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

Malavalli Taluk, Mandya District, Karnataka

दक्षिण पश्चिमी क्षेत्र, बेंगलुरु

South Western Region, Bengaluru

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भारत सरकार
जल शक्ति मंत्रालय
जल संसाधन, नदी विकास एवं
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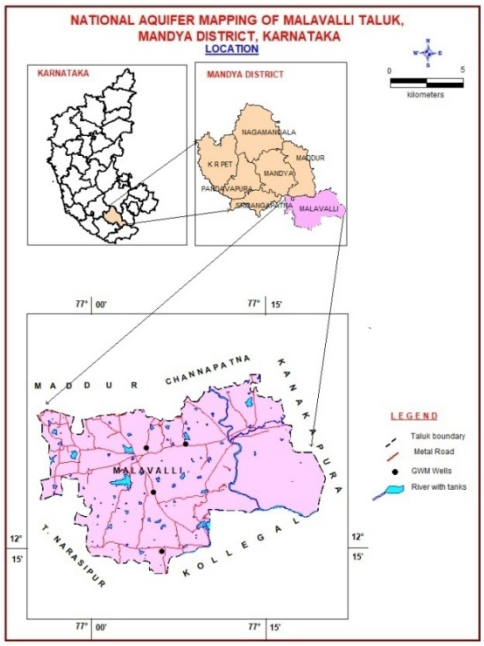
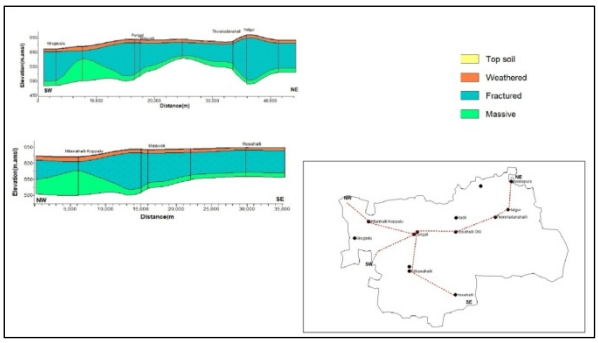
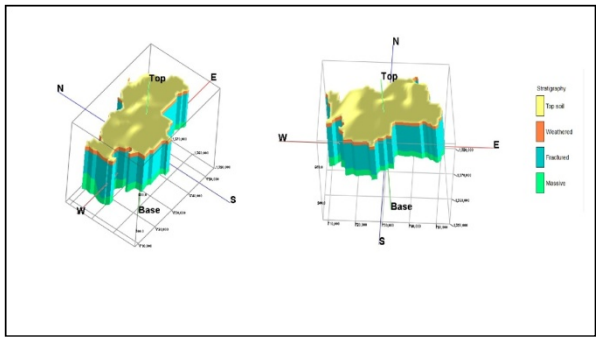
AQUIFER MAPS AND MANAGEMENT PLAN, MALAVALLI TALUK, MANDYA DISTRICT, KARNATAKA STATE

(AAP: – 2020-2021)







By

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AUGUST 2022

AQUIFER MAPS AND MANAGEMENT PLAN, MALAVALLI TALUK, MANDYA DISTRICT, KARNATAKA STATE

(AAP: – 2020-2021)

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AQUIFER MAPS AND MANAGEMENT PLAN OF MALAVALLI TALUK, MANDYA DISTRICT, KARNATAKA STATE

1 SALIENT FEATURES

Taluk name: **MALAVALLI**

District: Mandya

State: Karnataka

Area: 797 Sq.km.

Population:283265

Normal Annual Rainfall:686 mm

1.1 Aquifer Management study area

Aquifer mapping studies were carried out in Malavalli Taluk, Mandya district of Karnataka, covering an area of 797 sq.kms under National Aquifer Mapping (NAQUIM) during the AAP 2020-21. Malavalli Taluk of Mandya district is located between north latitude 12°13'7.36" to 12°29'58.93"& east longitude 76°55'11.94" to 77°20'1.44". It is covered in parts of Survey of India Toposheets 57D/15, 57H/3 and 57H/4.It is bounded by Maddur and Channapatna taluk in north, Kollegala and T. Narasipura taluks of Chamarajanagar district in the south, Srirangapatna Taluk in the western side and Kanakapura taluk of Ramanagarga district in the eastern side. Location map of Malavalli Taluk of Mandya district is presented in **Fig. 1.**

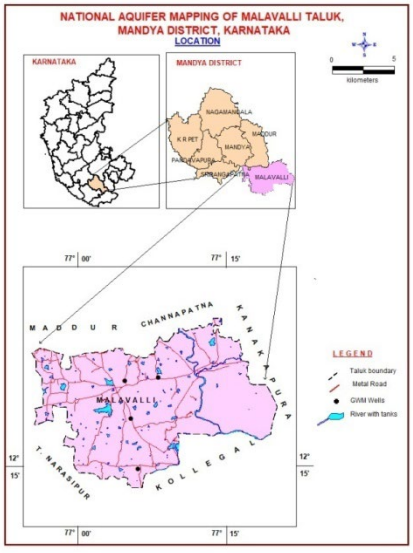


Fig. 1: Location Map

Malavalli town is the Taluk headquarter of Malavalli Taluk. There are 9Hoblis, 186 villages and 39 Gram Panchayats in Malavalli Taluk. It is situated about 105 South -west from Bangalore. It is connected by National Highway 275 which can be approached from Bengaluru-Ramanagara and National Highway 948 via Harohalli-Halagur. The nearest railway station is Mandya and the nearest airport is Kempegowda International Airport situated in Bangalore. Recently, a civil airport is also operating at Mysore.

1.2 Population

According to 2011 census, the population of Malavalli Taluk is 2,83,265. Out of the total population, 1,42,698 is the male population and 1,40,567 is the female population. This comprises about 0.46 % of the state share of population. The rural population is 245664 and urban one is 37601. Decadal change in population from 2001-2011 is 4.88% in Malavalli Taluk. Decadal change in rural and urban population is 0.51% and 0.11% respectively. The sex ratio is 983 females per 1000 males. The population density of the taluk is 350 person per square km. 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
283265	142698	140567	0.46	245664	37601	4.88	0.51	0.11

Source: District at a glance 2015-16, Govt. of Karnataka

1.3 Rainfall

Malavalli Taluk has semi-arid climate. Moist and hot weather prevails in major part of the year. All throughout the year, moderate weather prevails. The area falls under southern Dry Agro-climatic Zone 7 of Karnataka state and is drought prone. The climate of the study area is quite agreeable and free from extremes. The year is usually divided into three seasons namely summer from March to May; rainy season or south-west monsoon season from June to September along with post-monsoon season covering the months of October and November and dry or winter Season from December to February. April and May are regarded as the summer monthswith maximum temperature around 31 degree Celsius and minimum temperature is around 18 degree Celsius. There aretwo rain gauge stations in MalavalliTaluk. Theannual normal rainfall (1951-2000) is 686 mm and average rainfall comes to around 746.3 mm with 42 rainy days (KSNDMC, GoK). 50% of the rainfall is received in the Kharif season. Potential evapo-transpiration in summer, winter and rainy seasons are 563, 348 and 685 respectively with a cumulative of 1596.

1.4 Agriculture & Irrigation

Agriculture is the main occupation in Malavalli Taluk, since 87% of the total population constitutes the rural population. An area of 347 sq km is gross cropped area and 261 sq km is the net area sown. The amount of rainfall and its distribution throughout the season contributes to the cropping pattern in the area. There are two agricultural seasons namely Kharif (June – October) and Rabi season (Mid October – Mid February). Irrigation is done through canals in canal command area (medium irrigation project of Iggalur) and through ground water in non-command areas. Major crops grown are paddy which is grown in Kharif as well as Rabi season. Ragi, maize, pulses and groundnut are grown in rainfed season. Among the commercial crops, sugarcane is grown extensively. Fruits and vegetables are also grown in the area (**Table 2**).

Table 2: Area wise crops grown in MalavalliTaluk

Year	Paddy	Jowar	Maize	Ragi	Pulses	Sugarcane	Oil seeds	Total fruits	Total vegetables	Cotton
	Area under cultivation (in ha)									
2015-16	8777	0	3984	7087	3974	1956	1887	1085	1196	---

Source: District at a Glance, 2015-16, Govt. of Karnataka

During the year 2015-16, 15% of the taluk is covered by forest area. The net sown area is 44% of the total geographical area in Malavalli Taluk. Majority of the area is under agriculture and in the south eastern part is occupied by forest area. (**Table 3 and Fig 3**).

Table 3:Land use pattern of MalavalliTaluk

Year	Total Geographical Area (ha)	Area under Forest (ha)	Area not available for cultivation (ha)	Other uncultivated land (ha)	Total fallow land (ha)	Net sown area (ha)
2015-16	80949	12179	8957	8858	19747	36270

Source: District at a Glance, 2015-16, Govt. of Karnataka

Irrigation practices by different sources in the taluk are presented in **Table 4**. From Table 3, it can be seen that canal irrigation of Krishnarajasagar (KRS) dam is the prominent type of irrigation and it extends about 85 km. 0.30 BCM of water from KRS reservoir(District Irrigation Plan of Mandya, Department of Agriculture, Govt. of Karnataka, 2016) is available through canals in the taluk. Out of the total irrigated area of 22183 ha, 15840 ha is under canal irrigation which

constitute 71% of the total irrigated area (District Irrigation Plan of Mandya, Department of Agriculture, Govt. of Karnataka, 2016).

Table 4: Irrigation practice in Malavalli Taluk

Source of irrigation	No/km. of irrigation source	Net area irrigated (ha)	Gross area irrigated (ha)
Canal	84.8	15840	18256
Tanks	47	1234	1826
Wells	2006	850	1056
Tube/ Bore wells	7123	4165	5019
Lift Irrigation	12	53	53
Other Sources like water harvesting structures	--	41	41
Total		**22183**	**26251**

Source: District at a Glance, 2015-16, Govt. of Karnataka

Dug wells and Tube/borewells represent the groundwater component. About 7123 numbers of groundwater abstraction structures (bore wells) are available which irrigates a gross area of 5019 ha and a net area of 4165 ha. 2006 numbers of dug wells are existing in the taluk which irrigates a gross area of 1057 ha and a net area of 850 ha. Totally, a net area of 5015 ha is irrigated by the groundwater component. As per CADA 2021 data, an area of 48062 ha is the canal command area.

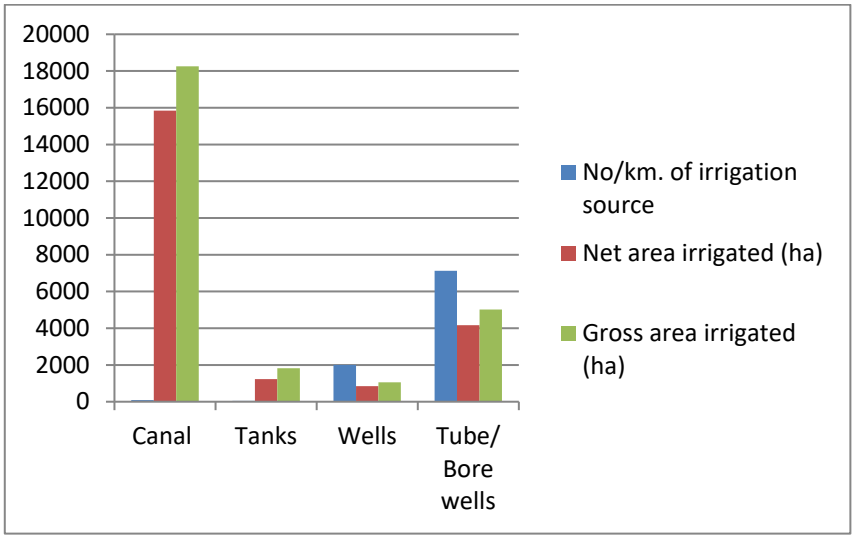


Fig 2:Sources of Irrigation

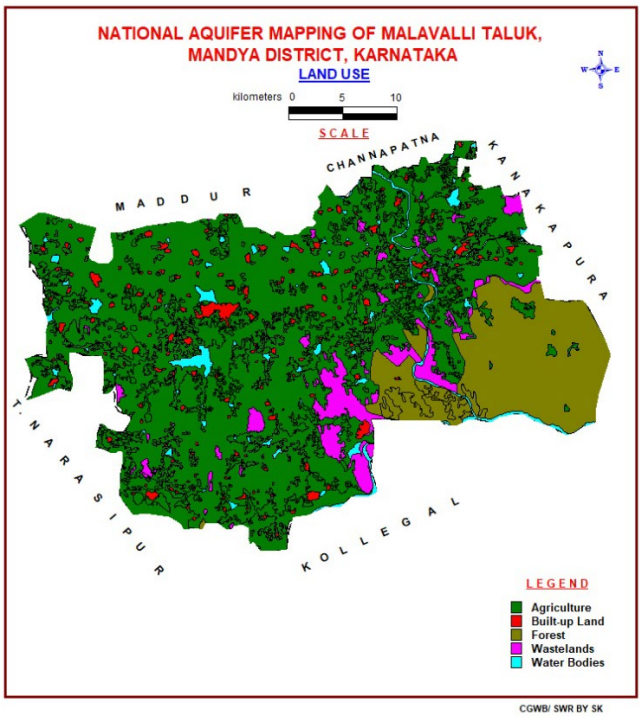
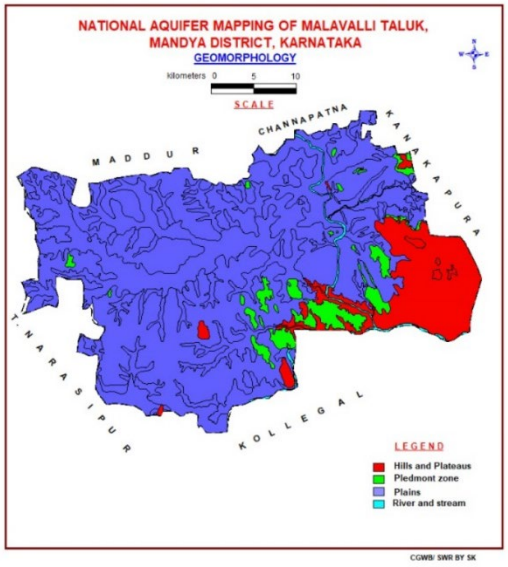


Fig. 3: Land use map

1.5 Geomorphology, Physiography & Drainage

Geomorphologically, Malavalli Taluk belongs to Southern Maidan region which is characterized by plain area with gentle rolling topography. The hills are mostly in the western and southern part of the Taluk with a general slope in the easterly direction. There are few piedmont zones in the south eastern part between which are scattered unevenly (**Fig. 4**). The mean elevation is 610 m above mean sea level with minimum of 555m to the maximum of 665m above mean sea level.

The Taluk lies in Cauvery river basin, belonging to the middle Cauvery sub-basin. The drainage pattern is dendritic to sub-dendritic drainage pattern (**Fig. 5**). The surface water availability is calculated out to be 0.30BCM.



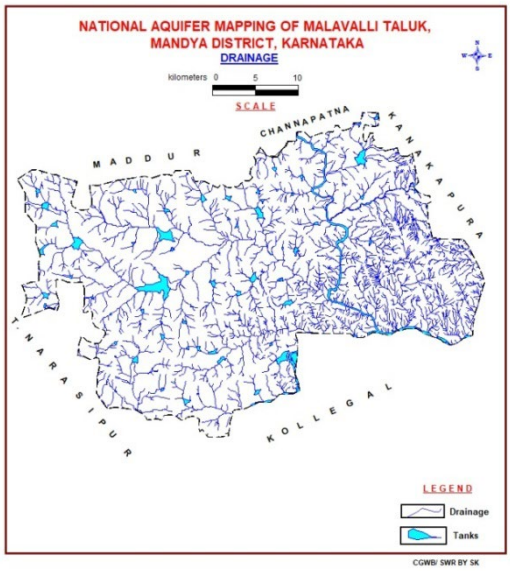


Fig. 4: Geomorphology map **Fig. 5: Drainage map**

1.6 Soil

TheTaluk is mainly covered by clayey soil and varieties of clayey soil like clayey skeletal and clayey mixed type. The northern part is occupied by clayey skeletal variety and very small area by clayey mixed soil in the southern part. The western nook of Malavalli taluk is covered by rocky land (**Fig. 6).**The soils are red in colour and sandy to sandy loam in texture.

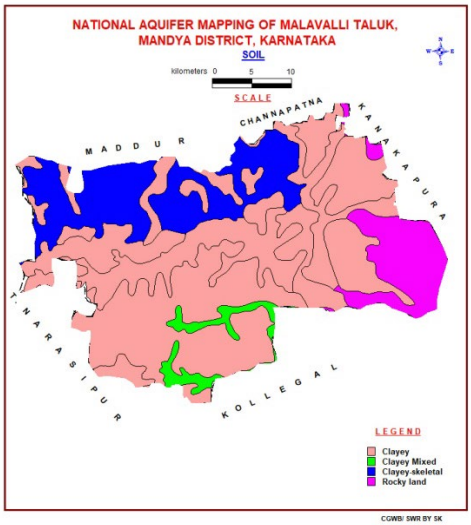


Fig. 5: Soil map

The soils are thin gravelly and underlain with a murrum zone comprising the weathered rocks. The water holding capacity of the soil is low and the old channel river area have high clay content. The infiltration rates of the red loamy and red soil are 2 to 12 cm/hr and 1 to 3 cm /hr.

1.7 Ground water resource availability and extraction

The groundwater resource estimation as per GEC, 2017 is presented in **Table 5.**

Table 5: Groundwater Resource of Malavalli taluk as per GEC 2017

Groundwater Resources: (Ham)	• Net Annual Ground Water Availability:15107 • Existing Gross Ground Water Draft for Irrigation:10322 • Existing Gross Ground Water Draft for Domestic & Industrial Uses: 334 • Existing Gross Ground Water Draft For All Uses: 10656 • Net Ground Water Availability For Future Irrigation Development:4674
Groundwater Stage of Development and category	• Stage of Ground Water Development: 71 % • Category: Semi Critical

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

As per the GWRA 2017, the net ground water availability is 15107 ham and the total ground water draft for all uses is 10656 ham with stage of development at 71% and the taluk falls in Semi-Critical category and there is a scope for future irrigation development @ 4674ham.

The details of dynamic ground water resources as on March 2020 is shown in **Table-6**. It is observed that there is no much difference in stage of extraction in 2017 and 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)
16723.81	11351.57	0.00	455.54	11807.11	512.56	5343.51	70.60	Semi-Critical

1.9 Water level behavior

The depth to water level of Aquifer-1 (phreatic or shallow representing weathered zone) and Aquifer-2 (representing fractured zone) for pre-monsoon and post-monsoon periods are furnished below.

(a) Depth to water level

Aquifer – I

- Pre-monsoon (May 2019):0.40to 17.85 mbgl (**Fig 6**)
- Post-monsoon (Nov 2019): 0.33 to 8.70 mbgl (**Fig 7**)

Aquifer – II

- Pre-monsoon (May 2019): 7.78 to 21.30 mbgl

  In the major part of the taluk, the range is 5 to 10m.
- Post-monsoon (Nov 2019):1.67 to 16.3mbgl

  In the major part of the taluk, the range is 2 to 5 m.

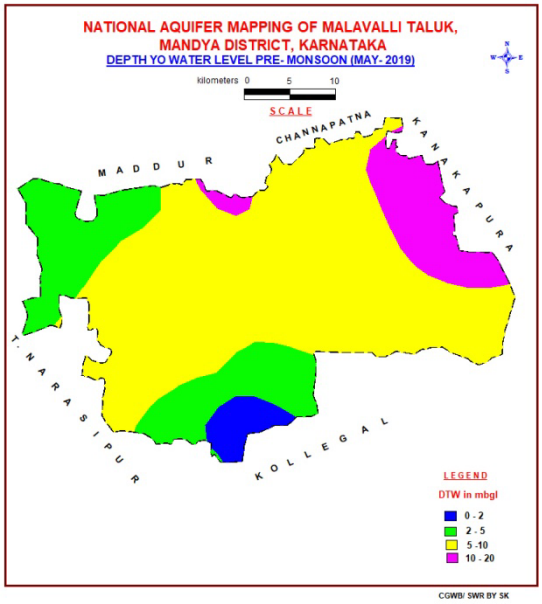


Fig.6: Pre monsoon depth to water level

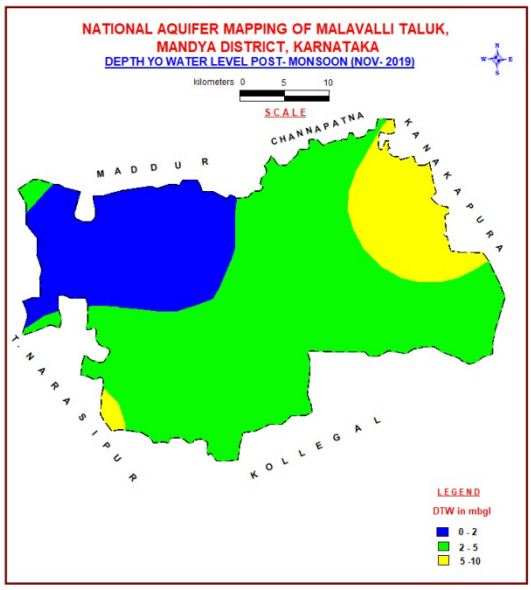


Fig.7: Post monsoon depth to water level

2 AQUIFER DISPOSITION

2.1 Aquifer Types

In Malavalli Taluk, there are mainly two types of aquifer systems

i. Aquifer-I (Phreatic aquifer): Weathered Banded Gneissic Complex

ii. Aquifer-II (Fractured aquifer): Fractured Banded Gneissic Complex

Banded Gneissic Complex (BGC) occupy nearly 95 % of the taluk with Charnockite occurring in the rest 5 % of the taluk in the south-western part **(Fig 8).** The gneisses comprise of migmatites associated with biotites and hornblendes. The granites are pink to grey in colour and

are fine to coarse grain in nature. The weathered thickness of BGC varies from 8 to 20 m bgl. Groundwater occurs under water table or phreatic condition in the weathered BGC and under semi-confined to confined conditions in the fractured granite and gneisses. The yield ranges from less than 1 lps in Aquifer I to 7 lps in Aquifer II.

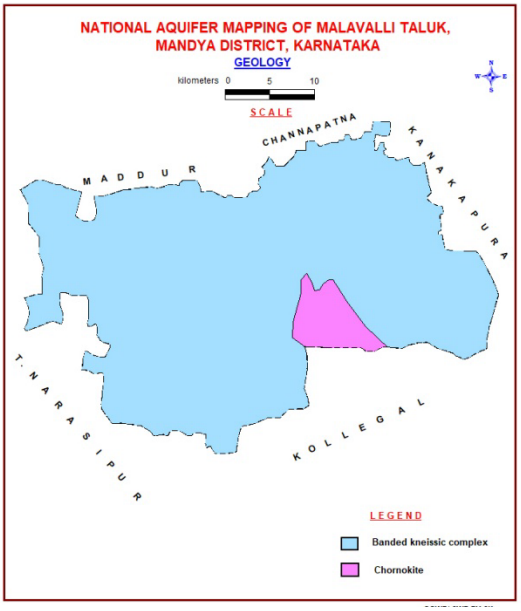


Fig 8: Geology Map

In-houseground water exploration programme ofCGWB was carried out in the taluk and 11 EW and 2 OW have been drilled so far in MalavalliTaluk (**Table 7**) and the aquifer characteristics are illustrated in (**Table 8**) which reveals that the jointed and fractured BGCis the potential aquifer system.

Table 7: Details of Exploration through In-house

Bore	Longitude	Latitude	Total depth (m)	Casing (m)	Discharge (lps)
Hosahalli	77.130556	12.275	90.5	8.2	4.4
Hosahalli OW	77.130857	12.386	63	13.5	5
Konnapura	77.230556	12.475000	75.2	12.5	0.095
Kythanahalli	77.047222	12.316667	79.25	14.87	5.5
Kythanahalli OW	77.047654	12.324561	83.5	14	1.6
Purigali	77.055557	12.381552	200	12	0.316
HittanhalliKoppalu	76.973611	12.404167	120	16.28	0.2
Kirugavlu	76.948700	12.374900	129	10	1.5
Thorekadanahalli	77.202223	12.41217	74	7	1
Malavalli	77.061688	12.38555	75	12	0.5
Hadli	77.131391	12.411054	55	5	1
Nelamakanahalli	77.173611	12.492546	122	8	1
Halgur	77.225	12.425	200	12	7

Table 8: Drilling details of Exploration Programme

Particulars	In-house
• Depth range (m bgl):	55 to 200
• Weathering (m bgl):	5 to 16
• Yield (lps):	0.095 to 7
• Fractures (mbgl)	30 to 188
• Transmissivity (m^2/day)	2 to 242
• Static Water Level (mbgl)	7.85 to 11.25

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

The sub-surface aquifer disposition of the study area were prepared based on the drilling data obtained from exploratory drilling programme for generating 2D and 3D sections and models through Rock works software. The outputs thus generatedare presented in **Fig-9A to 9C**.

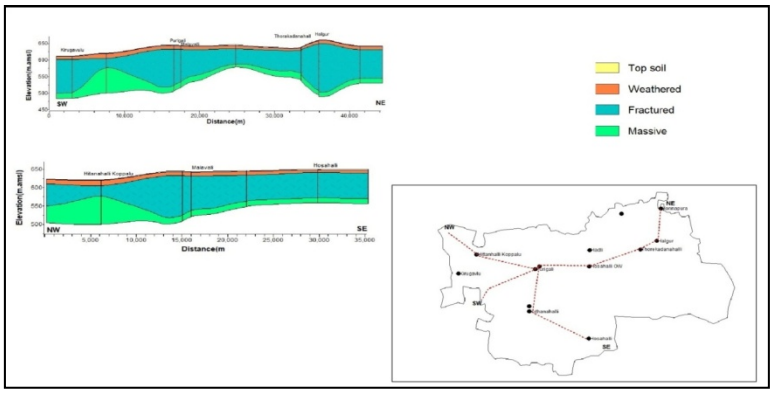


Fig 9 A: 2D output aquifer model

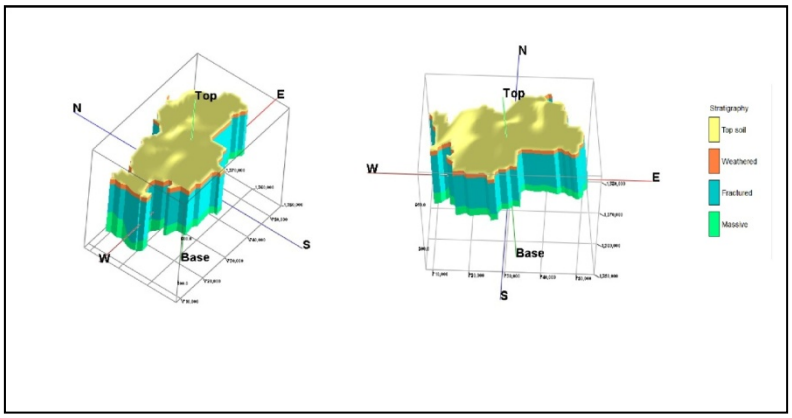


Fig-9B: 3D aquifer model

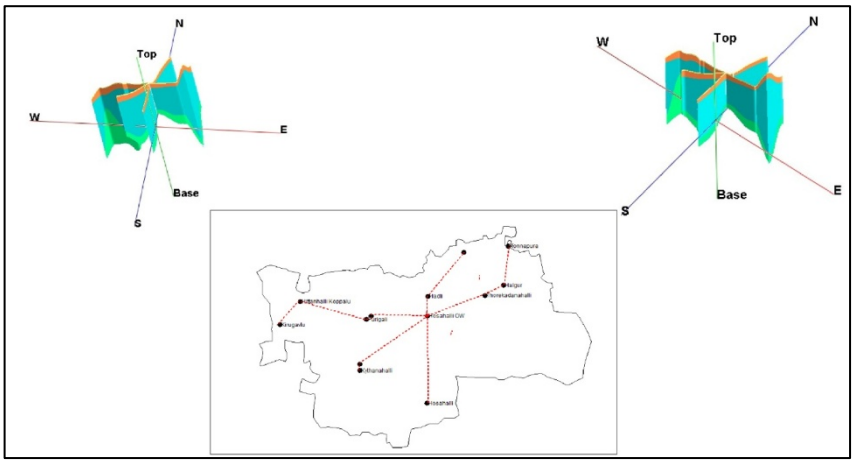


Fig-9C: Fence diagram

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

a) Aquifer wise resource availability and extraction (GEC, 2017) shown in Table.9a

Table.9a Aquifer wise resource availability and extraction (GEC, 2017)

Taluk	Annual Extract GW resource (ham)	Existing Gross GW extraction for Irrigation (ham)	Existing Gross GW extraction for domestic and industrial water supply (ham)	Existing Gross GW extraction for all uses (ham)	Allocation for domestic and industrial use for the next 25 years (ham)	Net Ground Water Availability For Future Irrigation Development (ham)	Stage of GW development (%)	Category
Malavalli	15107	10322	334	10656	451	4674	71	Semi Critical

b) The Total Ground Water Resources available as on 2017 is presented in Table.9b.

Table 9b: Present Total Ground Water Resource(Dynamic+Phreatic-in-storage fractured-in-storage)

Taluk	Annual Replenishable GW resources (Ham)	Fresh In-storage GW resources (Ham)		Total availability of GW resource (Ham)
		Phreatic Aquifer-I	Fractured Aquifer-II	Dynamic +phreatic in-storage + fractured in-storage
Malavalli	15107	3630	1680	20417

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

Table.9c: 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)
16724	11351	0	456	11807	71	Semi Critical	513	5344

The comparison of ground water availability and draft scenario as on 2009 to 2020 is shown in Table.9d. In comparison to 2009, the stage of ground water extraction has touched 71% in 2020 in the taluk. However, the ground water availability from 2009 to 2020 remained more or less same where as there is increase in the quantum of ground water extraction during the same period.

Table- 9d. Comparison of ground water availability and draft scenario (in ham)

Taluk	2009			2013			2017			2020		
	GW Availability	GW Draft	Stage of GW	GW Availability	GW Draft	Stage of GW	GW Availability	GW Draft	Stage of GW	GW Availability	GW Draft	Stage of GW
Malavalli	**13521**	**7852**	**58**	**13657**	**8739**	**64**	**15107**	**10656**	**71**	**13023**	**11807**	**71**

3.2 Chemical quality of ground water and contamination

Representative water samples have been collected from National Hydrograph Stations (NHS) during pre-monsoon (May 2019) and analyzed for various chemical constituents at Chemical Laboratory, Central Ground Water Board, Bengaluru and the results are presented in **Table 10**.

Table.10: Chemical analysis of Ground water of NHS

SITE_NAME	PH	EC µs/cm at 25°	TH as CaCO3 mg/L	Ca	Mg	Na	K	CO3	HCO3	Cl	SO4	NO3	F
Anchedoddi	8.02	1591	250	34	40	179	6	0	280	224	148	2	0.76
Hadli	7.98	2640	320	32	58	314	1	0	337	380	128	11	1.17
HunnadaDoddi	7.96	1522	220	32	34	189	4	0	342	152	89	53	0.95
Shivanasamudra	8.25	734	170	60	5	73	13	0	194	78	68	38	0.48

Data available with State Ground water department is always perused and it has been found that there are sporadic occurrence of salinity (**Fig 10)** and Nitrate above permissible limit **(Fig 11).** Concentration of Fluoride is within permissible limit **(Fig 12).**

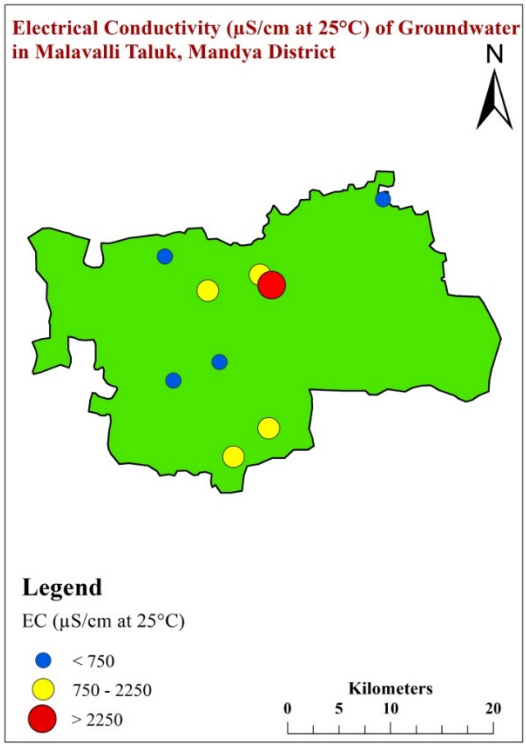


Fig 10: Distribution of EC

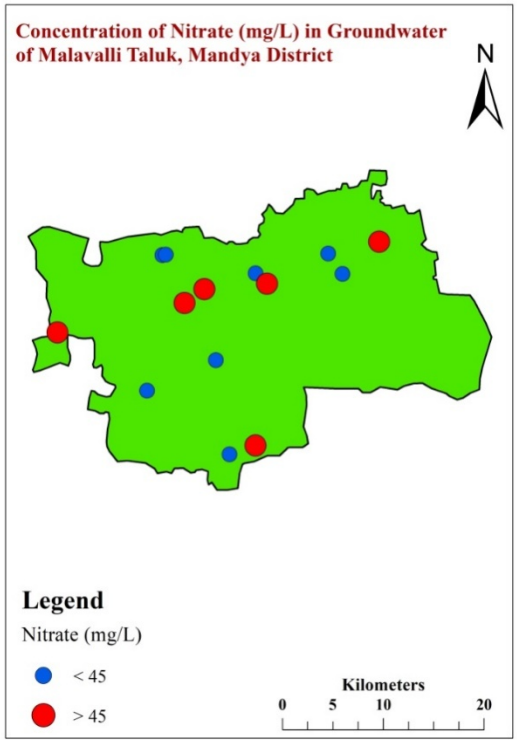


Fig 11: Distribution of Nitrate

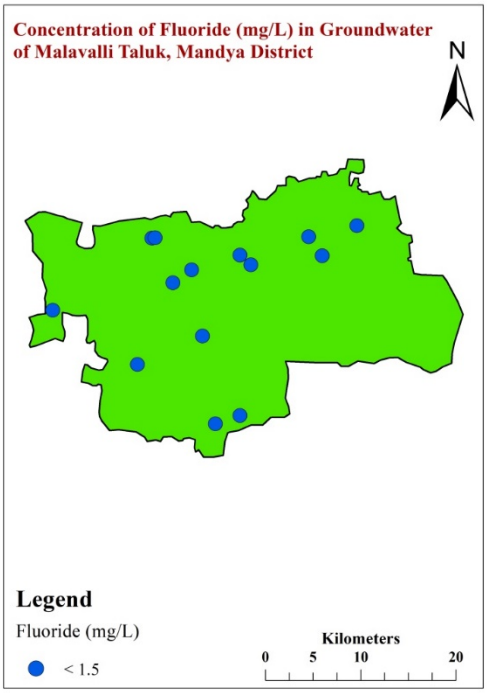


Fig 12: Distribution of Fluoride

In general, ground water quality in Malavalli Taluk is good and potable except in some localized areas where nitrate and salinity content are found to be greater than the permissible limit. Ground water samples have been found suitable for agriculture & irrigation purposes.

4 GROUND WATER RESOURCE ENHANCEMENT

4.2 Resource Enhancement by Supply Side Interventions

The Master Plan for Artificial recharge to ground water prepared by CGWB (2020) recommended to recharge the de-saturated and dried-up phreatic aquifer (Aq-I) in the taluk, through construction of artificial recharge structures such as check dams, percolation tanks and point recharge structures(i.e bore well recharge structure) (**Table11)**. 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. An area of 14900ha has been found feasible for construction of artificial recharge structures and the likely volume/quantum of recharge is 16.653 MCM (CGWB 2020).

Area suitable for AR Structures is shown in **Fig-13.** The choice of recharge structures should be site specific and such structures need to be constructed in areas already identified as feasible for artificial lrecharge. The tentative locations of sites proposed for artificial recharge is shown in **Fig.14**. The tentative list of the proposed Percolation tanks and Check dams are listed

in **Table.12**. The improvement in ground water availability as a result of the implementation of artificial recharge structures in the taluk is detailed in Table.13

Table-11: Quantity of non-committed surface runoff & expected recharge through AR structures in Malavalli Taluk

Artificial Recharge Structures Proposed	MalavalliTaluk
Non committed monsoon runoff available (MCM)	22.204
Number of Check Dams	111
Number of Percolation Tanks	20
Number of Sub surface Dyke	1
Tentative total cost of the project (Rs. in lakhs)	1525.75
Expected recharge (MCM)	22.204
Additional Irrigation Potential by ARS & RWH (Lakh Hectare)	0.020

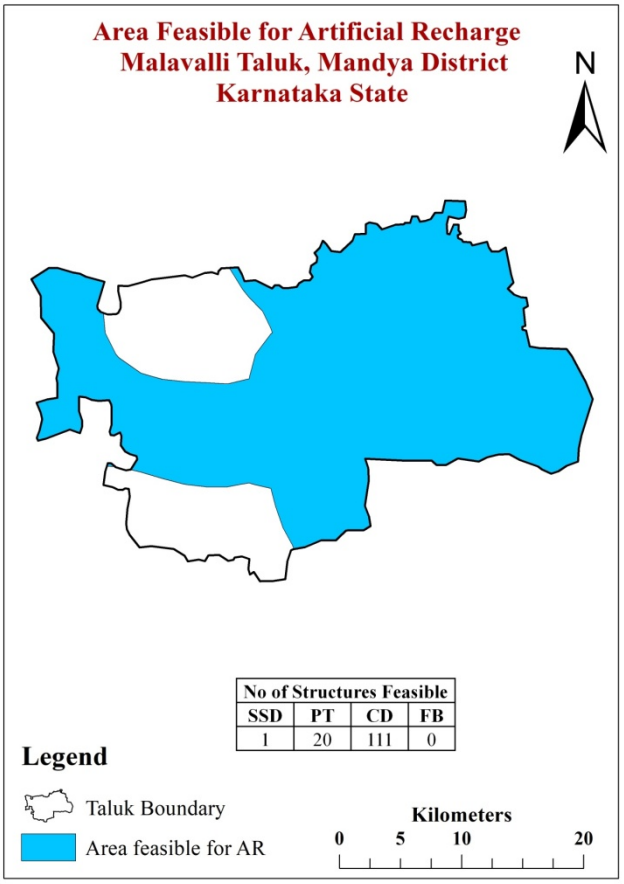


Fig.13. Map showing area feasible for Artificial Recharge

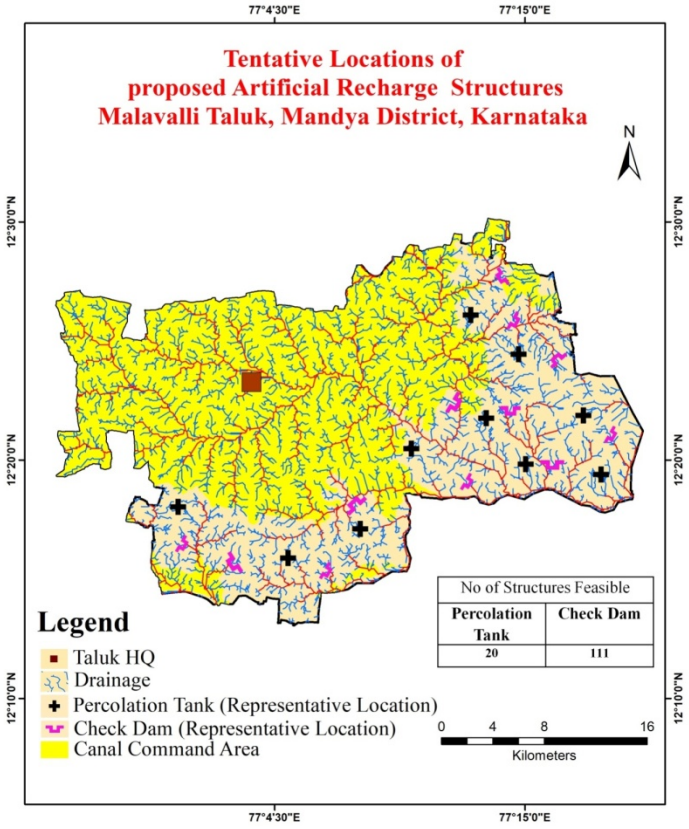


Fig.14. Map showing the tentative locations of Artificial Recharge

Table. 12: Tentative Locations of Proposed Percolation tanks,
MalavalliTaluk, MandyaDistrict.

(Source: Master Plan, CGWB, 2020. It is likely that the number of structures proposed may vary depending upon the ground truth verification and feasibility criteria)

SL.NO	Longitude	Latitude	Village	Grama Panchayat	Taluk
1	77.0884440	12.2281068	Hallidasanahalli	Kaggalipura	Malavalli
2	77.0843690	12.2645822	Nanjarayanapura	B.G.Pura	Malavalli
3	77.0051177	12.2693400	Poorigali	Poorigali	Malavalli
4	77.1228135	12.2722711	Belakavadi	Belakavadi	Malavalli
5	77.0494803	12.2745063	Saraguru	Saraguru	Malavalli
6	77.0540870	12.2849017	UdafeBhuhalli	Saraguru	Malavalli
7	77.1348435	12.2850652	Hosahalli	Hosahalli	Malavalli
8	77.0075448	12.3004634	Maliyuru	Sujjaluru	Malavalli
9	77.3032776	12.3231771	Basavanabetta Forest	H.Basavapura	Malavalli
10	77.2506457	12.3303744	Basavanabetta Forest	H.Basavapura	Malavalli
11	77.2704386	12.3409750	Basavanabetta Forest	H.Basavapura	Malavalli
12	77.1706052	12.3411697	Nettakallu	Chottanahalli	Malavalli
13	77.2990223	12.3546613	Basavanabetta Forest	H.Basavapura	Malavalli
14	77.2229708	12.3625943	Ganalu	Byadarahalli	Malavalli
15	77.2909322	12.3644647	Basavanabetta Forest	H.Basavapura	Malavalli
16	77.2495018	12.3863295	Basavanabetta Forest	H.Basavapura	Malavalli
17	77.2634216	12.4013795	Basavanabetta Forest	H.Basavapura	Malavalli
18	77.2456722	12.4072878	Gundapura	H.Basavapura	Malavalli
19	77.2122310	12.4347694	V. Basapura	Thorekadanahalli	Malavalli
20	77.2439968	12.4389097	Halaguru	Halagur	Malavalli

4.2 Resource Savings by Demand Side Interventions

Increase in agricultural activity and excessive ground water withdrawal has resulted in depletion of ground water table, reduction in yield of bore wells and deterioration of ground water quality mainly in the non -command areas, whereas in command area, there is water logging problem which may affect the soil and salinity. Malavalli Taluk receives less rainfall, hence cultivation of Ragi should be popularized than water intensive crops like Paddy and

sugarcane which consumes more water. Conjunctive use of surface and groundwater is recommended in canal command areas prone for water logging and area affected by water logging. Thus, there is need for ground water management, enhancement of storage capacity of aquifers, protection of ground water quality and proper utilization of ground water.

An area of 480.62 sq.km (48062 ha) is covered by canal command area of KrishnarajaSagar project. Out of this area, an area of 3496 ha is water logged, out of which 45 ha is reclaimed and 3451 ha. is yet to be reclaimed (Source: CADA as on March 2021). In addition to this reclamation, as mentioned above, conjunctive use plan is also recommended to benefit the water deficit and tail end areas of the irrigation command.

The details of improvement in ground water availability on implementation of the above plan is shown in **Table.13**.

Table 13: Improvement in GW availability due to Recharge and water use (WUE) efficiency Demand side interventions method in Malavalli Taluk.

Taluk	GW availability (ham)	Existing Gross Ground Water Draft for All Uses (Ham)	Stage of GW develo pment %	Expected Additional Recharge from non-committed monsoon runoff (Ham)	Expected Increase in GW Availability (Ham)	Expected Stage of GW Develop ment after recharge (%)	Expected GW availability due to recharge and WUE	Expecte d Stage of GW Develop ment after WUE
Malavall i	15107.19	10656.1 4	71	2220.4	17327.59	**61.5**	19392.01	**55**

4.2.1 Advanced irrigation practices

Bore well is one of the prevalent sources for irrigation in Taluk. Below mentioned techniques will contribute in ground water resource enhancement in the long run.

- Efficient irrigation techniques will contribute in saving ground water and thus will reduce the irrigation draft. The net area irrigated by canal is 15840 ha (Source: District At A Glance, 2015-16). As per the data collected from CADA and as mentioned above, there is water logging issue in the canal command area which will result damage to the soil and deterioration of ground water quality which requires attention and intervention to reclaim the water logged area through scientific management and proper distribution network.
- Water Use Efficiency (WUE) like Drip in irrigation practices needs to be further popularized instead of flood irrigation method.By adopting WUE and artificial recharge, the stage

ofground water extraction will be improved further from semi critical to safe with the stage of extraction of about55 %.(refer Table.11)

4.2.2 Change in cropping pattern

Change in cropping pattern is necessary since cultivation of water intensive crops like paddy and sugarcane is prevalent in the Taluk. An area of 8777 ha is under paddy and an area of 1956 Ha is covered under sugarcane; however, a shift from this practice is ideal owing to consistent increase in the stage of ground water extraction from 64 % in 2013 to 71 % in 2017 and 2020.

As the Taluk belongs to southern dry zone and is drought prone, farmers may be encouraged to grow drought resistant crops like pearl millet, cowpea, groundnut etc. The concept of inter-cropping, multi-cropping may be popularized among the farming community, so that the farmers have another crop to fall back on when one fails because of deficient rainfall.

4.2.3 Regulation and Control

- MalavalliTaluk is categorized as semi critical, since the stage of ground water development has reached 71 %(GEC March 2017 and MArh 2020). The stage of development was 64 % as per GEC 2013. The mandatory guidelines like rainwater harvesting and artificial recharge issued by Karnataka Ground Water Authority needs to be strictly implemented.
- Ground water recharge component needs to be made mandatory in State Govt. Projects and activities connected ground water and watershed development.
- As mentioned above, optimal dependence on ground water for irrigation is recommended. Efficient irrigation techniques need to be implemented which will contribute in saving ground water and thus will reduce the irrigation draft.

4.2.4 IEC activities and Participatory management

Awareness programmes and practice of participatory approach needs to be strengthened with the involvement of all the stake holders for sustainable management. Micro level ground water studies are recommended for effective management of ground water resource.

- Community participation and People's participatory approach towards sustainable development and management of Groundwater may be encouraged.

4.2.5 Other interventions proposed

- Wherever sufficient roof top area is available in government building, educational institution, or private houses, roof top rainwater harvesting may be implemented. As per Master Plan of Artificial Recharge,22. 204 MCM volume of water is likely to be harvested which will create an additional irrigation potential of 0.02Lakh hectare.

5 SUMMARY

- **Ground Water resource:** As per the resource estimation – 2020, Malavalli taluk falls under **Semi-Critical** category with the stage of ground water extraction of 71 **% and is facing** water scarcity problem. Hence, there is need to formulate management strategy to tackle the water scarcity related issues in the taluk.
- **Ground water resource enhancement:**As the area falls in Souther Agro-climatic zone with semi-arid type of climate and drought-prone, there is an increase in agricultural activity with excessive ground water withdrawal which has resulted in depletion of ground water levels, reduction in yield and ground water quality related issues etc.. Hence, there is a need to adapt scientific ground water management, enhancement of storage capacity of the aquifers and protection of ground water quality.
- **Quantity of water available through non-committed surface run-off:** The surplus non-committed monsoon run off is estimated to be 22.204 **MCM**. This can be used to recharge the aquifer mainly through percolation tanks (about 20 numbers) and check dams (about 110 number) as per Master plan for Artificial Recharge report, CGWB, 2020.Periodical maintenance of artificial recharge structures is recommended to derive maximum efficacy and optimum benefits.
- **Advanced irrigation practices:** Out of the total irrigated area by various sources, about 88% (as on 2021 including data of CADA) is being irrigated by irrigation canal ofKrishnarajasagarirrigation command and partly by lift irrigation canal command and the balance area by mostly by ground water. **B**ore wells are the main ground water abstraction structures. Water Use Efficiency (WUE)practices like drip irrigation and sprinkler are yet to pick-up in the taluk to the fullest extent which needs to be expanded. Presently, the ground water draft through irrigation is 11807 Ham (as on 2020). Implementation of efficient irrigation techniques will contribute in saving groundwater to considerable quantity. This ultimately enhances the area under irrigation potential.

- **Change in cropping pattern:** The concept of inter-cropping, multi-cropping may be popularized among the farming community so that the farmers have another crop to fall back on when one crop fails because of deficient rainfall.
- **Conjunctive use plan in water logged area:** An area of 480.62 sq.km (48062 ha) is covered by canal command area of Krishnarajasagar project. Out of this area, an area of 3496 ha. Is water logged, out of which 45 ha Is reclaimed and 3451ha. Is yet to be reclaimed (Source: CADA as on March 2021). In addition to this reclamation, conjunctive use plan is also recommended to benefit the water deficit and tail end area of the irrigation command.
- **Drinking water Supply:** In view of ground water contamination with higher concentration of Nitrate and EC, identification of contamination free ground water source is essential. Alternatively, drinking water supply from surface water source needs to be explored. It is recommended to minimize the use of nitrogenous fertilizers to avoid nitrate contamination.
- **Regulation and control:**Taluk is categorised as **"Semi-Critical".** The mandatory guidelines like rainwater harvesting and artificial recharge issued by Karnataka Ground Water Authority needs to be strictly implemented.
- **Participatory management:** Awareness programmes and practice of participatory approach needs to be strengthened with the involvement of all the stake holders for sustainable management.Micro level ground water studies are recommended for effective management of ground water resource.
- **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.