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

Siruguppa Taluk, Bellary District, Karnataka

दक्षिण पश्चिमी क्षेत्र, बेंगलुरु
South Western Region, Bengaluru

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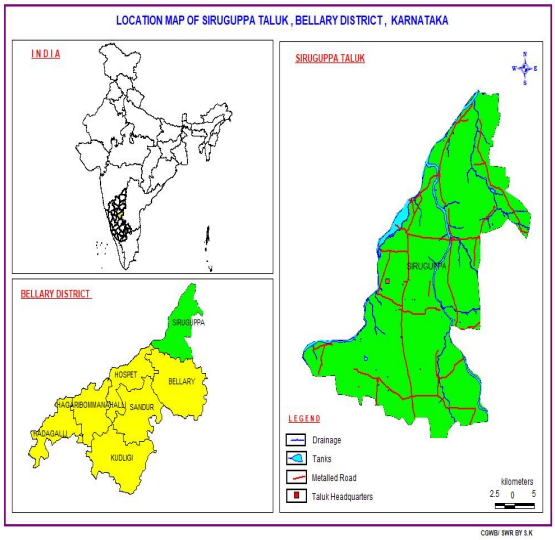
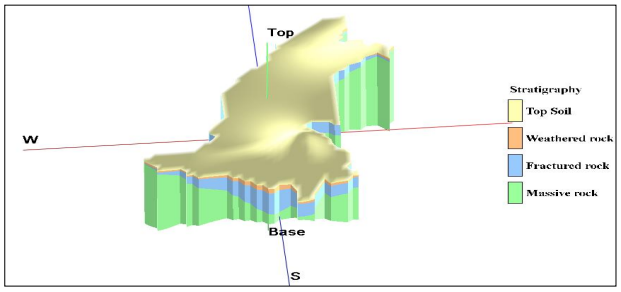
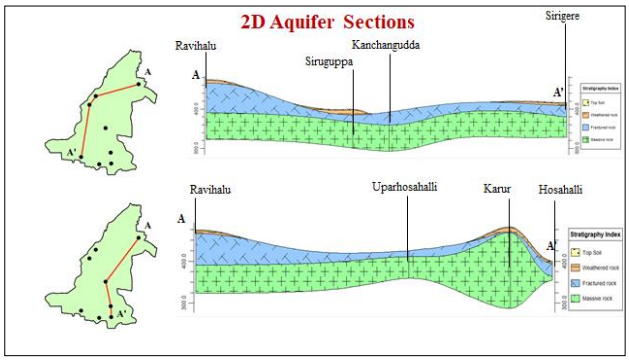
AQUIFER MAPS AND MANAGEMENT PLAN, SIRUGUPPA TALUK, BELLARY DISTRICT, KARNATAKA STATE

(AAP – 2021-2022)







By

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AUGUST 2022

AQUIFER MAPS AND MANAGEMENT PLAN, SIRUGUPPA TALUK, BELLARY DISTRICT, KARNATAKA STATE

(AAP – 2021-2022)

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AQUIFER MAPS AND MANAGEMENT PLAN, SIRUGUPPA TALUK, BELLARY DISTRICT, KARNATAKA STATE

1 SALIENT INFORMATION

Name of the taluk: **Siriguppa**

District: Bellary;

State: Karnataka

Area: **1040** sq.km.

Population: **269104** (Census, 2011)

Annual Normal Rainfall: **667** mm

1.1 Study area

Aquifer mapping studies have been carried out in Siriguppa taluk, Bellary district of Karnataka, covering an area of 1040 sq. kms under National Aquifer Mapping Project. Siriguppa taluk of Bellary district is located between North Latitudes 15°38' and 15°63' and East Longitudes between 76° 9' to 75°54' and is falling in Survey of India Toposheets No 57B/13, 14,15 and 57 E/1,2 and 3. The study area is bounded on the North by parts of Sindhanur and Manvi taluks Raichur district & Aloor taluk of Kurnool district of Andhra Pradesh, on the East by Andhra Pradesh, on the South by Bellary and Hospet taluk of Bellary district and by Koppal and Raichur district on the west. Location map of Siriguppa taluk of Bellary district is presented in **Fig-1**. Siriguppa is taluk head quarter and there are 84 inhabited villages in this taluk.

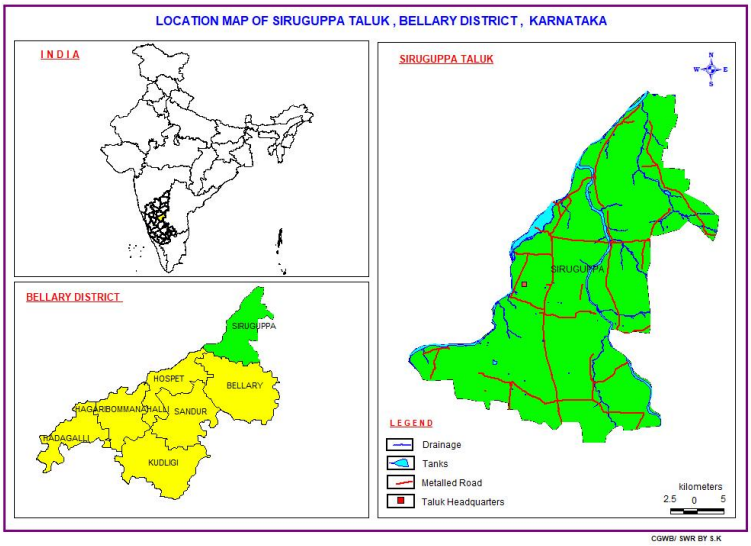

Fig 1: Location Map

1.2 Population

According to 2011 census, the population in Siriguppa taluk is 269104. Out of which 134246 are males and 134858 are females. Rural population is 190388 and urban population comprises of 78716. The average sex ratio of Siriguppa taluk is 1005. The Siriguppa taluk has an overall population density of 259 persons per sq.km. The decadal variation in population from 2001-2011 is 14.34 % in Siriguppa taluk. Total households in the taluk are 52180.

1.3 Rainfall

The climate of the taluk is characterized by dryness in the major part of the year and a hot summer. The period from December to February is the dry, comparatively cold season. The summer season starts from March to May is followed by the south-west monsoon season from June to September. October and November form the retreating monsoon or post monsoon season. In December the mean temperature is the lowest, the mean daily minimum temperature is 16.7^{0}C and the mean daily maximum temperature is 29.7 ^{0}C.

The area falls under Northern dry agro-climatic zone of Karnataka state and is categorized as drought prone. The climate of the study area 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 rainfall data in respect of Siriguppa station from the year 2007 to 2017 is analyzed and presented in **Table-1**. Normal annual rainfall in Siriguppa taluk for the period 2007 to 2017 is 683 mm. Seasonal rainfall pattern indicates that, major amount of (447 mm) rainfall was recorded during South-West Monsoon seasons, which contributes about 65% of the annual normal rainfall, followed by North-East Monsoon season (161 mm) constituting 24% and remaining (76 mm) 11% in Pre-Monsoon season. Overall the rainfall is scanty and unevenly distributed.

Table1: Annual Rainfall Data of Siriguppa taluk, Bellary district (2007 to 2017)

STATION		2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Annual
Siriguppa	Rainfall (mm)	600.7	908.5	535.5	1291.8	943.9	372.8	511.7	616.5	529.6	456.1	729.8	683

Table 2 presents the normal annual rainfall from the period 1981-2010. The data pertaining to gauges is of long-term nature and are well maintained. It is presumed that they are representative of the taluks and the same is used for analysis. Computations were carried out for the 30-year blocks of 1981-2010, the mean monthly rainfall at Siriguppa taluk is ranging between 1 mm during February to 158 mm during September. The coefficients of variation percent for pre-monsoon, monsoon and NE monsoon are 81, 36 & 69 percent respectively. Annual CV at this station works out to be 31 percent. Standard Deviation for pre-monsoon, monsoon and NE monsoon are 56,164 and 112 respectively.

Table 2: NORMAL ANNUAL RAINFALL (1981-2010), SIRIGUPPA TALUK, BELLARY DISTRICT

	Jan	Feb	Mar	Apr	May	PRE MONSOON	Jun	Jul	Aug	Se	MON SOON	Oct	Nov	Dec	NE MONSOON	Annual
NRM	4	1	7	17	40	**70**	106	73	117	158	**454**	126	29	6	**162**	**686**
STDEV	9	4	18	26	51	**56**	84	50	86	107	**164**	97	58	14	**112**	**214**
CV%	229	358	247	153	126	**81**	79	68	74	68	**36**	77	199	223	**69**	**31**

1.4 Agriculture & Irrigation

Agriculture is the main occupation in Siriguppa taluk. Major Kharif crops are Paddy, Jowar, Maize, Bajra, Bengal gram and Vegetables. Main crops of Rabi season are Jowar, Maize and Bajra **(Table 3).** Water intensive crops like paddy and sugarcane are grown in an area of 44416 ha and 370.2 ha respectively. Among pulses, Bengal gram is grown extensively in an area of 2463.98 ha. Paddy is grown in 60 % of total net area sown of taluk. Jowar & Bengal gram are grown in 8 % and 3 % of net area sown respectively. The taluk is referred as the land of paddy and is one of the largest producers of rice in the state of Karnataka. 184592 tonnes of paddy were produced during the year 2013-14 which is the highest for any crop in the entire district.

Table 3: Cropping pattern in Siriguppa taluk 2017-2018 (Ha)

Year	Paddy	Jowar	Maize	Bengal Gram	Pulses	Oil seeds	Sugar cane	Cotton
2017-18	44416	5857.8	754.97	2463.98	2772.61	139.7	370.2	34111.32

It is observed that net sown area accounts 71 % and area sown more than once is 19% of total geographical area in Siriguppa taluk **(Table-4).** Area not available for cultivation and Fallow land cover 3 % & 8% of total geographical area respectively. 62 % of net area irrigated is only from canals and 25% from lift irrigation **(Table-5 & Fig.2).** Hence, surface water is an important source of irrigation than

ground water accounting for meeting 87% of irrigation needs and groundwater accounting for meagre 9% only.

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

Taluk	Total Geographical Area	Area under Forest	Area not available for cultivation	Total Fallow land	Net sown area	Area sown more than once
Siriguppa	104000	2171	3008	8815	73546	19361

Source: District at a Glance 2017-18, Govt. of Karnataka

Table 5: Irrigation details in Siriguppa taluk (ha)

Source of Irrigation	Km in length/No.	Net area irrigated	% of area
Canals	87 km	26255.30	62
Tanks	0	0	--
Wells	290	251	0.6
Tube/Bore wells	735	3510	8.3
Lift Irrigation	2014	10431	25
Other Sources		1822	4.3
Total		42269.3	

Source: District at a Glance 2017-18, Govt. of Karnataka

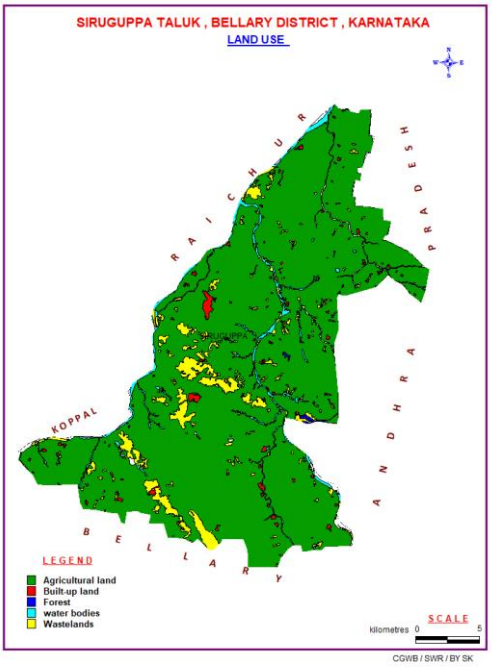

Fig. 2: Land Use and Land cover

1.5 Geomorphology, Physiography & Drainage

Siriguppa taluk falls in the northern dry region with flat terrain dotted by rocky hills. The taluk is more or less vast plain at an average elevation of 373 m above mean sea level. The minimum elevation is 351 m and the maximum is 470 m above mean sea level. The general slope is towards

northward which is along Tungabhadra River. **(Fig.3)**. The hilly portion are restricted in the central and southern part of the taluk.

The entire Siriguppa taluk falls in Krishna River basin and Tungabhadra River which is a tributary of Krishna River drains the western boundary of the taluk adjoining Raichur. Hagari also called as Vedavathi the other tributary originates near Mullaianagiri hills in Chikamagalur district and enters the eastern part of the Bellary district and drains Hadagali and Kudligi taluks before joining to Tungabhadra after travelling 92 kms at Bagavadi village in Siruguppa taluk. Hagari is a 6th order stream with a form factor of 0.6. Drainage density of Hagari river is 1.7 with an average slope of 1.75.Some small streams and nallas like Mylapuram, Manur, Sugur are also present which have dried over the years. The Drainage pattern is dendritic to sub-dendritic **(Fig. 4).** It is denser in the northern part compared to southern part.

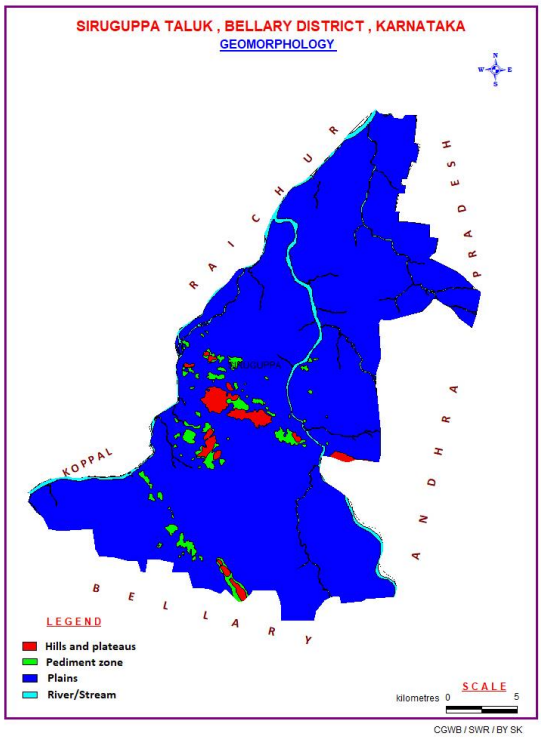

Fig-3: Geomorphology Map

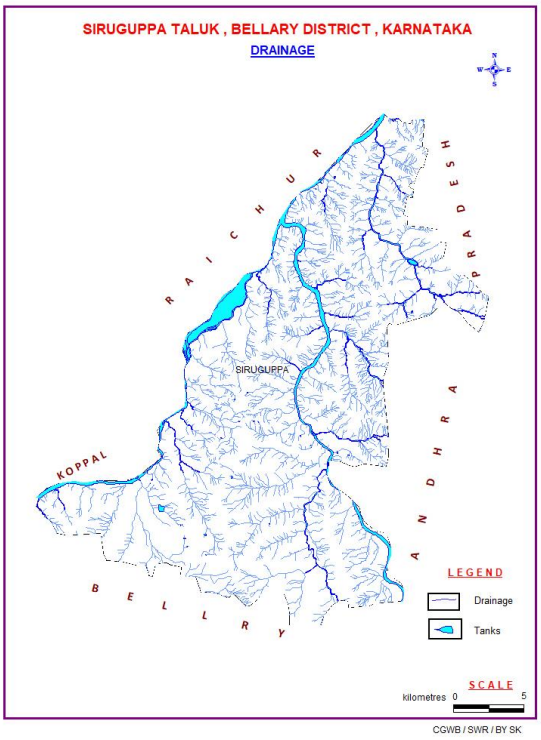

Fig-4: Drainage Map

1.6 Soil

The soil type found in the taluk is of the black and red varieties. The soil is rich in calcium and poor in nitrogen, phosphate and potash. The soils are mainly of the deep black cotton type which is the result of disintegration of Hornblende schist which is the derivations of old volcanic flows of metamorphic lava. Under rainfed condition, these soils yield the crops of jowar, groundnut and cotton and when suitably irrigated, yield paddy and sugarcane as well. **(Fig. 5).** Clay content is high in the soil type with rocky land in the hill areas of central and southern portion of the taluk.

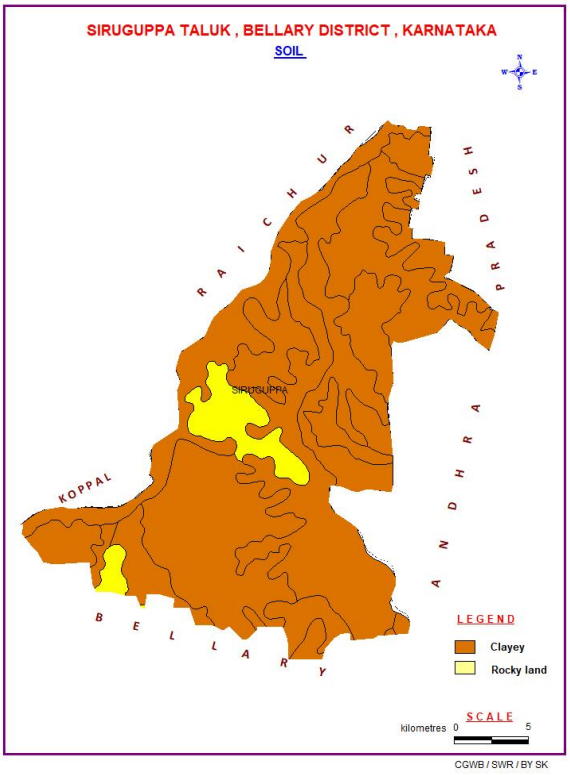

Fig. 5: Soil map

1.7 Ground water resource availability and extraction

Aquifer wise total groundwater resources up to 200 m depth are given in **Table-6** below.

Table-6: Total Ground Water Resources (2017) (Ham)

Taluk	Annual replenishable GW resources	Fresh In-storage GW resources		Total availability of fresh GW resources
Siriguppa	8418	Phreatic	Fractured (Down to 200m)	Dynamic + phreatic in-storage + fractured
		10209	2520	21147

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

- Net ground water availability for future irrigation development: 68.38 MCM
- Domestic and Industrial sector demand for next 25 years: 4.04 MCM

1.9 Water level behavior

(a) Depth to water level

Aquifer - I

- Pre-monsoon: 3.73 to 3.95 mbgl (**Fig.6**)
- Post-monsoon: 1.53 to 2.30 mbgl (**Fig.7**)

It is seen that in the major part of the taluk, the depth to water level is 2 to 5 mbgl during the pre-monsoon period.

Aquifer -II (State Groundwater Data)

- Pre-monsoon: 1.8 to 9.3 mgl
- Post-monsoon: 0.4 to 4.93 m bgl

(b) Water level fluctuation

Aquifer-I Seasonal Fluctuation: Rise ranges from 1.65 to 1.69 m bgl

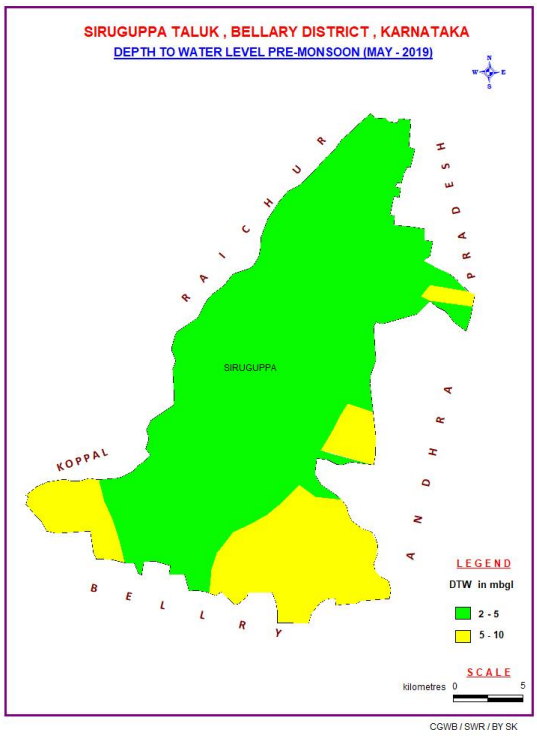

Fig-6: Pre-monsoon Depth to Water Level

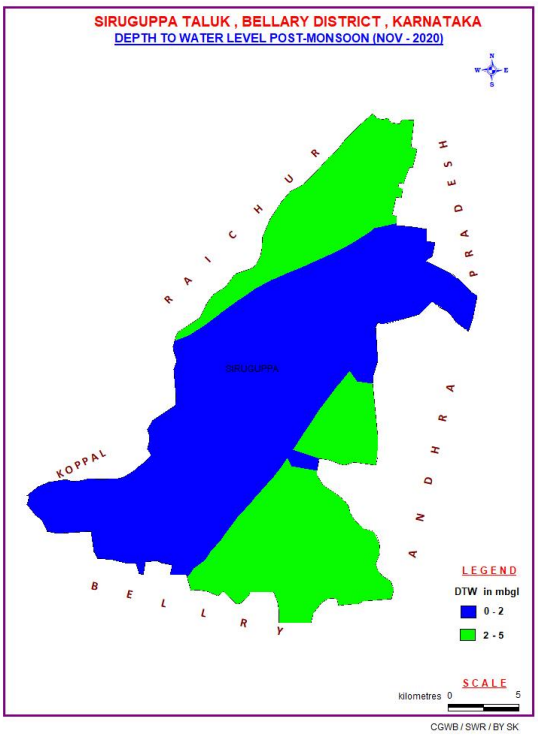

Fig-7: Post-monsoon Depth to Water Level

2 AQUIFER DISPOSITION

2.1 Aquifer Types

Mainly, two types of aquifer systems exist in the area;

i. **Aquifer-I (Phreatic aquifer)** comprising Weathered Granitic Gneiss
ii. **Aquifer-II (Fractured aquifer)** comprising Fractured Granitic Gneiss

Granitic Gneiss is the main water bearing formations **(Fig-8).** Ground water occurs within the weathered and fractured Granitic Gneiss under water table condition and in fractured Granitic Gneiss under semi-confined condition. In Siriguppa taluk, bore wells were drilled from a minimum depth of 141 mbgl to a maximum of 200 mbgl. Depth of weathered zone ranges from 7.92 mbgl to 20.05 mbgl. Ground water exploration reveals that aquifer-II, the fractured formation was encountered between the depth of 34.10 to 192.5 mbgl. Yield ranges from 0.01 to 5.24 lps (**Table 7**). The basic characteristics of each aquifer are summarized in **Table-8.**

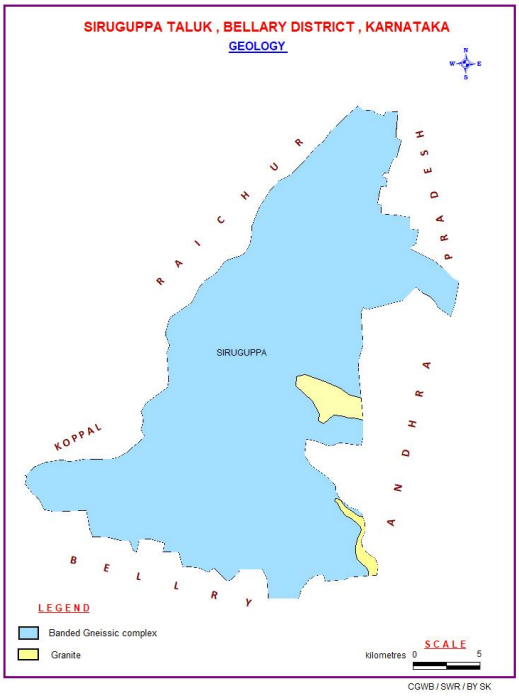

Fig-8: Geology Map

Table-7: Details of Ground Water Exploration

Location	Latitude	Longitude	Year of Drilling (FSP)	Depth Drilled (mbgl)	Casing length (m)	Lithology	Fracture Zones (m)	SWL (mbgl)	APT Results			
	DD	DD							Q (LPS)	DD (m)	T m2/day	
Siriguppa	15.650	76.892	2002-03	199.2	16.5	Banded Gneissic Complex	17.50, 24.50, 34.10, 65.40, 134.85191.90	5.24	1.73	23.67	2.73	
Karur	15.442	76.950	2002-03	199.25	12.15	Banded Gneissic Complex	6.75,9.8,15.9,38.25,179.9, 180.95	3.00	2.34	19.52	7.9	
Ravihalli	15.704	77.058	2002-03	179.6	7.92	Banded Gneissic Complex	5,11,26, 143	6.86	0.58	2.28		
Sindgeri EW	15.369	76.914	2001-02	193.75	19.65	Banded Gneissic Complex		10.87	6.3	7.71	40	
Sindgeri OW	15.369	76.914	2002-03	141	12.05	Banded Gneissic Complex	17.9,36,42,84,119	13.63	5.24	3.33	350	

Table-8: Basic characteristics of each aquifer

Aquifers	Weathered Zone (Aq.-I)	Fractured Zone (Aq.-II)
Prominent Lithology	Weathered Granitic Gneiss	Fractured / Jointed Granitic Gneiss
Thickness range (mbgl)	2 - 12	Fractures upto 192 mbgl
Depth range of occurrence of fractures (mbgl)	5-12	34-192
Range of yield potential (lps)	Poor yield	1 -5.24
T (m^2/day)	-	1 – 350
Quality Suitability for Domestic &Irrigation	Generally Suitable	Generally Suitable

2.2 2 D, 3 D aquifer disposition and basic characteristics of each aquifer

The sub-surface aquifer disposition of the study area was prepared based on the drilling data obtained from exploratory drilling programme for generating 2D and 3D sections and fence diagrams/models through Rock works software. The outputs thus generated are presented in **Fig 9(a), Fig 9 (b) and 9(c).**

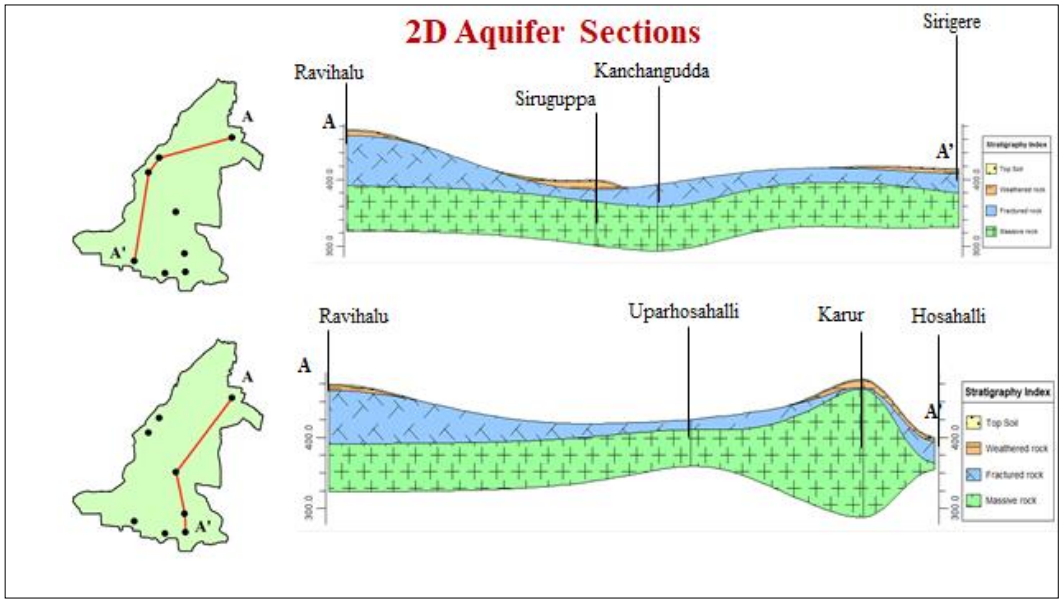

Fig 9 (a): The 2D aquifer dispositon, Siriguppa taluk, Bellary district

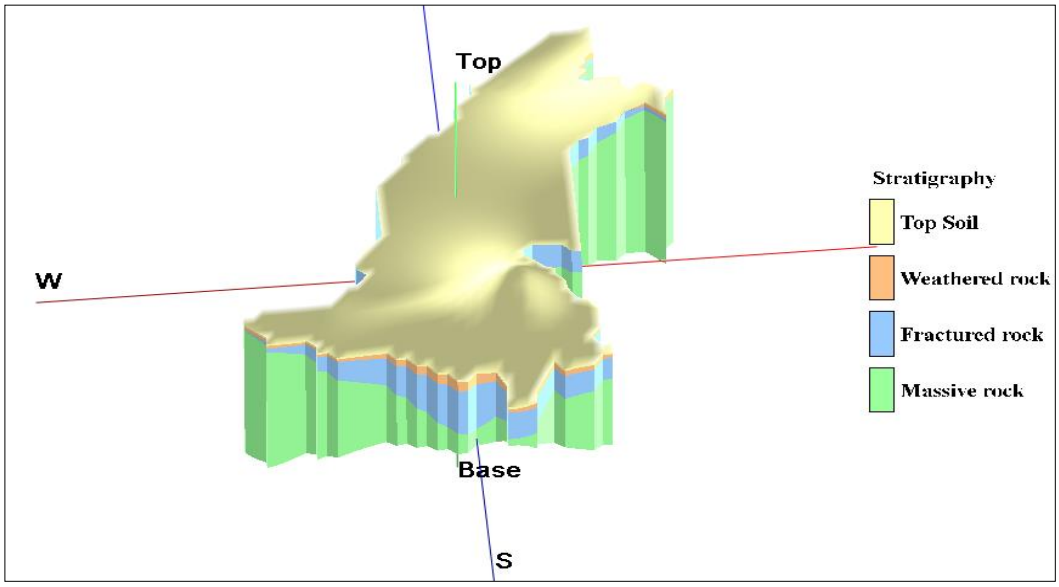

Fig 9 (b): The 3D Aquifer disposition, Siriguppa taluk, Bellary district

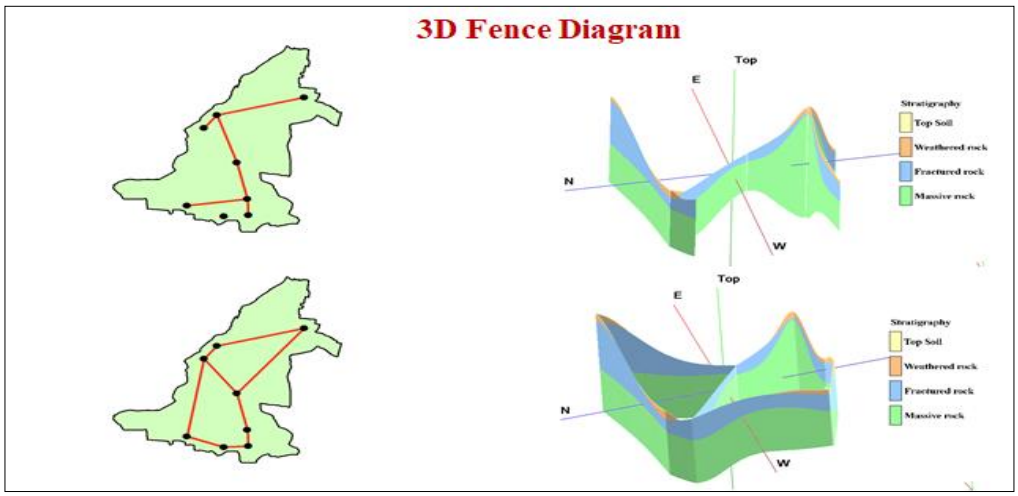

Fig 9 (c): The 3D Fence Diagram, Siriguppa taluk, Bellary district

3 0GROUND WATER RESOURCE, EXTRACTION, CONTAMINATION AND OTHER ISSUES

3.1 Groundwater Resource and Extraction

a) The ground water resource estimated as on 2017 is summarised below in **Table.9(a)**. The taluk is categorised as "Safe" with stage of ground water extraction of 16 % as on 2017. As mentioned above, Total Availability of Ground Water Resource (Phreatic + Phreatic In-storage + fractured In-storage)is estimated to be 21148 ham for the taluk.

Table.9 (a) Dynamic Ground Water Resource (2017) ham

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
Siriguppa	8418	1176	205	1381	404	6838	16	Safe

b)Ground Water Resource availability and Stage of extraction as on 2020

The Ground Water Resource availability and stage of extraction as on 2020 is shown in **Table.9(b).**

Table. 9(b) Ground Water Resource availability and stage of extraction as on 2020

Annual Extractable ground water resource (ham)	GW extraction for Irrigation use (ham)	GW extraction for Industrial use (ham	GW extraction for Domestic use (ham)	Total GW extraction (ham)	Stage of GW extraction (%)	Category	Annual GW allocation for Domestic use as on 2025 (ham)	Net GW availability for future use (ham)
8956	1367	0	418	1784	19.92	Safe	448	7142

3.2 Chemical quality of ground water and contamination

Interpretation from Chemical Analysis results (**Table.10**) from the Aquifer - I (NHS) in Siriguppa taluk is shown below:

Electrical Conductivity: In general, EC values range from 590 to 3700 µ/mhos/cm in the aquifer-I at 25°C (**Fig 10**).

Fluoride: Fluoride concentration in groundwater ranges between 0.98 to 4.50 mg/l in the aquifer-I (**Fig 11**).

Nitrate: Nitrate value ranges from 1 and 18 mg/l (**Fig 12**).

However, higher values of EC, fluoride and nitrate are observed in water samples collected from deeper fractured aquifers.

Table-10: Quality of ground water, 2019 (Aquifer-I) in Siriguppa taluk of Bellary district

Location	PH	EC µs/cm at 25°	TH as CaCO3 mg/L	Ca	Mg	Na	K	CO3	HCO3	Cl	SO4	NO3	F
				mg/l									
Ganikallu	8.98	590	160	28	22	32	40	54	146	41	17	10	4.50
Sirigeri	8.40	2700	370	50	59	220	43	33	177	383	118	18	0.98
Tekkalakote A	9.23	3700	295	54	39	472	41	96	445	540	165	1	3.10

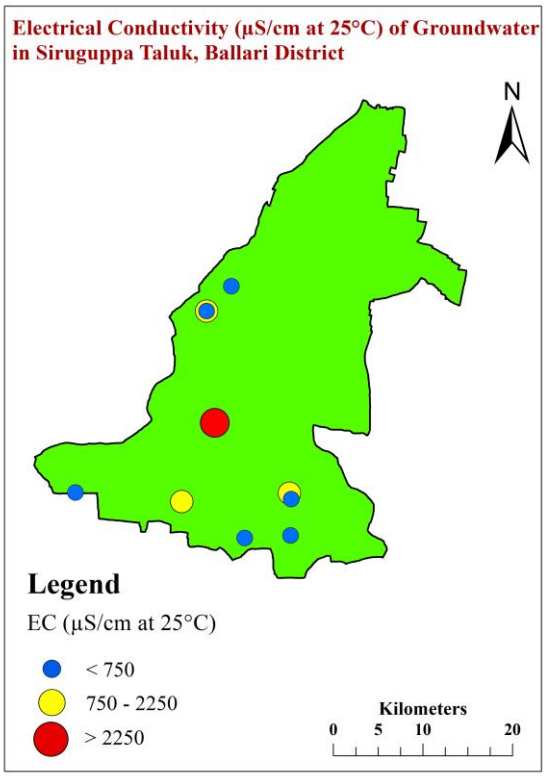

Fig.10: EC concentration

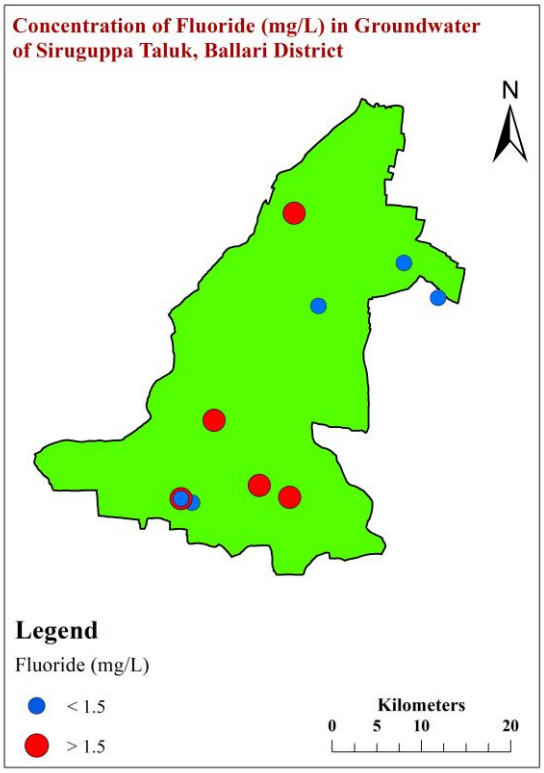

Fig 11: Fluoride concentration

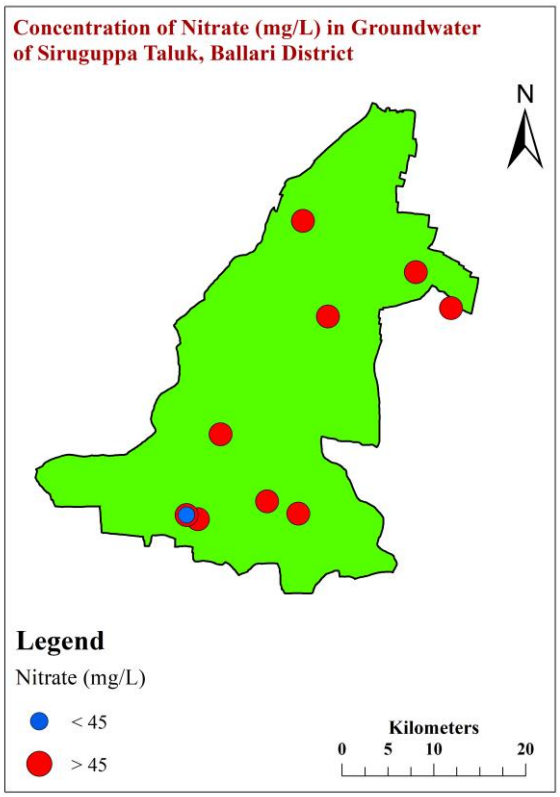

Fig 12: Nitrate concentration

4 GROUND WATER RESOURCE ENHANCEMENT

4.1 Resource Enhancement by Supply Side Interventions

Recharging dried-up phreatic aquifer (Aq-I) in the taluk, through construction of artificial recharge structures, viz; check dams and percolation tanks has already been taken up by state Government agencies and the area feasible for Artificial recharge is shown in **Fig 13.**

As of now, artificial Recharge structures like CD, MACD etc are being implemented under MGNREGA apart from the watershed treatment programmes. As per the District Irrigation Plan (DIP) report of 2016, 60 Check dams, 100 Farm Ponds, 6 Percolation Tanks, 599 Bore well Recharge structures, 25 *Nalla* bunds and 1050 Field Bunds were proposed for the taluk. Maintenance of the existing recharge structures is very much required to derive the maximum efficacy.

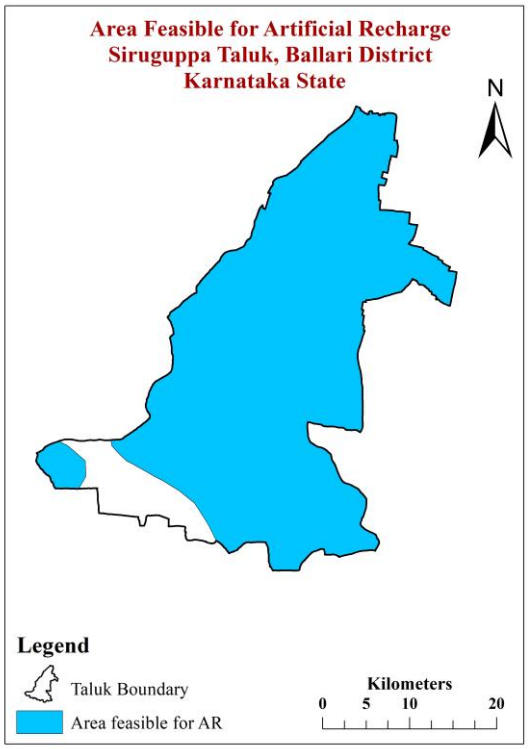

Fig 13: Area feasible for Artificial Recharge in Siriguppa taluk

4.2 Demand Side Interventions

4.2.1 Advanced irrigation practices

It is observed that groundwater through wells & borewells contribute only 9% of the source for irrigation in Siriguppa taluk. Balance 91% irrigation is from surface water of Tungabhadra River through canals. As abundant surface water is present in the taluk water intensive crops like paddy is grown. Present stage of ground water development is 16.4% (GEC 2017) and there is ample scope for development of groundwater. Thus, Water Use Efficiency (WUE) measures are suggested in the taluk

so that it can retain the same stage of ground water extraction. The farmer community must be aware of adopting such measures in tandem with development of groundwater which will contribute in ground water resource enhancement in the long run. Efficient irrigation practices like Drip irrigation need to be propagated among the farmers. (**Table-11**). Conjunctive use of surface and ground water is recommended in canal command areas to prevent water logging and change in soil quality.

Table-11: Improvement in GW availability due to saving by adopting water use efficiency

Taluk	Net Annual Ground Availability	Existing gross ground water draft for all uses	Stage of ground water development	Saving due to adopting WUE measures	Cumulative annual ground water availability	Expected improvement in stage of ground water development after the implementation of WUE	Expected improvement in overall stage of ground water development
	Ham	Ham	%	Ham	Ham		%
Siriguppa	8418.10	1381.31	16.4	352.479	8771.047	15.7	0.7

4.2.2 Other interventions proposed

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

4.2.3 Conjunctive Use in Water Logged areas

- Out of canal command area of 1011 sq km, an area of 97.29 sq.km is water logged due to excessive irrigation and poor drainage system in the canal command area. Though this area has been reclaimed, it is recommended that conjunctive use of surface and ground water in these areas need to be practiced to benefit the water deficit and tail end areas of the irrigation command.

5 SUMMARY AND CONCLUSIONS OF MANAGEMENT PLAN

- **Ground Water resource**: As per the resource estimation – 2020, Siruguppa taluk falls under "**Safe"** category with the stage of ground water extraction of **19.92** %. 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. The taluk is mostly covered by surface water for irrigation (91%). Ground is used for irrigation in the remaining area.
- **Ground water resource enhancement**: Agriculture is the main occupation of the people. Ground water is the source of water for irrigation in the non-command areas, mainly through bore wells. The area is prone to frequent droughts, particularly during the years of low rainfall below the normal. Increase in agricultural activity, ground water withdrawal and ground water quality related issues etc., suggests the need for scientific ground water management, enhancement of storage capacity of the aquifers and protection of ground water quality.
- **Advanced irrigation practices:** The important crops grown are paddy, jowar, bajra,maize,Ragi, Tur, cereals, grams, oil seeds, cotton and sugarcane. About 1008 sq.km area is being irrigated by canal irrigation and the remaining part of the irrigated area is fed by ground water. In view of this, 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.
- **Water conservation and artificial recharge:** Artificial recharge through percolation tank, check dam and *nalla* bunds are the solutions to recharge ground water in the taluk as per feasibility and as per need. As mentioned above, artificial Recharge structures like CD, MACD and related watershed treatment activities are being implemented under MGNREGA apart from the watershed treatment programmes. As per the District Irrigation Plan (DIP) report of 2016, 60 Check dams, 100 Farm Ponds, 6 Percolation Tanks, 599 Bore well Recharge structures, 25 *Nalla* bunds and 1050 Field Bunds were proposed for the taluk. Maintenance of the existing recharge structures is very much required to derive the maximum efficacy.
- **Conjunctive use plan in water logged area:** Out of the total 1008 sq.km of the canal command area in the taluk about 9729 ha is water logged since inception, which is already reclaimed. (Source: CADA as on March 2021). In addition to this reclamation, conjunctive use plan is also recommended to benefit the tail end area of the irrigation command.
- **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 Fluoride and Nitrate, 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.
- Additional ground water abstraction structures like dug wells and bore wells as per need are recommended in non-command areas to create additional irrigation potential. As mentioned above, dug wells and shallow bore wells are recommended in water logged areas of the canal command to deplete the ground water level in these areas.
- **Water Linkages with other Activities:** Water sector has strong linkages with other developmental activities. Hence, the proposed management plans cannot be considered as static and needs to be reviewed and improved from time to 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.