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

Gundlupete Taluk, Chamarajanagara District, Karnataka

दक्षिण पश्चिमी क्षेत्र, बेंगलुरु

South Western Region, Bengaluru

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भारत सरकार
जल शक्ति मंत्रालय
जल संसाधन, नदी विकास
एवं गंगा संरक्षण विभाग
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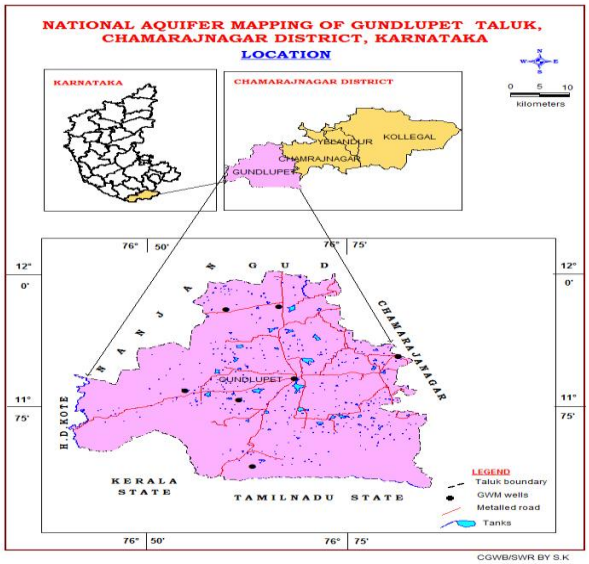
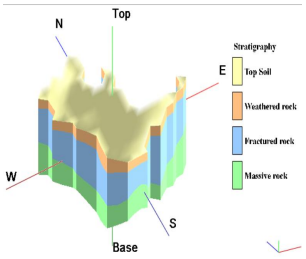
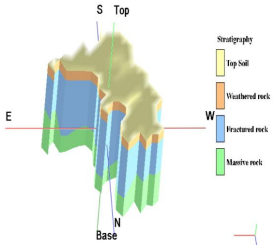
South Western Region,
Bengaluru

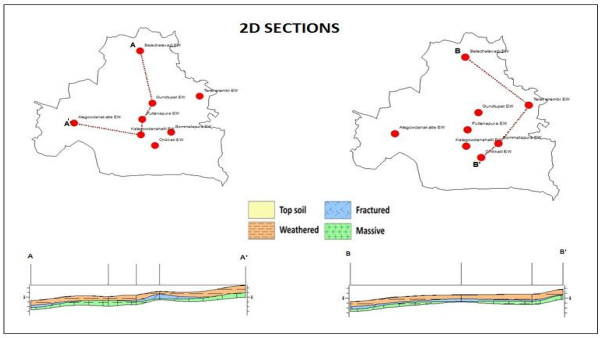
AQUIFER MAPS AND MANAGEMENT PLAN, GUNDLUPETE TALUK, CHAMARAJANAGARA DISTRICT, KARNATAKA STATE

(AAP: – 2020-2021)









By

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AUGUST 2022

AQUIFER MAPS AND MANAGEMENT PLAN, GUNDLUPETE TALUK, CHAMARAJANAGARA DISTRICT, KARNATAKA STATE

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AQUIFER MAPS AND MANAGEMENT PLAN, GUNDLUPETE TALUK, CHAMARAJANAGARA DISTRICT, KARNATAKA STATE

1 SALIENT INFORMATION

Name of the taluk: **GUNDLUPETE**

District: **CHAMARAJANAGARA**

State: Karnataka

Area: 1376 sq.km.

Population: 2,23,070

1.1 Aquifer Management Study Area

Aquifer Mapping Studies have been carried out in Gundlupete taluk, Chamarajnagara district of Karnataka, covering an area of 1376sq.kms under National Aquifer Mapping Project. The Gundlupete taluk is located between North Latitudes 11° 34' 56" and 12° 00' 31"and East Longitudes between 76° 24' 14" and 76° 51' 37". The study area is bounded on the East by Chamarajanagara taluk of Chamarajanagara District, on the North by Nanjangud Taluk of Mysore District, on the South by Tamil Nadu State, on the West by Kerala State. Location map of Gundlupete taluk of Chamarajnagara district is presented in **Fig-1**. Gundlupete is taluk headquarters. There are 158 villages and 34 Gram panchayats in this taluk.

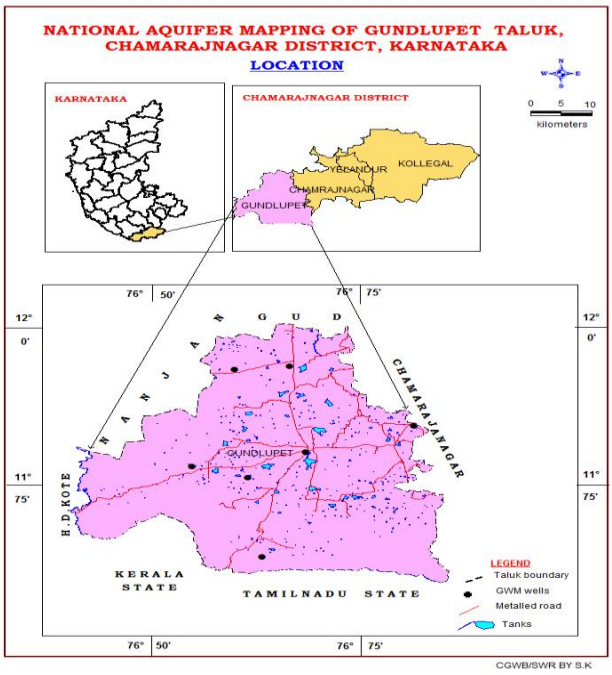

Fig-1: Location map

1.2 Population

According to 2011 census, the population in Gundlupete taluk is 2,23,070, in which 194965 male population and 28105 is the female population . The taluk has an overall population density of 195 persons per sq.km. The decadal variation in population from 2001-2011 is 4.7% in Gundlupete taluk.

1.3 Rainfall

Gundlupete taluk enjoys semi-arid climate. The normal annual rainfall in Gundlupete taluk for the period 1951 to 2000 is 772 mm. 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 Gundlupete taluk is collected from the District at Glance, Chamarajanagara report and is given in **Table.1.**

Table-1 Actual Annual Rainfall of GUNDLUPETE taluk from 2006 to 2016

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Rainfall (mm)	763	963	899	846	930	833	565	655	930	892	333.5

1.4 Agriculture & Irrigation

Agriculture is the main occupation in Gundlupete taluk. Major crops are Jowar, Maize, Ragi Tur, Pulses, Oil seeds, Fruits and Vegetables. Water intensive crops like Paddy and Tobacco are grown in Gundlupete Taluk **(Table.2).**

Table-2: Cropping pattern in GUNDLUPETE taluk 2016-2017 (Ha)

Principle crops grown in GUNDLUPETE Taluk

Crops	Cereals (Area in Ha)			Pulses (Area in Ha)					Fruits (Area in Ha)	Veg (Area in Ha)	Oil seeds (Area in Ha)			
	Jowar	Ragi	Maize	Tur	Horse gram	Avare	Cow pea	Bengal gram			Groundnuts	Sun flower	Castor	Sesame
	8458	753	638	507	8871	46	1390	461	2409	6135	6588	9272	257	39
Total	9849			11275					2409	6135	16156			
	Total Food grains - 21124								2409	6135	Total Oil seeds - 16156			

Source: District at a glance 2016-2017

It is observed that net sown area accounts 52164(Ha) and area sown more than once is 6526(Ha) of total geographical area in Gundlupete taluk **(Table-3).** Area under Forest is 44859(Ha) Area not available for cultivation and Fallow land cover 11372(Ha) and 15175(Ha) of total geographical area respectively. 10920 (Ha) of net area irrigated from Groundwater and 13136 (Ha) of Gross area irrigated from Ground water **(Table.4).**

Table-3: Details of land use in GUNDLUPETE taluk 2018-2019 (Ha)

Landuse pattern of GUNDLUPETE Taluk (Ha)

Geographical area	Area under Forest	Area not available for cultivation	Uncultivable land	Fallow land	Area Sown		
					Net sown area	Area sown more than once	Total sown/ Cropped area
140607	44859	11372	17037	15175	52164	6526	58690

Source: District at a glance 2016-2017

Table-4: Irrigation details in GUNDLUPETE taluk (in ha)

Details of irrigation in GUNDLUPETE Taluk

S.No	Source		No/Length	Net area irrigated	Gross area irrigated
1	Surface water	Canals	25.2	0	0
		Tanks	75	0	0
		Lift irrigation	1	0	0
2	Ground water	Dug wells	75	597	913
		Bore wells	7276	10323	12223
		Total	-	10920	13136

Source: District at a glance 2016-2017

1.5 Geomorphology, Physiography & Drainage

The geomorphology of the Gundlupete is formed by Southern maidan region plain to undulating mountainous. The southern and eastern ghat ranges converging into group of hills, the elevation in the taluk varies from 640m to 1687m in the taluk. 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 Gundlupete taluk falls in Cauvery river basin. The Drainage pattern is dendritic to subdendritic **(Fig.-3).**

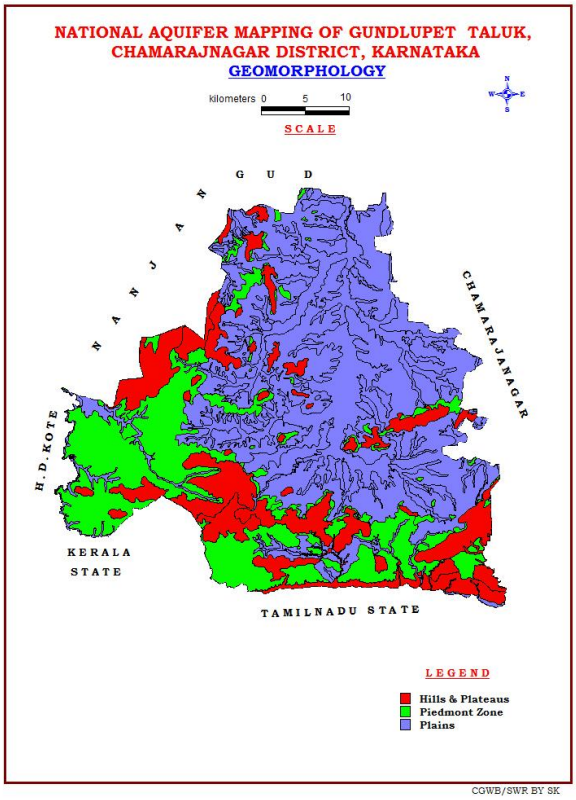

Fig-2: Geomorphology Map

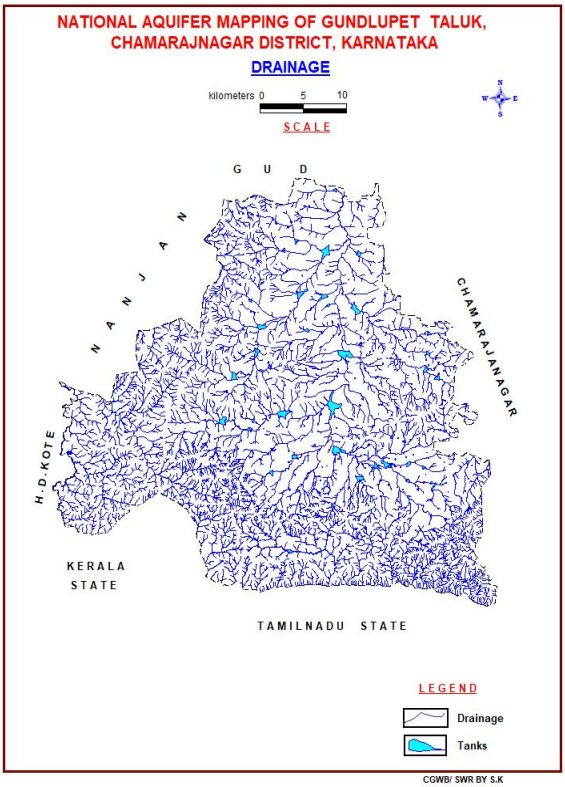

Fig-3: Drainage Map

1.6 Soil and Landuse

The soils of Gundlupete taluk can broadly be classified into Clayey to clayey mixed greyish sandy loam soil and mixed soils. These soils vary in depth and texture, depending on the parent rock type, physiographic settings and climatic conditions **(Fig-4).** Landuse map shown in **Fig.5**

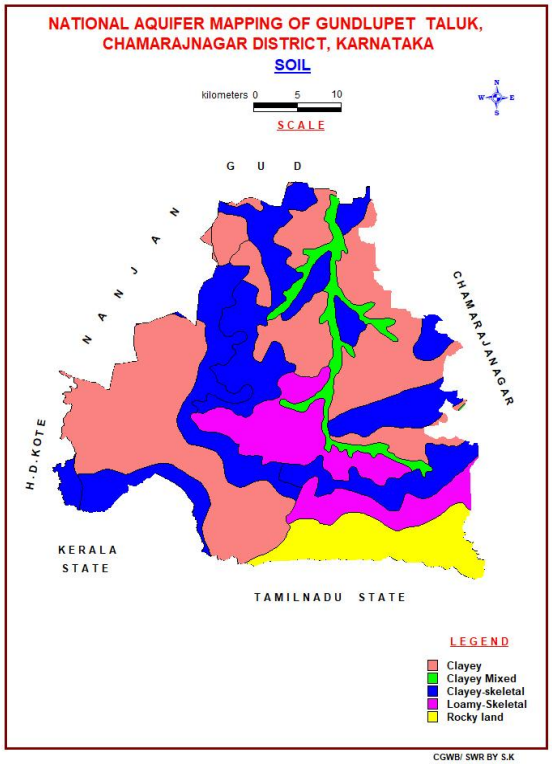

Fig-4: Soil Map

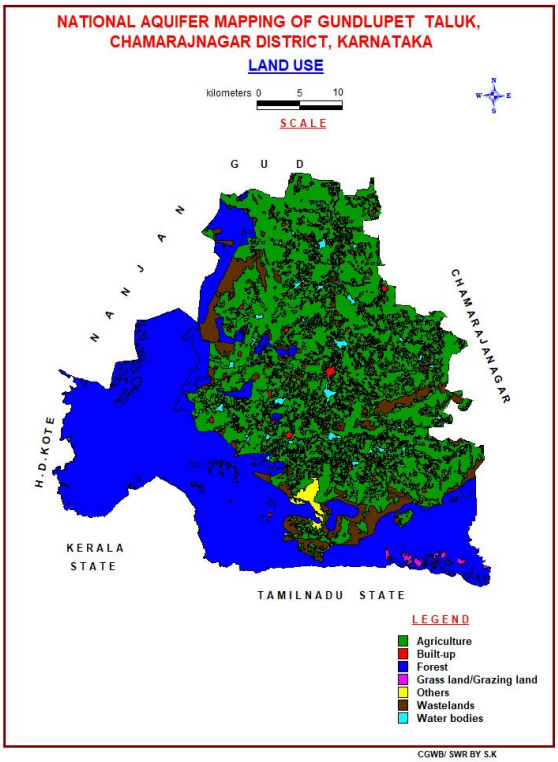

Fig-5: Land use Map

1.7 Ground water resource availability and extraction

As per the ground water resource estimation 2017 **(Table 5a),** the data on ground water resources shows that the net annual ground water availability is 6341 ham. The existing gross groundwater for irrigation is 7192 ham. The stage of groundwater development is 127% and falling under 'Over Exploited' category.

Aquifer wise total ground water resources up to 175 m depth is given in **Table-5b** below.

Table.5.a Dynamic Ground Water Resource, (March 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 Develop-ment	Existing Stage of Ground Water Development	Category
6341	7192	867	8059	1127	82	127	Over Exploited

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

Taluk	Annual replenishable GW resources	Fresh In-storage GW resources		Total availability of fresh GW resources
Gundlupete	38831	Phreatic	Fractured (Down to 150m)	Dynamic + phreatic in-storage + fractured
		48641	8359	95831

1.8 Existing and future water demands (as per GWRA-2017 and 2020)

The details of dynamic (Phreatic) ground water resources for Gundlupete taluk as on March 2020 is shown in **Table.6.** It is observed that the stage of ground water extraction is slightly decrease in the taluk from 127 % to 121 % from 2017 to 2020.

Table.6 Detail of Dynamic Ground Water resource, (as on March 2020)

Annual Extractable GW Resource (Ham)	GW Extraction for Irrigation Use (Ham)	GW Extraction for Industrial Use (Ham)	GW Extraction for Domestic Use (Ham)	Total Extraction (Ham)	Annual GW Allocation for for Domestic Use as on 2025 (Ham)	Net GW Availability for future use (Ham)	Stage of GW Extraction (%)	Categorization (Over-Exploited/ Critical/ Semi-critical/ Safe/Saline)
7242.52	7775.50	0.00	1007.12	8782.62	1373.70	262.02	121.26	Over Exploited

1.9 Water level behavior

Depth to Water level in GUNDLUPETE Taluk

	Pre monsoon		Post monsoon	
	Aquifer-I	Aquifer-II	Aquifer-I	Aquifer-II
Range	3.31-19	4.89-35.8	1.48-18.2	6.02-33.29
Average	8.18	23.11	5.93	19.91

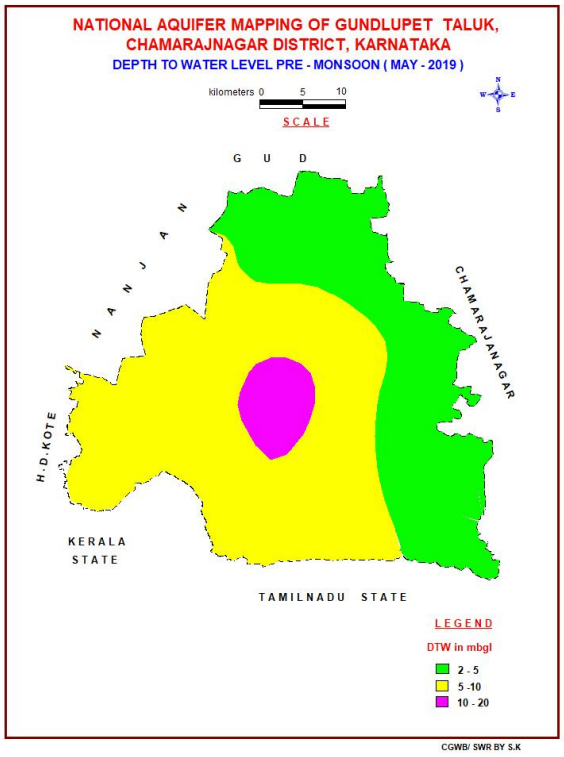

Fig-6: Pre-monsoon Depth to Water Level

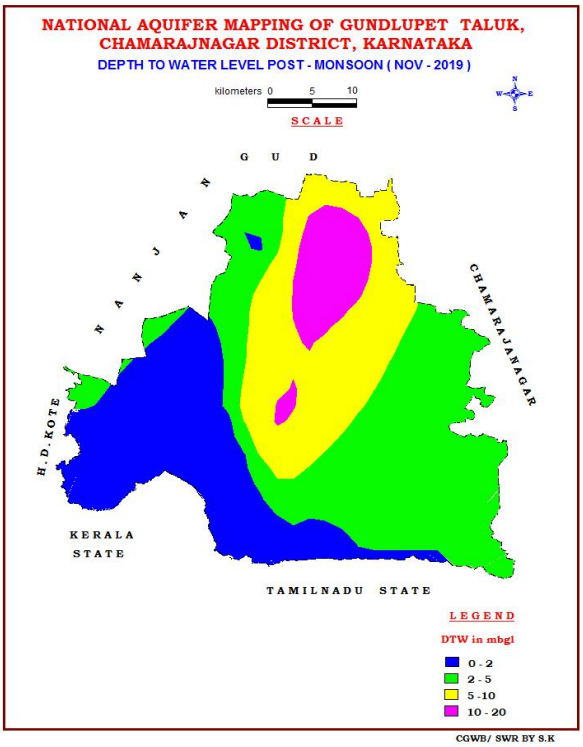

Fig-7: Post-monsoon Depth to Water Level

2 AQUIFER DISPOSITION

2.1 Aquifer Types

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

i. Aquifer-I (Phreatic aquifer) comprising Weathered Banded gneissic complex

ii. Aquifer-II (Fractured aquifer) comprising Fractured Banded gneissic complex

In Gundlupete taluk, Banded gneissic complex is the main water bearing formations **(Fig-8).** Ground water occurs within the weathered and fractured Schist, Granite and Granitic gneiss under water table condition and semi-confined condition. In Gundlupete taluk bore wells were drilled from a minimum depth of 40mbgl to a maximum of 175mbgl. Depth of weathered zone ranges from 5mbgl to 30mbgl. Ground water exploration reveals that aquifer-II fractured formation was encountered between the depths of 75 to 175mbgl. Yield ranges from Negligible to 12.03lps. The basic characteristics of each aquifer are summarised in **Table-7.**

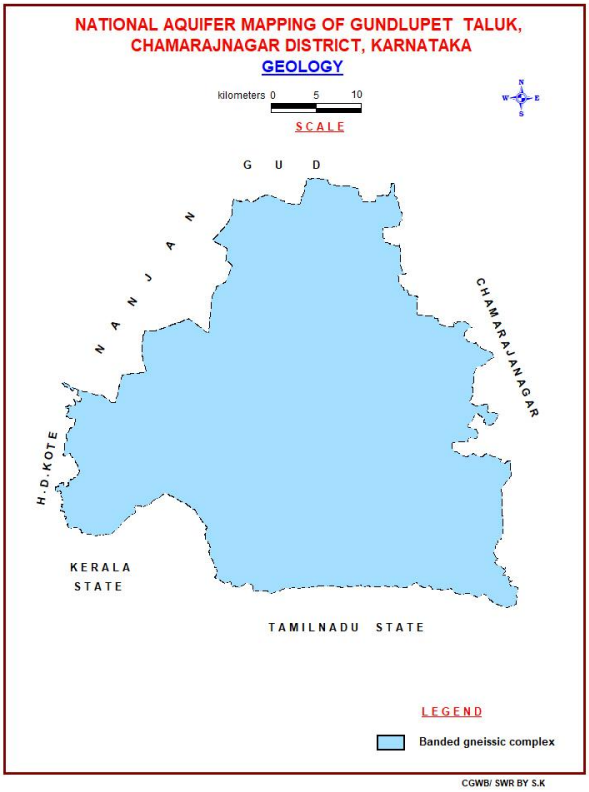

Fig-8: Geology map

Table-7: Basic characteristics of each aquifer

Aquifers	Weathered Zone (Aq.-I)	Fractured Zone (Aq.-II)
Prominent Lithology	Weathered Granitic gneiss	Fractured Granitic gneiss
Thickness range (mbgl)	6-35	Fractures upto 160 mbgl
Depth range of occurrence of fractures (mbgl)	-	75-175
Range of yield potential (lps)	-	<1 – 12.03
T (m^2/day)	-	5-951

2.2 3D aquifer disposition and Cross-Sections

Aquifer disposition – Rockworks output **(Fig.8,9,10)**

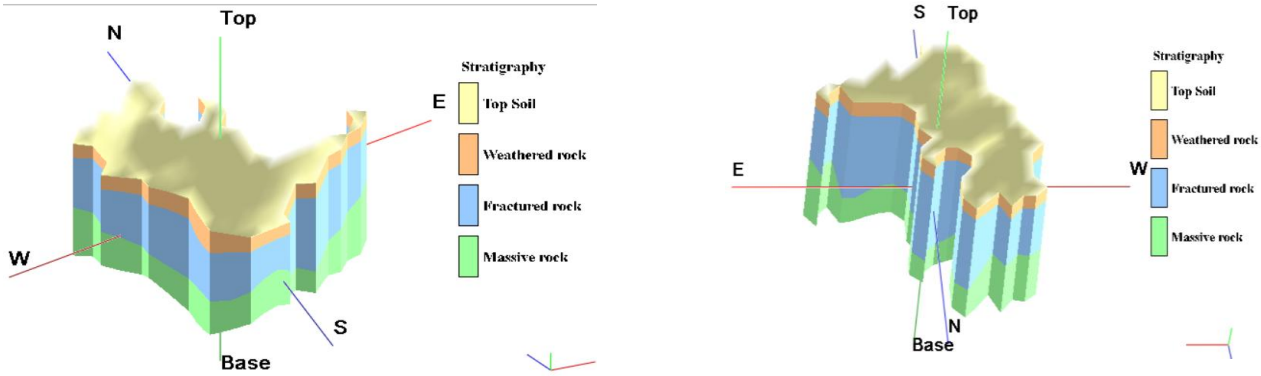

Fig-9: 3D Aquifer Dispositions

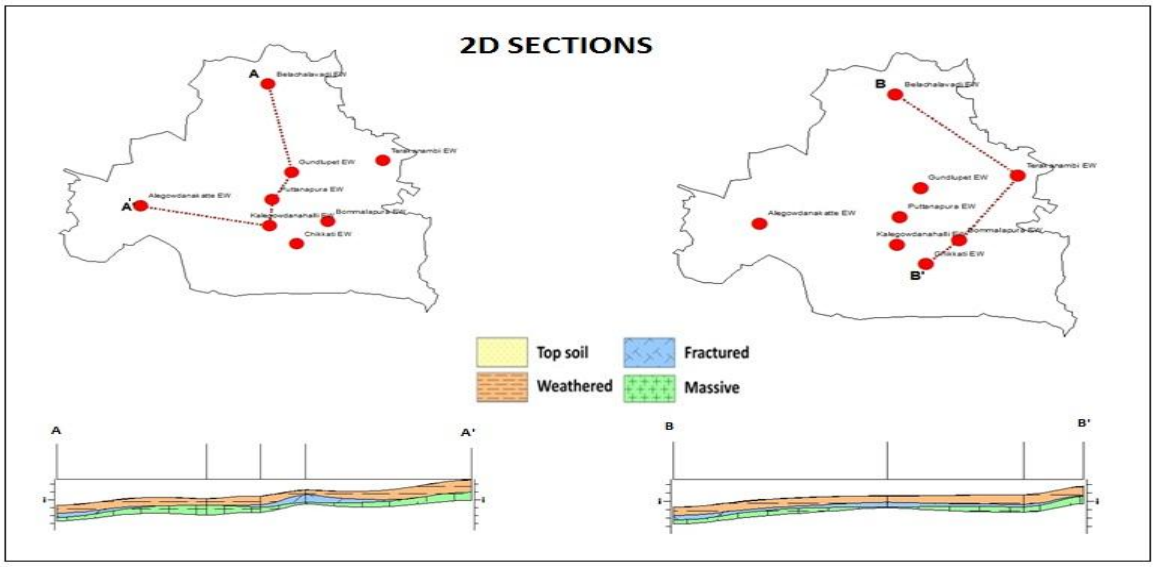

Fig-10: 2D Cross sections in different directions

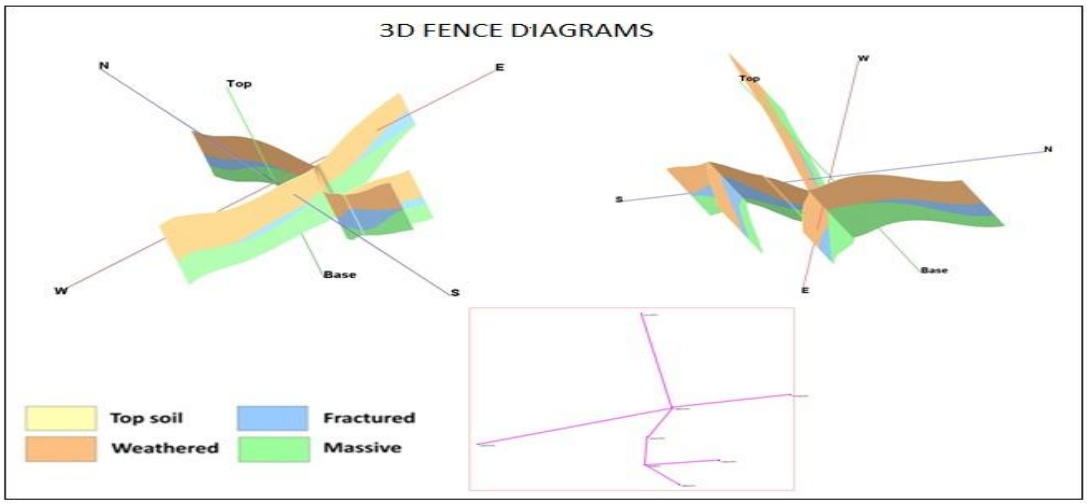

Fig-11: 3D Aquifer Fence Diagram

3 Ground water resource, extraction, contamination and other issues

The main ground water issues are over exploitation, Limited Ground Water Potential / Limited Aquifer Thickness / Sustainability, deeper water levels especially in Aquifer II, 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 already been summarised above and are shown in **Table 8**. It is observed that the ground water availability in 2020 is more compare to 2017 due to increase in rainfall and in water table. 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 govt. and other agencies.

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

Taluk	March 2017			March 2020		
	GW availability	GW Extraction	Stage of GW development	GW availability	GW Extraction	Stage of GW development
Gundlupete	6341	8059	127	7242.52	8782.62	121.26

3.2 Chemical quality of ground water and contamination

Interpretation from Chemical Analysis results in Gundlupete taluk is mentioned as under:

- **ELECTRICAL CONDUCTIVITY:** In general, EC values range from 1030 to 1400 µ/mhos/cm in the aquifer-I at 25°C
- **NITRATE:** Nitrate concentration in ground water ranges from 1 to 18 mg/l in the Aquifer –I
- **FLUORIDE:** Fluoride concentration in ground water ranges between 0.2and 0.61mg/l in the aquifer-I

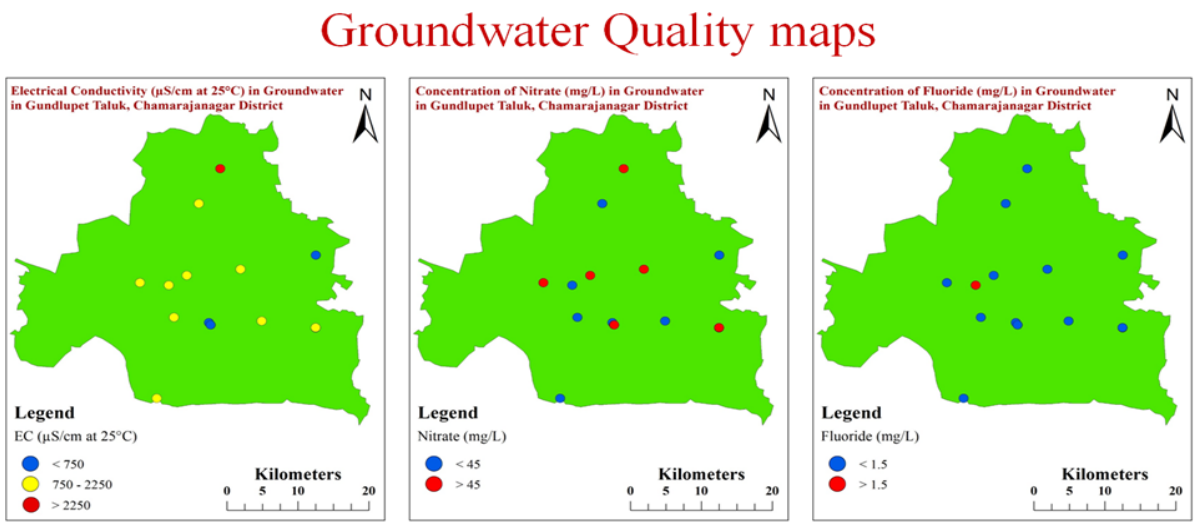

Fig-12: GW Quality Maps

4 GROUND WATER RESOURCE ENHANCEMENT

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-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.

Table-9: Quantity of non-committed surface runoff & expected recharge through AR structures

Details of Artificial Recharge structures in GUNDLUPETE Taluk		
S.No	**Artificial recharge structures available/proposed**	
1	Non committed monsoon runoff available in (MCM)	179.144
2	No of sub surface dykes	5
3	No of Check Dams	923
4	No of percolation tanks	117
5	No of Filter beds	17
6	Tentative total cost of the project (Rs in lakhs)	11699.98
7	Expected Recharge in (MCM)	57.16
8	Expected Rise in water level in (m)	0.095
9	Cost benefit ratio (Rupees/Cubic.m of water harvested)	10.05

After implementation of Artificial Recharge structures for GW recharge, the annual ground water availability will increase from 7242.52 to 12958.52 ham and the expected improvement in stage of development is 53.5% from 121% to 67.7%.

Table-10 Improvement in GW availability due to Recharge, GUNDLUPETE taluk

Details of Resource enhancement after proposed artificial recharge structures of GUNDLUPETE Taluk		
S.No	Resource Details	As per 2020 Estimation
1	Net Groundwater Availability in Ham	7242.52
2	Existing stage of Ground water development in %	121.26
3	Existing Gross Groundwater Draft for all use in Ham	8782.62
4	Expected recharge from Artificial recharge projects Ham	5716
5	Cumulative annual groundwater availability in Ham	12958.52
7	Expected improvement in stage of ground water development after implementation of project in %	53.5
8	Expected improvement in overall stage of ground water development in %	67.77

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 Benefit 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

It is observed that presently, in the command areas, canals are the source of irrigation and in non-command areas, ground water through bore/tube wells is used for irrigation purpose. But in this taluk Groundwater is the only main source for irrigation. Water use efficiency measures have to be adopted for saving the ground water resources.

Efficient irrigation practices like Drip irrigation and sprinkler has to be adopted by the farmers in the existing 13136 ha of gross irrigated area. Presently, groundwater extraction for irrigation is 7775.5 ham. It is proposed to adopt micro irrigation (drip) techniques in fruits and vegetables (8544 ha) as well as water intensive sugarcane grown area (68 ha). It is assumed that 50% of this area i.e., 4272 and 34 ha

is irrigated by ground water. Implementation of efficient irrigation techniques will contribute in saving ground water by 551 ham and thus enhancing the cumulative net availability of ground water from 12958.52 ham to 13509.52 ham. Implementation of efficient irrigation techniques will contribute in saving ground water by 551 ham. Thus, will improve stage of extraction by 2.77% from 67.77% to 65% **(Table 11).**

4.2.2 Grey Water Utilization

As per data 540 ham of domestic grey water is available. It is suggested to put 50% of this grey water to secondary treatment and use the treated water either for irrigation or recharging the tanks and ponds. Thus 270 ham of treated sewage water can be utilized for gainful purposes thereby reducing the load on fresh groundwater. The resource enhancement by grey water use will bring the stage of extraction from 65% to 63.7%.

Table 11: Improvement in GW availability due to saving by adopting water use efficiency and Grey Water

Sl No.	Resource Details	As per 2020 Estimation
1	Cumulative Ground Water availability after implementation of artificial recharge schemes (ham)	12958.52
2	Existing Ground Water Extraction for all uses in ham	8782.62
3	Expected improvement in stage of Ground Water extraction after implementation of artificial recharge schemes	67.77%
4	Saving due to adopting Water Use Efficiency measures in ham a. **Fruits & Vegetables** irrigated by GW – 2467 ha, CWR by surface flooding – 0.50m, CWR by drip irrigation – 0.375 m, Savings – 0.125 b. **Sugarcane** irrigated by GW – 241 ha, CWR by surface flooding – 2.00 m, CWR by drip irrigation – 1.50 m, Savings – 0.50	551 ham 534 ham 17 ham
5	Additional saving by adopting Grey Water (50% of Available grey water) in ham	270
6	Cumulative Ground Water Availability after adopting WUE and Grey water in ham	13779.52
7	Expected improved stage of Ground Water extraction after implementation of all interventions (%)	63.7
8	Total water likely to be saved after all interventions (ham)	6537

4.2.3 Regulation and Control

Gundlupete taluk has been categorized as **Over Exploited**, since the Stage of ground water extraction has reached **121.26%** (GEC 2020). Hence, stringent action has to be taken up through Karnataka Ground Water Authority to control ground water exploitation in the taluk**.** Ground water recharge component needs to be made mandatory in the taluk to save the situation from deteriorating further.

5 SUMMARY

The main ground water issues are over exploitation, limited Ground Water Potential / Limited Aquifer Thickness / Sustainability, deeper water levels particularly in Aquifer II in some parts, semi-urbanized areas which are all inter-related or inter dependent along with nitrate contamination in some parts. The summary of ground water management plan of Gundlupete taluk is given in **Table-12.**

Table 12: Summary of Management plan

Stage of GW Extraction and Category (2020)	121.26%, Over Exploited
Annual Extractable GW Resource (Ham)	7242.52
Total Extraction (Ham)	8782.62
Ground Water Draft for Irrigation (Ham)	7775.5
Ground Water Resource Enhancement by Supply side Interventions	
No of Proposed AR structures SSD PT CD FB	 5 117 923 17
Expected Additional Recharge to GW due to AR (Ham)	5716
Total Estimated Expenditure (Rs. in Lakhs.)	11699.98
Additional Irrigation Potential that can be created (Lakh Ha)	0.162
Change in Stage of GW Extraction (%)	121.26 to 67.77

Ground Water Resource Enhancement by Demand side Interventions	
Expected Saving due to adopting WUE measures (ham)	551
Change in Stage of GW Extraction (%)	67.77 to 65
Expected Saving by adopting Grey water re-use (ham)	270
Change in Stage of GW Extraction (%)	65 to 63.7
Cumulative Ground Water availability by adopting all interventions (ham)	13779.52
Change in Stage of GW extraction after adopting all interventions, %	121.26 to 63.7
Total water likely to be saved after all interventions (ham)	6537

As per the resource estimation – 2020, Gundlupete taluk falls under Over Exploited category with the stage of ground water extraction 121.26%. However, there is need to formulate management strategy to tackle the over exploitation, water scarcity related issues and nitrate contamination in the taluk. It is suggested to adopt a scientific and multi-pronged ground water management strategy covering supply side and demand side interventions 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 179.144 MCM. This can be used to recharge the aquifer through Sub surface dykes (5), Percolation tanks (117), Check dams (923) and Filter beds (17). The volume of water expected to be recharged is 5716 ham through these AR structures. The approximate cost estimate for construction of these AR structures is Rs. 11699.98 lakhs. 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 overall irrigation is by bore wells (ground water). It is proposed to adopt micro irrigation (drip) techniques in fruits and vegetables (8544 ha) as well as water intensive sugarcane grown area (68ha). It is assumed that 50% of this area i.e., 4272 and 34 ha is irrigated by ground water. Implementation of efficient irrigation techniques will contribute in saving ground water by 551 ham and thus enhancing the cumulative net availability of ground water from 12958.52 ham to 13509.52 ham. Implementation of efficient irrigation techniques will contribute in saving ground water by 551 ham.

Grey water utilization: As per data 540 ham of domestic grey water is available. It is suggested to put 50% of this grey water to secondary treatment and use the treated water either for irrigation or recharging the tanks and ponds. Thus 270 ham of treated sewage water can be utilized for gainful purposes thereby reducing the load on fresh groundwater.