluk are Paddy, Maize, Tur, Pulses, Tobacco, Fruits and Vegetables. Water intensive crops like Paddy and Tobacco are also grown in Gubbi Taluk. The detailed list of cropping pattern in the Gubbi taluk has given in Table 3.

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

Crops		Area (ha)	Total area (ha)	Total area (ha)
Cereals	Paddy	853	20490	Total Food grains - 25008
	Jowar	-		
	Ragi	19631		
	Maize	6		
Pulses	Tur	832	4518	
	Horse gram	2077		
	Black gram	35		
	Green gram	360		
	Avare	728		
	Cow pea	480		
	Bengal gram	6		
Fruits	7009			
Vegetables	742			
Oil Seeds	Groundnuts	58	162	Total Oil seeds - 162
	Niger seed	14		
	Castor	75		
	Sesamum	7		
	other	8		
Commercial crops	-			Total Commercial crops – 0

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

It is observed that net sown area accounts for 64,846 (Ha) and area sown more than once is 10199 (Ha) of total geographical area 122500 (Ha) in Gubbi taluk (Table-4). Area under Forest is 10090 (Ha). Area not available for cultivation and Fallow land cover 22512 (Ha) and 15217 (Ha) of total geographical area respectively. 2,605 (Ha) of net area is irrigated from surface water and 28,487 (Ha) are irrigated from Groundwater (Table.5).

Table-4: Details of land use in Gubbi taluk 2016-2017 (Ha)

Geographical area	Area under Forest	Area not available for cultivation	Fallow land	Area Sown		
				Net sown area	Area sown more than once	Total sown/ Cropped area
122500	10090	22512	15217	64846	10199	75045

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

Table-5: Irrigation details in Gubbi taluk (in ha)

S.No	Source		Number of Structures	Gross area irrigated (ha)	Net area irrigated (ha)
1	Surface water	Canals	-	-	-
		Tanks	162	2605	2605
		Lift irrigation	-	-	-
		Total (I)		2605	2605
2	Ground water	Dug wells	6543	218	218
		Bore wells	36002	28279	25664
		Total (II)		28497	25882
Grand Total (I + II)				31102	28487

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

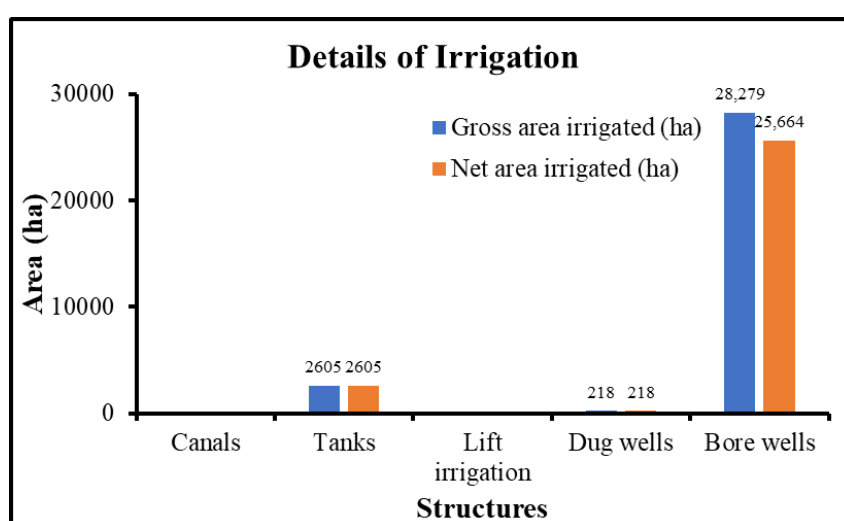


Fig 3: Details of Irrigation from various sources at Gubbi taluk of Tumkur district

1.5 Geomorphology, Physiography & Drainage

The geomorphology of the Gubbi is formed by hills and plateaus in the northern and north western parts, whereas the plain region is covered rest of the regions of the taluk (**Fig.-4**). The topographical elevation varies from 764m to 852m in the taluk. The differential altitude is significant because, it is likely to cause irregular ground water flow patterns on the microscale. Topography is dominantly controlled by geological structures. The entire Gubbi taluk falls in Krishna & Cauvery River basin. The observed Drainage pattern in the taluk is dendritic to sub dendritic (**Fig.-5**).

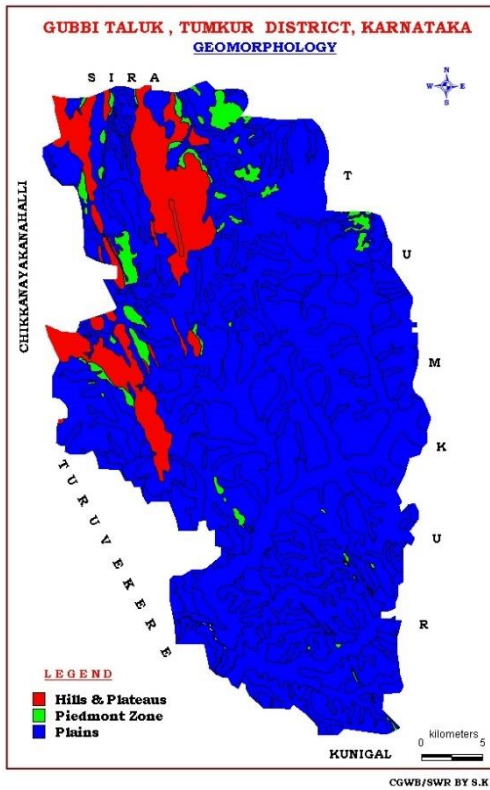


Fig-4: Geomorphology Map

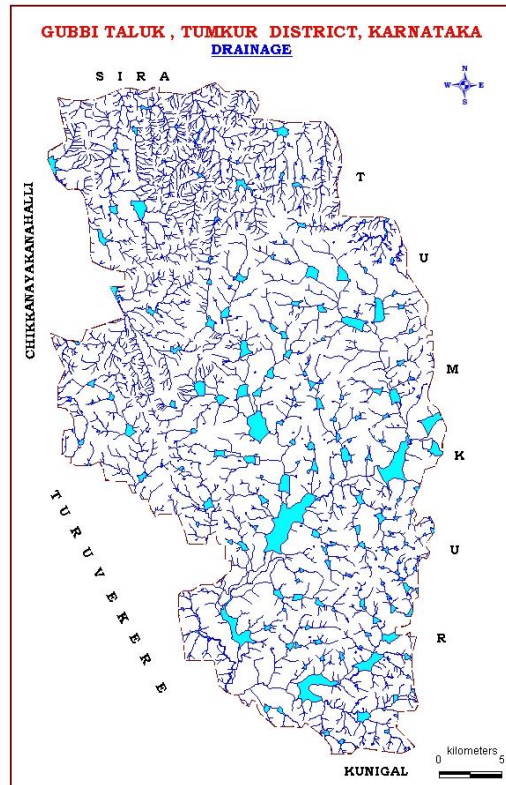


Fig-5: Drainage Map

1.6 Soil and Landuse

The soils of Gubbi taluk can broadly be classified into Clayey soils and Clayey Skeletal soils, clayey mixed and Loamy soils (**Fig -6**). These soils vary in depth and texture, depending on the parent rock type, physiographic settings and climatic conditions. Landuse pattern of the taluks resembles that most part of the taluk is covered by agricultural land, followed by forest cover in the northern part of the taluk (**Fig -7**).

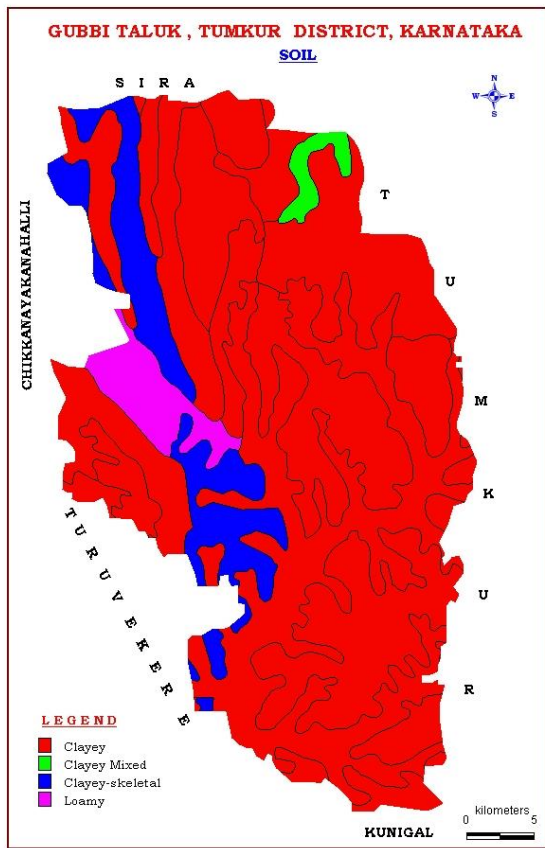


Fig-6: Soil Map

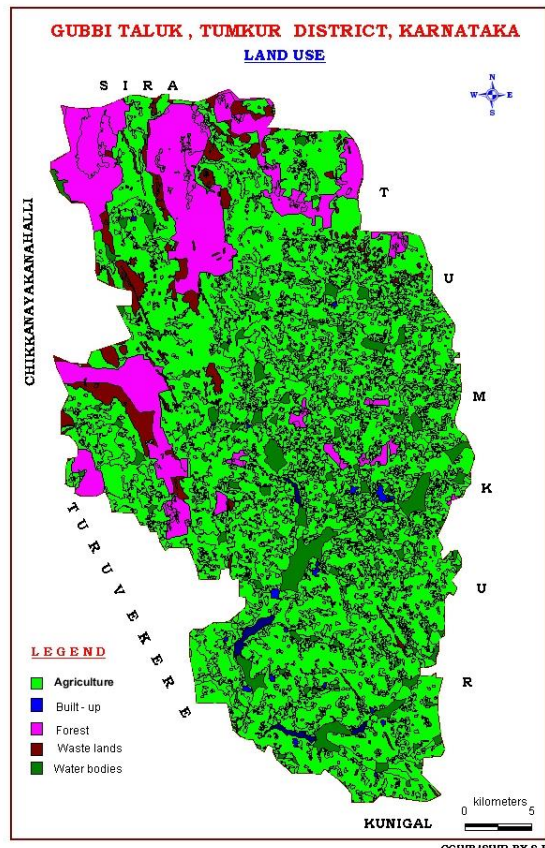


Fig-7: Landuse Map

1.7 Ground Water Resource Availability and Extraction

Aquifer wise total ground water resources up to 200 m depth is given in **Table 6** as per 2020 estimations. The details of dynamic (phreatic) ground water resources are shown in **Table 7**.

Table-6: 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)	
Gubbi	9453.43	19004	2244	Dynamic +phreatic in-storage + fractured
				30701.43

Table.7: Dynamic Ground Water Resource, Gubbi taluk - 2017(Ham)

Net Annual Ground Water Availability	8913.48
Existing Gross Ground Water Draft for Irrigation	3663.64
Existing Gross GW Draft For Domestic And Industrial Water Supply	399.24
Existing Gross Ground Water Draft For All Uses	4062.88
Allocation For Domestic And Industrial Use For Next 25 Years	453.54
Net Ground Water Availability For Future Irrigation Development	5280.93
Existing Stage of Ground Water Development	45.58 %
Category	Safe

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

As per the GWRA 2017, the net ground water availability was 8913.48ham and the total ground water draft for all uses is 3663.64ham with stage of development at 45.58% and the taluk falls in Safe category. Thus there is further scope for future irrigation development5280.93Ham. The domestic (Industrial sector) demand for next 25 years is estimated at453.54Ham.

The details of dynamic (Phreatic) ground water resources for Gubbi taluk as on March 2020 is shown in Table-8. It is observed that the stage of ground water extraction is remains same in the taluk from 45.58 % to 45.77 % from 2017 to 2020 with an increase in the net ground water availability during 2020 with a figure of 9453.43Ham.

Table.8: Dynamic Ground Water Resource, Gubbi taluk – 2020 (Ham)

Net Annual Ground Water Availability	9453.43
Existing Gross Ground Water Draft for Irrigation	3880.12
Existing Gross GW Draft For Domestic And Industrial Water Supply	446.72
Existing Gross Ground Water Draft For All Uses	4326.84
Allocation For Domestic And Industrial Use For Next 25 Years	486.67
Net Ground Water Availability For Future Irrigation Development	5427.19
Existing Stage of Ground Water Development	45.77%
Category	Safe

1.9 Water level behaviour

The ground 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 the same has given in **Table 9**. During pre-monsoon season water level ranges from 4.97 to 14.32 mbgl, whereas in post-monsoon it varies from 0.70 to 10.00 mbgl. Whereas in Aquifer II, the water level ranges from 15.55 to 145.64 mbgl in pre-monsoon and 10.95 to 140.08 mbgl during post-monsoon (**Table 10**) as per Ground water Department, Govt of Karnataka. The ground water level maps prepared to the Gubbi taluk Pre and post monsoon are showed inFig 8andFig 9 respectively.

Table 9: Depth to water level of Pre and Post-monsoon (2019), CGWB, SWR

S.No	Well Type	Location name	Depth of the Well (m bgl)	May-19	Nov-19
1	Dug Well	Gubbi	18.00	13.42	6.24
2	Dug Well	Iriksandra	15.24	14.32	5.93
3	Dug Well	Mavinahalli	11.00	10.00	10.50
4	Dug Well	Singanahalli	12.00	5.00	0.70

Table 10: Depth to water level of Pre and Post-monsoon (2019), State GW Directorate, Govt. of Karnataka

S.No	Location name	Depth of well (m bgl)	May-19	Nov-19
1	Ankasandra	70	60.00	59.70
2	C.S Pura	39.02	29.20	22.55
3	Gubbi	62	30.73	22.22

4	Kadaba	48	34.50	27.55
5	Kondli Cross	157.1	145.64	140.08
6	M.M.Kaval	197	54.50	44.18
7	Nitturu	48	15.55	10.95
8	Sopanahalli	162.1	49.91	22.12
9	Uddehoskere	49	23.60	16.43

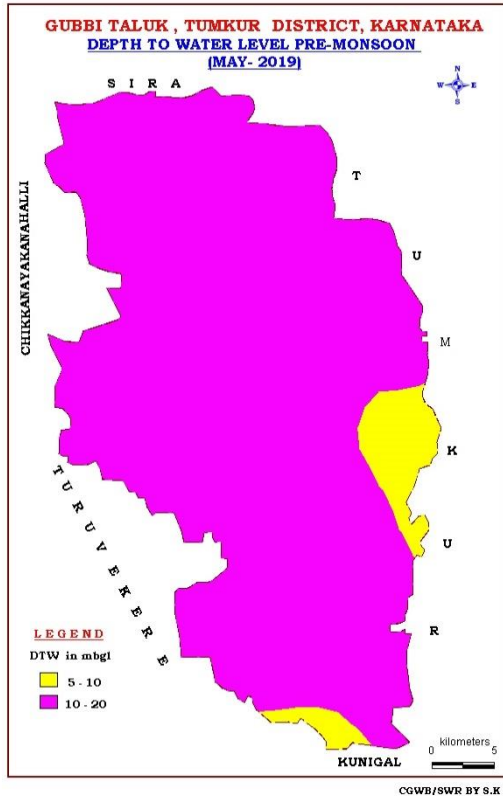


Fig-8: Pre-monsoon Depth to Water Level

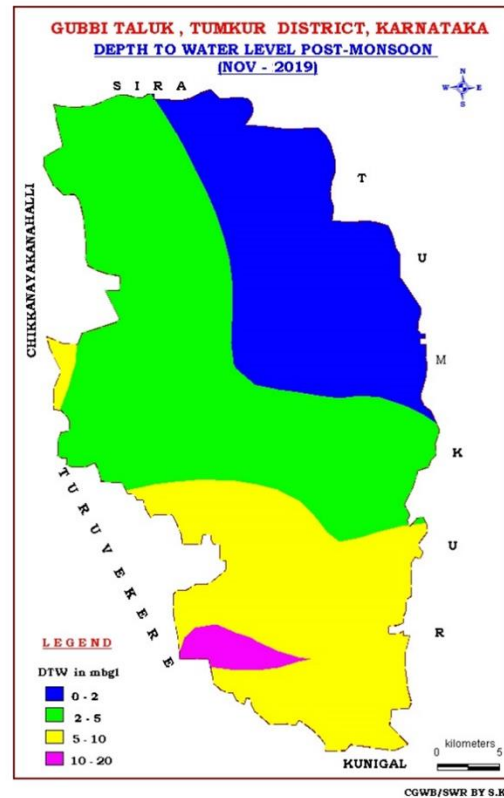


Fig-9: Post-monsoon Depth to Water Level

2 AQUIFER DISPOSITION

The occurrence and movement of water in the subsurface is broadly governed by geological frameworks i.e., nature of rock formations including their porosity (primary and secondary) and permeability. The principal aquifers in the area is Banded Gneissic complexes and Schist, the occurrence and movement of ground water in these rocks are 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 Gubbi taluk, there are mainly two types of aquifer systems have encountered

- **Aquifer-I (Phreatic aquifer)** comprising Weathered Gneissic complex and Schist
- **Aquifer-II (Fractured aquifer)** comprising Fractured Gneissic complex and Schist

In Gubbi taluk, Granitic gneiss and Schist are the major water bearing formations (**Fig-10**). Ground water occurs within the weathered and fractured Granitic gneiss and Schist under water table condition and semi-confined condition. In Gubbi taluk bore wells were drilled to a maximum depth of

200 mbgl. Depth of weathered zone ranges from 19.2 mbgl to 50.5mbgl. Ground water exploration reveals that aquifer-II fractured formation was encountered between the depths of 21.4 to 181.4mbgl. Yield ranges from Negligible to 16.44lps. The detailed aquifer characteristics of the Gubbi taluk is given in **Table 11**.

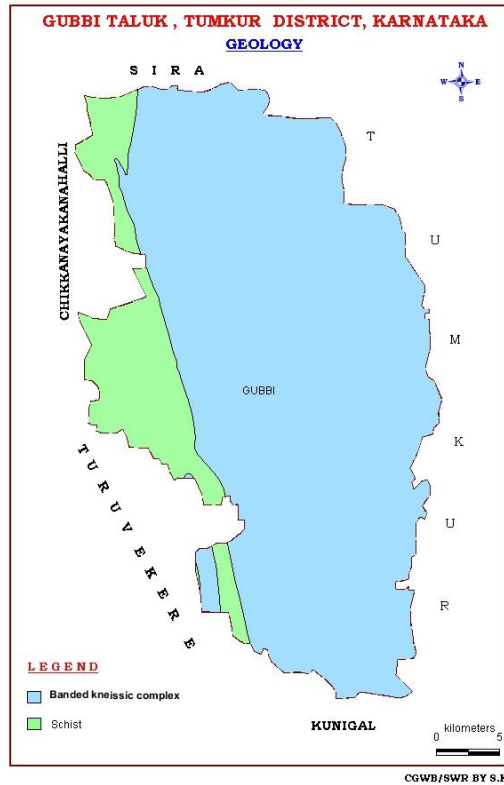


Fig-10: Geology of the Gubbi taluk

Table-11: Basic characteristics of each aquifer

Aquifers	Weathered Zone (Aq.-I)	Fractured Zone (Aq.-II)
Major Lithology	Weathered Granitic gneiss	Fractured Granitic gneiss
Thickness range (mbgl)	19.2 – 50.5	Fractures upto 181.4 mbgl
Depth range of occurrence of fractures (mbgl)	-	21.4-181.4
Range of yield potential (lps)	-	<1 – 16.44
Transmissivity (m ² /day)	-	-

2D AQUIFER DISPOSITION

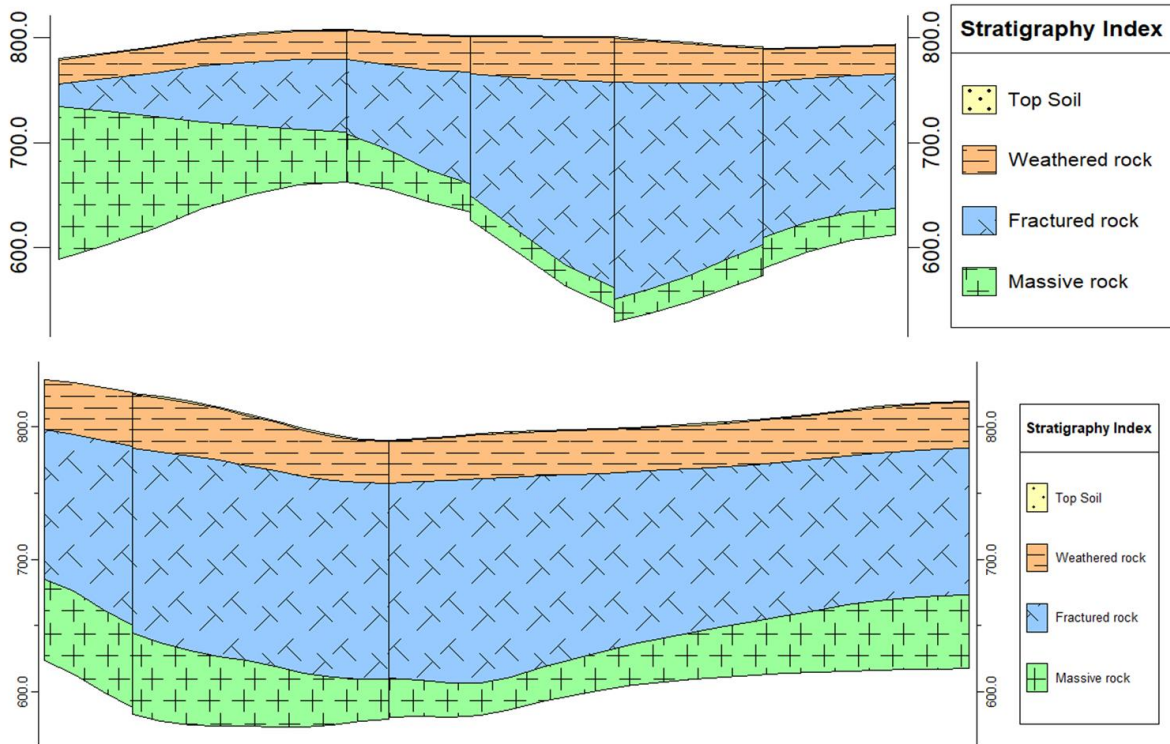


Fig.11:2-D Cross Sections of Gubbi Taluk

3D AQUIFER DISPOSITION

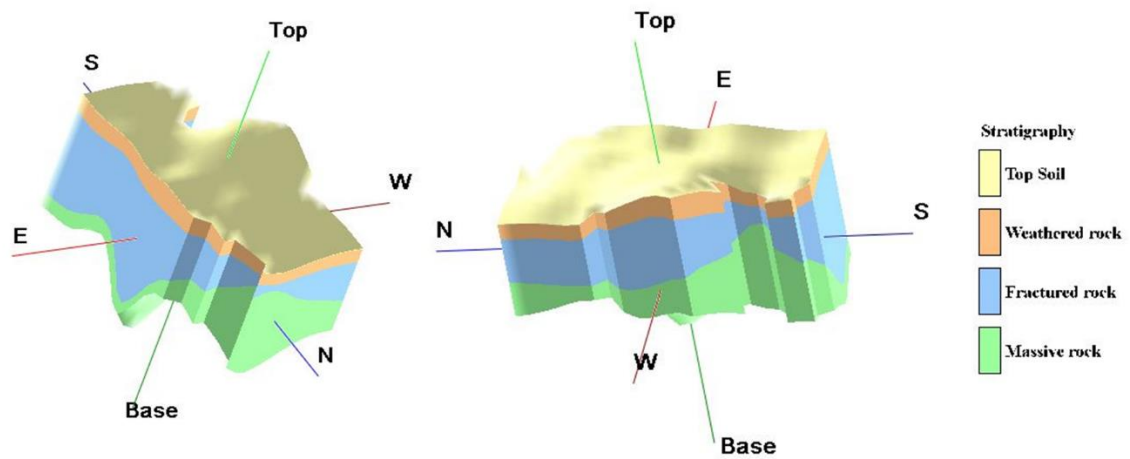


Fig.12: 3-D Aquifer Disposition model of Gubbi Taluk

3D FENCE DIAGRAM

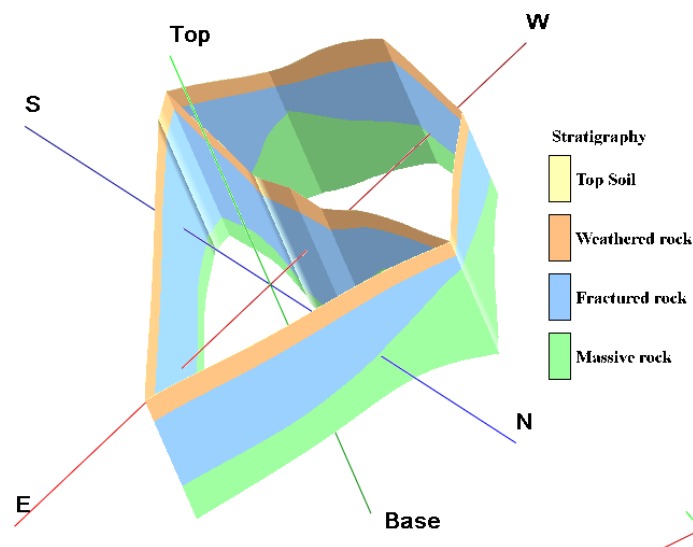


Fig.13: 3D Fence Diagram of Gubbi Taluk

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 are the major issues in the Gubbi taluk.

3.1 Comparison of Ground Water Resource and Extraction

The Dynamic Ground Water Resource 2017 and as on 2020 has summarised in table 12. It is observed that the ground water availability has remained more or less same during the years 2017, and 2020. However, it is attributable to the improvement in the irrigation practice, influence of command area and also due to the water conservation / recharge activities carried out in the taluk by various state government and other agencies.

Table-12: Comparison of ground water availability and draft scenario in Gubbi taluk

Taluk	GW availability (ham)	GW draft (ham)	Stage of GW development (%)	GW availability (ham)	GW draft (ham)	Stage of GW development (%)
	2017			2020		
Gubbi	8913.48	4062.88	45.58	9453.43	4326.82	45.77

It is seen that the stage of ground water extraction remains same in the taluk in comparison with 2017 estimations, there is no notable change in the stage of ground water development & the taluk is categorized as "Safe".

3.2 Chemical Quality of Ground Water and Contamination

Interpretation from Chemical Analysis results in Gubbi taluk is mentioned as under, the chemical data of the taluk is given in Table-13

- **ELECTRICAL CONDUCTIVITY:** In general, EC values range from 417 to 1692 μ /mhos/cm at 25°C (Fig-14)
- **NITRATE:** Nitrate concentration in ground water ranges from 2.06 and 43 mg/l (Fig-14).
- **FLUORIDE:** Fluoride concentration in ground water ranges between 0.39 and 1.13 mg/l. (Fig-14)

Table-13: Groundwater quality in Gubbi taluk

S.No	Location	Ph	EC (μ S/sec)	Cl (mg/l)	NO3(mg/l)	F(mg/l)
1	Prabhuvanahalli	7.62	867	85.2	13.4	ND
2	Gubbi	7.88	1021	156.2	10.28	ND
3	Tulsikatte	7.77	1132	145.55	20.36	ND
4	Bidare	7.96	1482	145.55	25.62	0.39
5	Chellur	8.1	417	24.85	ND	1.13
6	Kechenahalli	7.9	1618	255.6	15.78	ND
7	Apanahalli	7.84	1692	223.65	2.06	1.01
8	Bomarasanahalli	8	1210	142	7.12	ND
9	Doddaguni	7.91	840	46.15	ND	ND
10	Kundarnahalli	8.37	1091	163.3	7.38	ND
11	Gaddehalli	8.01	1495	259.15	18.46	ND

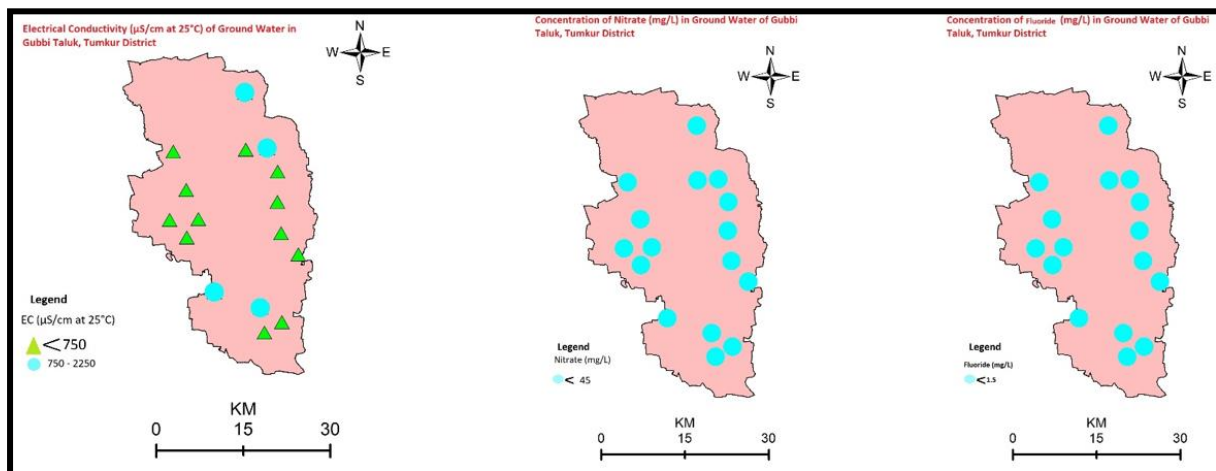


Fig.14: Ground water quality of the Gubbi taluk

In general, ground water quality in Gubbi taluk is good for drinking purpose as depicted in above illustrated maps, and data as per “Indian Standard Drinking Water Specification 2009”. Ground water samples have also been tested and found suitable for agriculture & irrigation purposes.

4 GROUND WATERRESOURCE ENHANCEMENT AND PROPOSED MANGEMENT STRATEGY

4.1 Resource Enhancement by Supply Side Interventions

The overall stage of ground water development is at moderate levels of 45.58% as per GEC 2017 and 45.77% as on 2020. However, the pre-monsoon long term ground water trend shows the declining trend. During post monsoon, most part of the taluk show rise in water level in greater values.

Considering the long-term water level trend, seasonal water level, it is proposed to construct artificial recharge (AR) structures to enhance the ground water resources and to arrest the decline in long term ground water level. It has found that the rising trend in rainfall pattern (**Fig – 2**) may also yield good amount of recharge and it can be conquered through the constructed artificial recharge structures. Recharge dry phreatic aquifer (Aq-I) in the taluk, through construction of artificial recharge structures, viz; check dams, percolation tanks & Sub surface dyke (**Table-14**). 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-14: Quantity of non-committed surface runoff & details of AR structures

S.No	Artificial recharge structures proposed	
1	Non committed monsoon runoff available in (MCM)	80.973
2	Number of sub surface dykes	2
3	Number of Check Dams	394
4	Number of percolation tanks	73
5	Number of Filter Beds	09
6	Tentative total cost of the project (Rs in lakhs)	5453.440
7	Expected Recharge in (MCM)	60.730
8	Additional irrigation potential (hectares)	7300

The surface surplus non-committed runoff availability in the taluk is 80.973 MCM, which is considered for planning of AR structures. For this, a total of 2 sub-surface dykes, 73 percolation tank and 394 Check dams are proposed. The volume of water expected to be conserved/recharged @75% efficiency is 60.730 MCM through these AR structures. The approximate cost estimate for construction of these AR structures is Rs. 5453.440 Lakhs. The figures given are tentative and pre-field studies / DPR are recommended prior to implementation of these recharge structures.

4.2 Resource Savings by Demand Side Interventions

4.2.1 Advanced irrigation practices

Gubbi Taluk falls under Safe category with the stage of groundwater extraction of 45.77%. 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.

4.2.2 Regulation and Control

Gubbi 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. Ground water recharge component needs to be made mandatory in the non-command area of the taluk for further development of ground water.

4.3 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, of major part of the area. The summary of ground water management plan of Gubbi taluk is given in **Table-15**.

Table 15: Summary of Management plan (GWRA-2020) of Gubbi taluk

Stage of GW Extraction and Category (2020)	45.77%, Safe
Annual Extractable GW Resource (Ham)	9453.43
Total Extraction (Ham)	4326.82
Total GW Resources (Dynamic & Static up to the depth of 200 mbgl) (Ham)	30701.43
Ground Water Draft for Irrigation (Ham)	4326.84
Ground Water Resource Enhancement by Supply side Interventions	
No of Proposed AR structures	
SSD	2
PT	394
CD	73
FB	9
Expected Additional Recharge to GW due to AR (Ham)	6073
Additional Irrigation Potential that can be created (Ha)	7300
Total Estimated Expenditure (Rs. in Cr.)	54.53
Change in Stage of GW Extraction (%)	45.77 to 27.87

As per the resource estimation – 2020, Gubbi taluk falls under Safe category with the stage of ground water extraction is 45.77%. 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 ground water quality protection aspects as mentioned in the management plan.

- **Ground water resource enhancement:** Continuous drought, increase in agricultural activity, subjected to excessive ground water withdrawal leading to depletion of ground water level, reduction in yield and deterioration of ground water quality etc., suggests a need for proper ground water management and enhancement of storage capacity of aquifers, protection of ground water quality and proper utilization of ground water. To enhance the storage capacity of aquifers, the dewatered aquifers are to be recharged, for which the artificial recharge structures like Check dams, percolation tanks, point recharge structures etc have to be constructed.
- **Ground Water resource:** As per the resource estimation – 2020, Gubbi taluk falls under Safe category with the stage of ground water extraction of 45.77%. However, there is need to formulate management strategy to tackle the water scarcity related issues in the taluk during the summer and scarcity of water during the future days.
- **Quantity of water available through non-committed surface run-off:** The surplus non-committed monsoon run off is estimated to be approximately 59.354MCM. This can be used to recharge the aquifer mainly through Sub Surface Dykes, percolation tanks, Check Dams, Filter Beds.
- **Advanced irrigation practices:** The important crops grown are Paddy, Ragi, Maize, gram, tur, groundnut, sunflower and sugarcane. Water Use Efficiency (WUE) practices like Drip needs and Micro irrigation to be strengthened to save irrigation water by way of precision farming mechanism. This ultimately enhances the area under irrigation potential.
- **Change in cropping pattern:** Farmers are facing inadequacy of groundwater for agriculture during summer and can opt for more rain-fed millets and water efficient Pulses for agricultural production.
- **Drinking water Supply:** In view of ground water contamination with mainly higher concentration Nitrate and fluoride, drinking water supply from surface water needs to be explored/ ensured.
- **Regulation and control:** Taluk is categorized as "Safe". However, the mandatory guidelines like rainwater harvesting and artificial recharge issued by Karnataka Ground Water Authority needs to be strictly implemented in the taluk, so that quality of ground water will improve in due course of time.
- **Participatory management:** Awareness programmes and practice of participatory approach needs to be strengthened with the involvement of all the stake holders for sustainable management.