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

Maddur Taluk, Mandya District, Karnataka

दक्षिण पश्चिमी क्षेत्र, बेंगलुरु

South Western Region, Bengaluru

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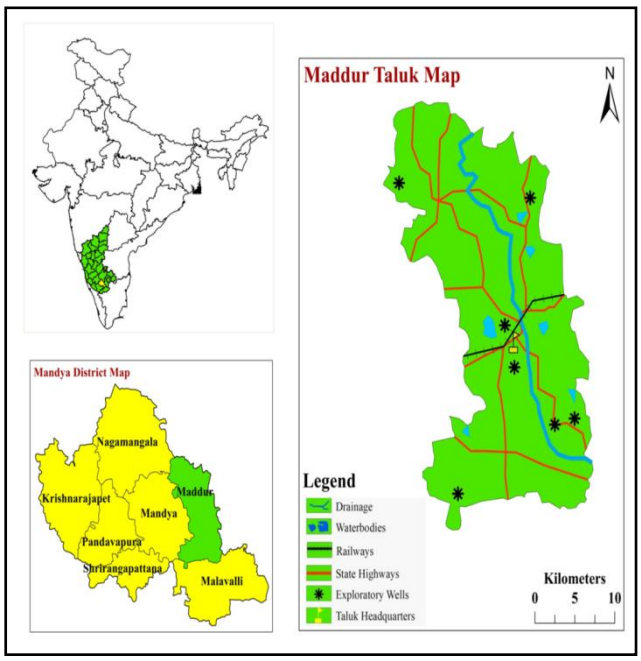
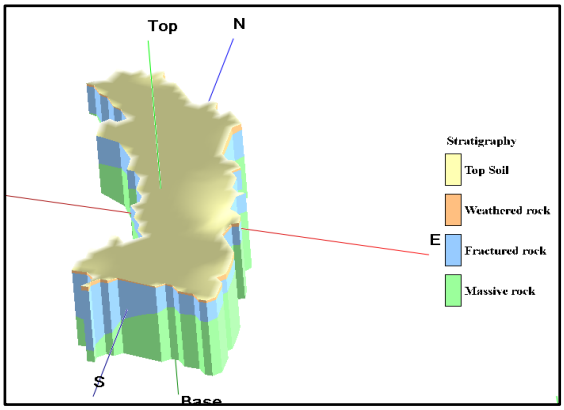
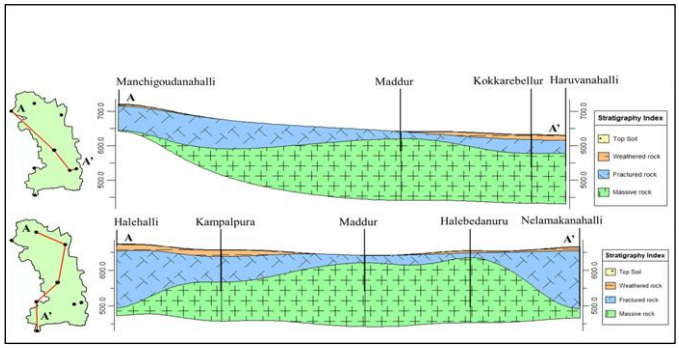
AQUIFER MAPS AND MANAGEMENT PLAN, MADDUR TALUK, MANDYA DISTRICT, KARNATAKA STATE

(AAP: – 2021-2022)







By

Saritha S, Scientist 'B', CGWB, SWR, Bengaluru

SEPTEMBER 2022

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

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

1 SALIENT INFORMATION

Name of the taluk: Maddur

District: Mandya

State: Karnataka

Area: 621sq.km.

Population:2,95,432(2011 census)

Average Annual Rainfall: 854 mm

1.1 Study area

Aquifer mapping studies were carried out in Maddur taluk, Mandya district of Karnataka, covering an area of 621 sq.km under NAQUIM during the AAP 2020-21. Maddur taluk of Mandya district is located between north latitude 12°25' 5.16" to 12°48'7.2"and East longitudes 76°56'40.56" to 77°07'21.72". Maddur taluk is bounded by Kunigal talukof Tumkur district in north, Channarayapatna talukof Hassan district in the east, Malavalli taluk in the south, Nagamangala &Mandya taluks in the west. Administratively, Maddur taluk is divided into 4 Hoblies, 44 Panchayats (http://panchamitra.kar.nic.in) and 162 villages (http://e-krishiuasb.karnataka.gov.in). Location map of Maddur taluk of Mandya district is presented in **Fig.1**.

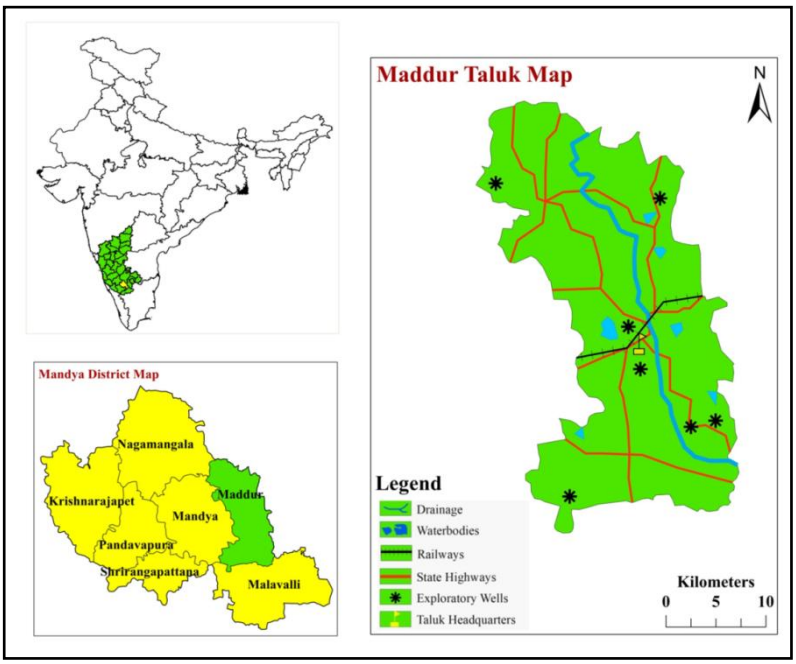

Fig.1: Location map

1.2 Population

Maddur Taluk has total population of 2,95,432 as per the Census 2011. Out of which 1,47,879 are males while 1,47,553 are females. In 2011, there were total 71,028 families residing in Maddur Taluk. As per Census 2011 out of total population, 11.9% people live in Urban areas while 88.1% lives in the Rural areas. The total literacy rate of Maddur Taluk is 68.59%**.** The male literacy rate is 69% and the female literacy rate is 55.2%.

1.3 Rainfall

The rainfall of the Maddur is accounted by the Pre-monsoon (PRE) months, SW monsoon (SWM) months and NE monsoon (NEM) months. Bulk of the rainfall is contributed by SW Monsoon i.e., during June to September. In general, humid to semi-arid climatic conditions prevail in the area. The Normal rainfall data (1951 to 2000) is 737 mm. The Actual and Normal rainfall of Maddur taluk from 2016 to 2019 & Season wise rainfall of 2020 is given in **Table 1 and 2**.

Table 1: Actual and Normal rainfall of Maddur taluk from 2016 to 2019

Maddur	Normal(mm)	2016		2017		2018		2019	
		Actual (mm)	% Dep	Actual (mm)	% Dep	Actual (mm)	% Dep	Actual (mm)	% Dep
	771	538	-30	1093	42	832	8	823	7

Table 2: Rainfall (mm) of Maddur taluk during 2020

Premonsoon (Jan-May)			SW (Jun-Sep)			NE(Oct-Dec)			Annual (Jan-Dec)		
Normal	Actual	% of Departure	Normal	Actual	% of Departure	Normal	Actual	% of Departure	Normal	Actual	% of Departure
170	237	40	358	397	11	239	220	-8	767	854	11

Source; KSNDMC, Karnataka

1.4 Agriculture & Irrigation

Agriculture is the main occupation in Maddur taluk, since 92 % of the total population constitutes the rural population. 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 to October) and Rabi season (Mid October to Mid-February). Major Kharif crops are paddy and vegetables. Main crops of Rabi season are pulses and oilseeds which together constitute 811 ha of cropped area. Fruits and vegetables are the other crops grown **(Table 3).**The sample Paddy cultivation is shown in **Photo.1.**

Table 3: Area wise crops grown in Maddur Taluk

Sl.No	Name of Crop	Area in Ha(2014-15)
1	Paddy	9898
2	Ragi	3550
3	Jowar	0
4	Maize	125
5	Pulses	3779
6	Oilseeds	363
7	Total Fruits &Vegetables	973

Source: District at a glance 2014 - 15, Govt. of Karnataka

Photo.1 Paddy cultivation in Maddur Taluk

During the year 2014-15, percentage of gross cropped area of total geographical area was 59% and net cropped area was 49% in the taluk (**Table.4**).The land use map of Maddur taluk is shown in **Fig.2.** As mentioned above, it is seen that agriculture is the main occupation of the people in the taluk.

Table 4: Land use pattern in Maddur taluk

Total Geographical Area (ha)	Area under Forest (ha)	Area not available for cultivation (ha)	Other Cultivable land(ha)	Fallow land (ha)	Net sown area (ha)	Area sown more than once (ha)
61846	20	19450	387	11687	30202	6350

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

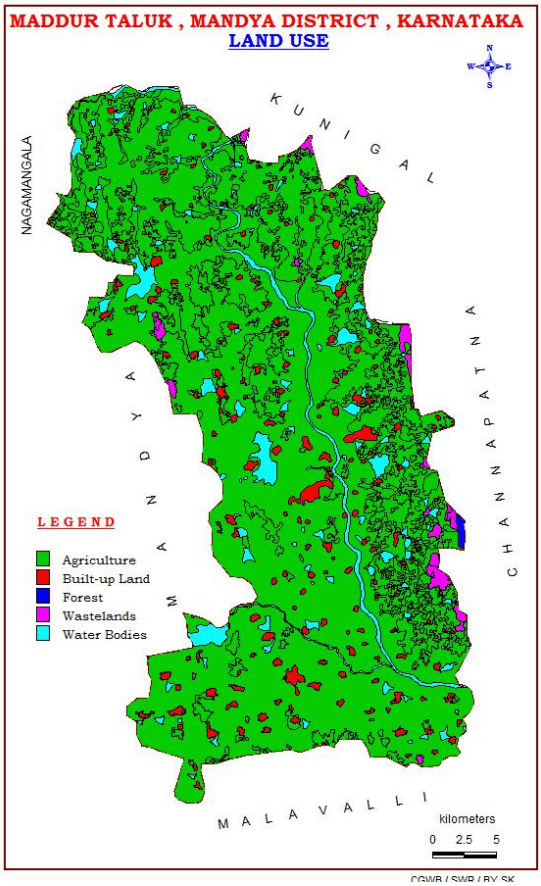

Fig.2: Landuse map

Maddur taluk are marked by a series of tanks varying in size from small ponds to considerably large tanks. Gross irrigated area by borewells is 2850 ha and net irrigated area is 1960 ha (**Table 5**). Gross irrigated area by all the sources in the taluk is 25986ha and net irrigated area is 20919 ha.

Table 5: Irrigation sources in Maddur taluk, Mandya district

Sl. No.	Irrigation source	Area / Nos	Gross area irrigated (Ha)	Net area irrigated (Ha)
1	Canal	92.8 km length	18534	15486
2	Tanks	143	3580	2751
3	Wells	1910	886	586
4	Bore Well	5143	2850	1960
5	Lift Irrigation	40	84	84
6	Other Sources	-	52	52
	Total		**25986**	**20919**

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

1.5 Geomorphology, Physiography & Drainage

Maddur taluk represents an uneven landscape with intermingling of hills and valleys. Geomorphology map of the taluk is shown in **Fig.3.** Generally, the land topography is plain.

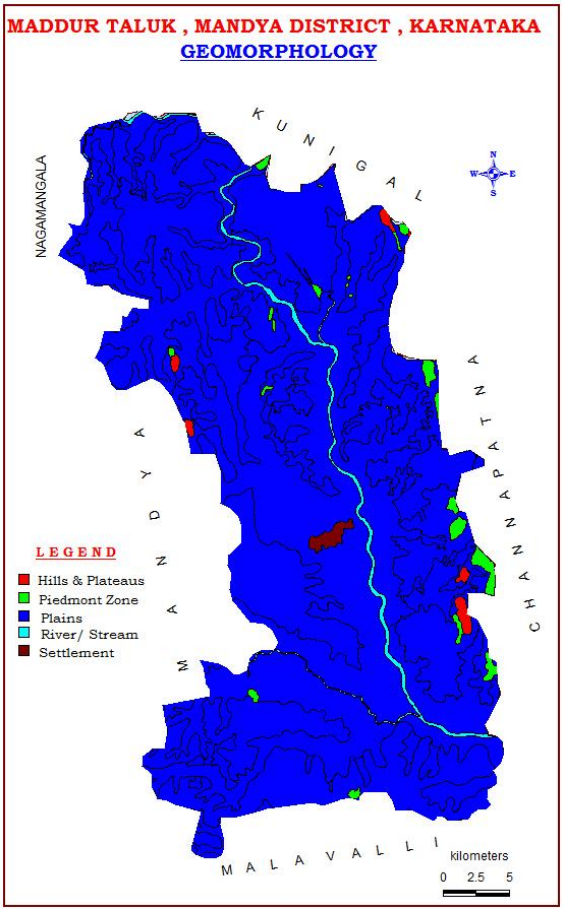

Fig 3: Geomorphology Map

The Maddur taluk drains by Cauvery and its tributaries. Drainage pattern is dendritic to sub dendritic. The map of the study area is presented in **Fig.4**.

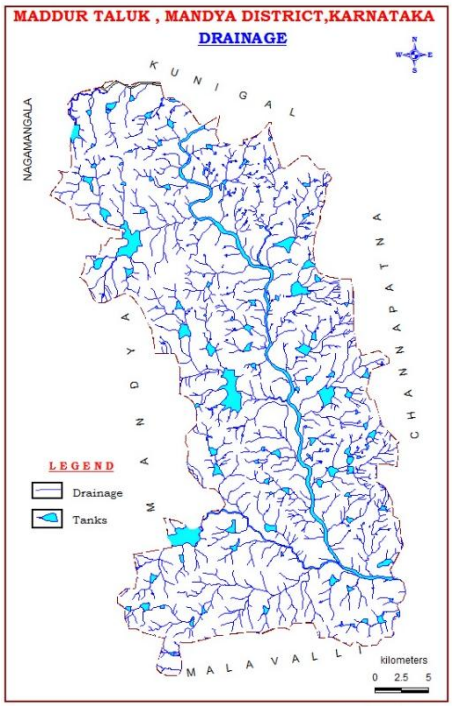

Fig 4: Drainage Map

1.6 Soil

The soil of Maddur taluk range from red sandy loam to red clay loam, very thin in ridges and higher elevations and comparatively thick in valley portions. Major part of the taluk is covered by clayey-skeletal soil. The soils are highly leached and poor in bases. The water holding capacity is low (**Fig.5**).

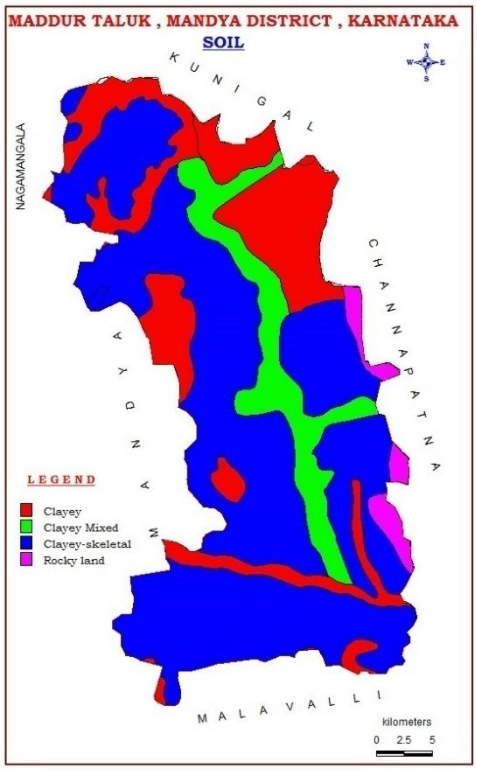

Fig 5: Soil Map

1.7 Groundwater resource availability and extraction

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

Table.6: Total GW Resources (2017) (Ham)

Taluk	Annual Replenishable GW resources	Fresh In-storage GW resources		Total availability of fresh GW resources
		Phreatic	Fractured (Down to 200m)	Dynamic +Fresh in-storage
Maddur	9893	6159	1406	17458

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

The details of dynamic (Phreatic) ground water resources for Maddur taluk as on March 2020 is shown in **Table.7**. The annual extractable water resource is 8154.38ham.Total groundwater extraction for irrigation use is 4040.45ham. Annual GW Allocation for domestic use as on 2025 is 488.45ham. Net Ground Water Availability for future use is 3625.49ham.

Table.7 Detail of Dynamic Ground Water resource, (as on March 2020)

Annual Extractable Ground Water Resource (Ham)	Ground Water Extraction for Irrigation Use (Ham)	Ground Water Extraction for Industrial Use (Ham)	Ground Water Extraction for Domestic Use (Ham)	Total Extraction (Ham)	Annual GW Allocation for Domestic Use as on 2025 (Ham)	Net Ground Water Availability for future use (Ham)	Stage of Ground Water Extraction (%)
Ham	Ham	Ham	Ham	Ham	Ham	Ham	%
8154.38	4040.45	0.00	452.85	4493.30	488.45	3625.49	55.10

1.9 Hydrogeology

Aquifer I - The weathered thickness ranges from 6 to 21m. The premonsoon depth to water level in National Hydrograph Stations(NHS) of CGWB ranges from 0.24 to 8.46mbgl (May 2020)and post monsoon depth to water level ranges from 1.07 to 5.03mbgl (Nov 2020).Generally, aquifers in the area are not sustainable for longer duration pumping and becomes desaturated.

Aquifer II- The major formations are fractured Granites and Gneisses. The pre-monsoon depth to water level ranges from 2 to 19 mbgl in the stations/wells maintained by Ground Water Department (GWD) during May 2019.The yield of the fractured aquifer ranges from 0.5 to 1.2 m^3/hrand sustainability is less than 1 hour. The hydrogeology map of the Maddur taluk is shown in **Fig.6.**

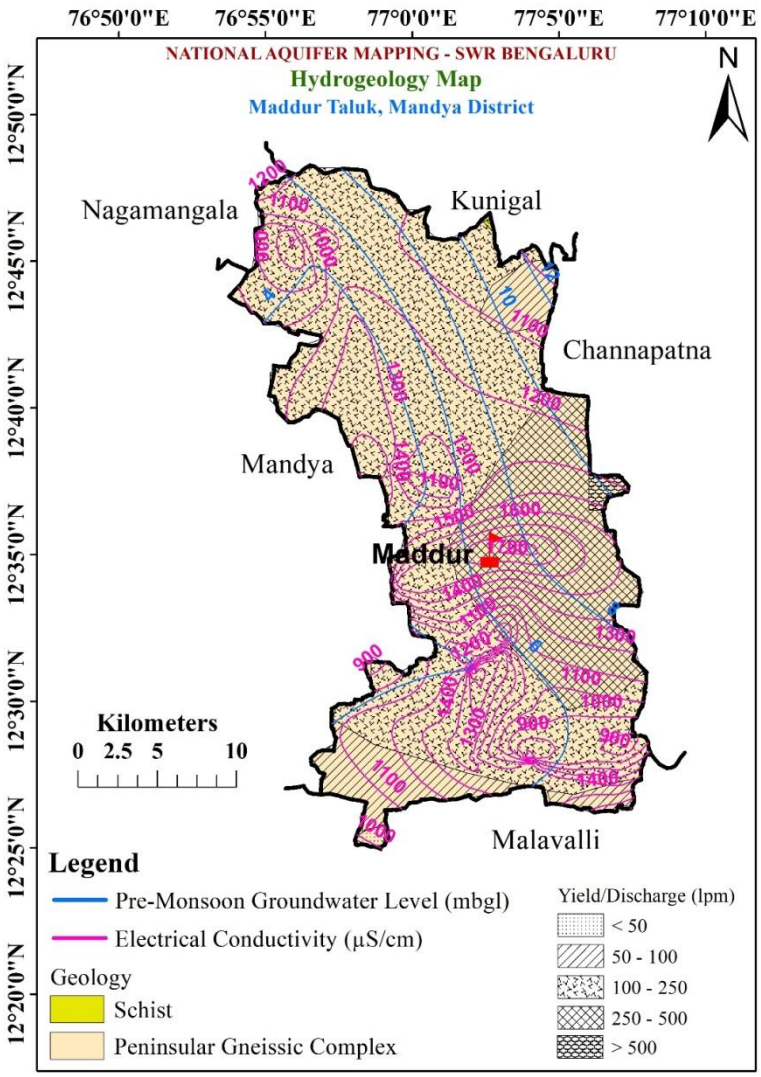

Fig 6: Hydrogeology map

1.10 Water level behavior

(a) Depth to water level

Aquifer – I (Phreatic)

- Pre-monsoon: 0.24- 8.46 mbgl **(Fig.7)**
- Post-monsoon: 1.07–5.03 mbgl **(Fig.8)**

The depth to water level data of the monitoring wells of State Ground water Dept and CGWB from 2011 to 2020 is given in **Table 8.**

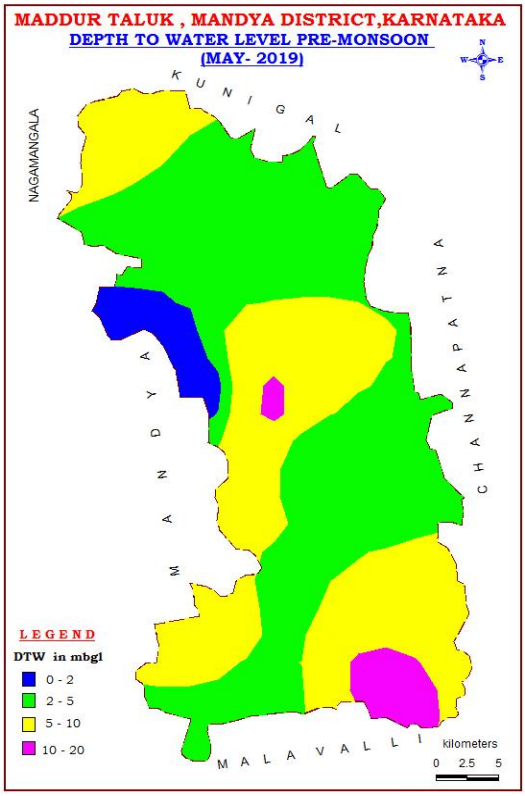

Fig7:Pre-monsoon DTW (May 2019)

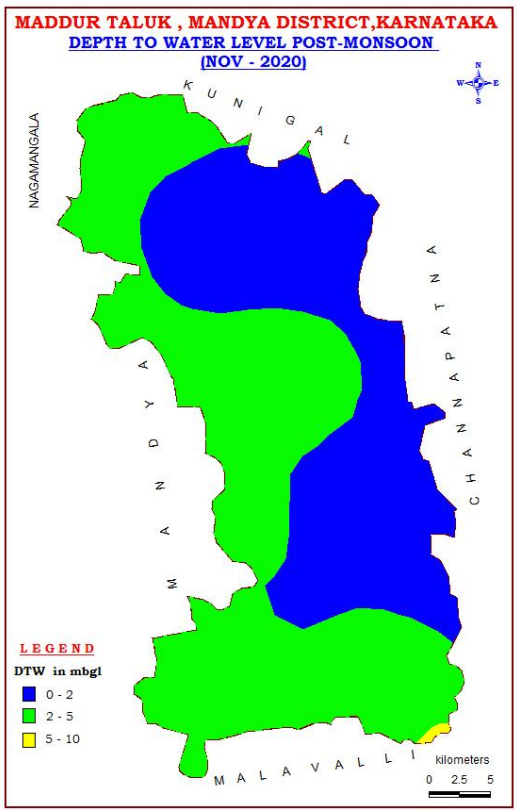

Fig.8:Post-monsoon DTW (Nov 2020)

Seasonal water level fluctuation map of phreatic aquifer during May & November 2019 is shown in **Fig.9.** The Decadal Fluctuation Map of Phreatic aquifer (Aquifer-1) from 2010 to 2019 is shown in **Fig. 10** and the values are shown in **Table 9.**

Table 8: Depth to WL data of the Monitoring wells of GWD & CGWB in Maddur taluk from 2011 to 2020

SL. No	Agency (CGWB/ GWD)	Location	Well type (Bore/ Dug well)	Latitude (in decimals)	Longitude (in decimals)	Depth to water level (mbgl)																				Premonsoon Decadal average (May 2011-May 2020)	Postmonsoon Decadal average (Nov 2011-Nov 2020)
						May-11	May-12	May-13	May-14	May-15	May-16	May-17	May-18	May-19	May-20	Nov-11	Nov-12	Nov-13	Nov-14	Nov-15	Nov-16	Nov-17	Nov-18	Nov-19	Nov-20		
1	GWD	Besagarahalli	DW	12.6367	76.9947	2.43	2.07	2.30	2.15	2.50	5.00	2.50	1.70	2.52	1.82	1.81	1.84	1.15	1.05	2.35	2.3	1.8	1.89	1.8		2.63	2.63
2	GWD	Hunnanadoddi	DW	12.5186	76.0339	1.92	2.02	8.25	3.65	2.25	2.67	7.30	2.80	3.92	3.03	1.83	1.88	0.95	1.4	1.15	4.92	3.45	3.1	2.92		3.78	3.78
3	GWD	Kowdley	DW	12.7883	76.9325	6.73	7.15	10.75	7.20	4.60	8.00	10.70	2.83	5.60	3.35	4.88	6.37	3.6	1.9	5.10	5.94	3.2	3.88	4.2		6.95	6.95
4	GWD	Maddur	DW	12.5811	77.0403	4.74	2.23	10.90	5.25	5.00	6.00	4.50	5.08	7.55	5.00	1.58	3.91	2.3	1.3	6.2	2.3	2.45	3.5	3.1		5.34	5.34
5	GWD	Koppa	DW	12.7003	76.9569		1.54	5.73	0.60	0.55	1.73	2.50	1.37	2.36	1.82	1.39	1.63	5.55	0.35	0.35	2.94	1.5	1.7	1.53		2.33	2.33
6	GWD	Thorebommanahalli	DW	12.4725	77.0919	4.83	5.94			6.25						4.55	6.49	9.55	7.57	6.9						6.37	6.37
7	GWD	Kowdley	BW	12.7881	76.9322	6.08	6.98		6.20						3.95	4.34	5.69	3.95								6.23	6.23
8	GWD	Maddur	BW	12.5783	77.0400			12.50	11.45	9.00	9.76	12.30	7.79	10.00	8.58			7.6	6.4	8	11.5	5.05	5.93	5.08		10.40	10.40
9	GWD	Torebommanahalli	BW	12.4197	77.2039				3.00		10.83	9.90	6.70	8.59	1.81	7	6.49		1.07		7.29	3.45	2.8	1.1		7.80	7.80
10	GWD	Hunnanadoddi	BW	12.5200	76.0347	2.26	2.34	8.70	5.00	2.20	4.92	9.20	4.05	4.70	3.50	1.72	1.91	4.2	2.06	2.3	5.56	3.05	3.6	3.06		4.64	4.64
11	GWD	Kesthur	BW	12.6928	77.0442	23.17	31.5	38.85	40.5	39.20	37.50	37.50	29.66	23.34	18.98	22.97	36.1	34.3	42.6	39.61	35.27	20.6	15.48	15.71		32.77	32.77
12	CGWB	Basavanapura	Dw			3.53	5.87	12.53	6.08	2.05	12.05	14.09	11.75	6.11	2.63	3.24	5.78	3.90	2.22	1.16	8.30	2.80	3.19	2.90	5.03	7.41	3.58
13	CGWB	Bharati Nagar	Dw	12.28	77.02			3.82	5.98	3.50	8.10	2.64	4.28	4.10	3.60	2.28	7.72	3.97	2.02	0.60	2.85	0.63	1.47	1.50	2.75	4.50	2.90
14	CGWB	ChapuraDoddi	Dw	12.62	77.02			13.65	13.29	10.90	10.77	15.25	10.53	10.79	8.46			12.60	11.39	6.50	13.67	4.77	4.19	7.70	4.67	11.71	8.19
15	CGWB	ChikkaArasinkere	Dw	12.31	77.02			9.52	4.02	2.00	7.70	11.10	0.70	3.90	2.75			3.27	2.53	0.55	4.52	2.20	3.13	2.90	2.62	5.21	2.72
16	CGWB	Hagalahalli	Dw					7.65	7.01			7.80	8.70	7.00					4.41	3.05		1.00	4.02	4.57		7.63	3.41
17	CGWB	Honnanayakanathalli	Dw	12.45	77.09			10.80	6.25	3.20	8.17	14.50	14.50	14.50	5.00			5.53	2.88	1.90	10.34	4.49	5.45	1.36	4.20	9.62	4.52
18	CGWB	Kawdley	Dw	12.76	78.93	5.81	5.85	9.66	7.11	3.01	7.03	10.14	7.11	4.93	1.52	3.00	5.14	3.66	3.09	1.61	5.03	2.24	3.19	3.87	2.45	6.20	3.24
19	CGWB	Koppa1	Dw	12.72	76.96	1.90	1.29	4.02	1.46	1.65	1.91	3.40	1.42	1.95	0.77	1.27	2.72	1.62	1.39	1.05	2.50	1.40	1.65	1.47	1.36	2.00	1.59
24	CGWB	Shivapura	Dw	12.59	77.05			5.10	1.52	1.40	3.60	4.18	2.69	4.25	1.43			1.20	1.09	1.20	2.84	2.32	1.72	1.66	1.40	3.02	1.68
21	CGWB	Maddur2	Dw	12.60	77.05	1.40	0.57	2.60		1.40	1.86		1.23	1.55	0.24	1.45	1.73		1.19	1.00	1.60	1.07	1.43	2.04	1.07	1.38	1.37
20	CGWB	Maddur	Bw	12.6	77.05	3.60	3.32	7.20	5.02	4.17	5.80	6.56		2.30	2.55	2.23	4.81	3.81	2.98	2.29	5.18	2.50	3.10	3.14	4.15	4.45	3.28

Table 9: Long Term Ground Water Level Trend (2011 to 2020) in Maddur taluk

Sl_No	Location	Pre monsoon		Post monsoon	
		Rise (m/year)	Fall (m/year)	Rise (m/year)	Fall (m/year)
1	Basavanapura		0.5972		0.1380
2	Bharati Nagar	0.1204		0.1261	
3	ChapuraDoddi	0.3432		1.0536	
4	ChikkaArasinkere	0.5069			0.0319
5	Honnanayakanathalli		1.3693	0.1421	
6	Kawdley		0.0490	0.0230	
7	Koppa1	0.0088		0.0017	
8	Maddur		0.0247		0.0845
9	Maddur2		0.0074		0.0105
10	Malavalli		0.4033	0.1923	
11	Shivapura		0.0884		0.0621

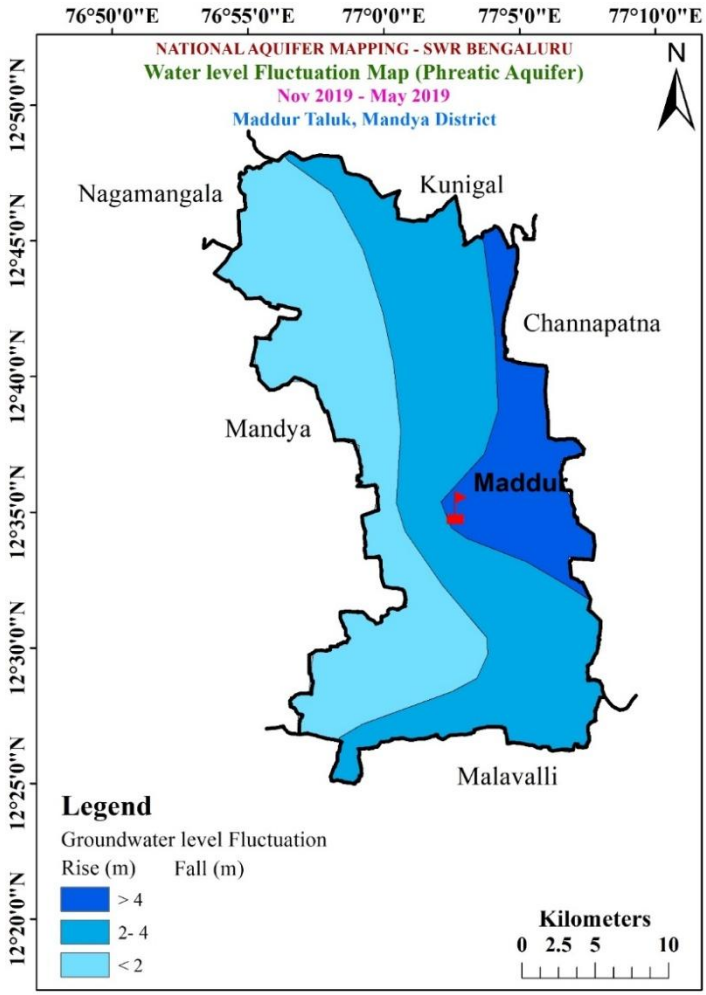

Fig. 9: Seasonal Water level fluctuation (Nov 2019- May 2019)

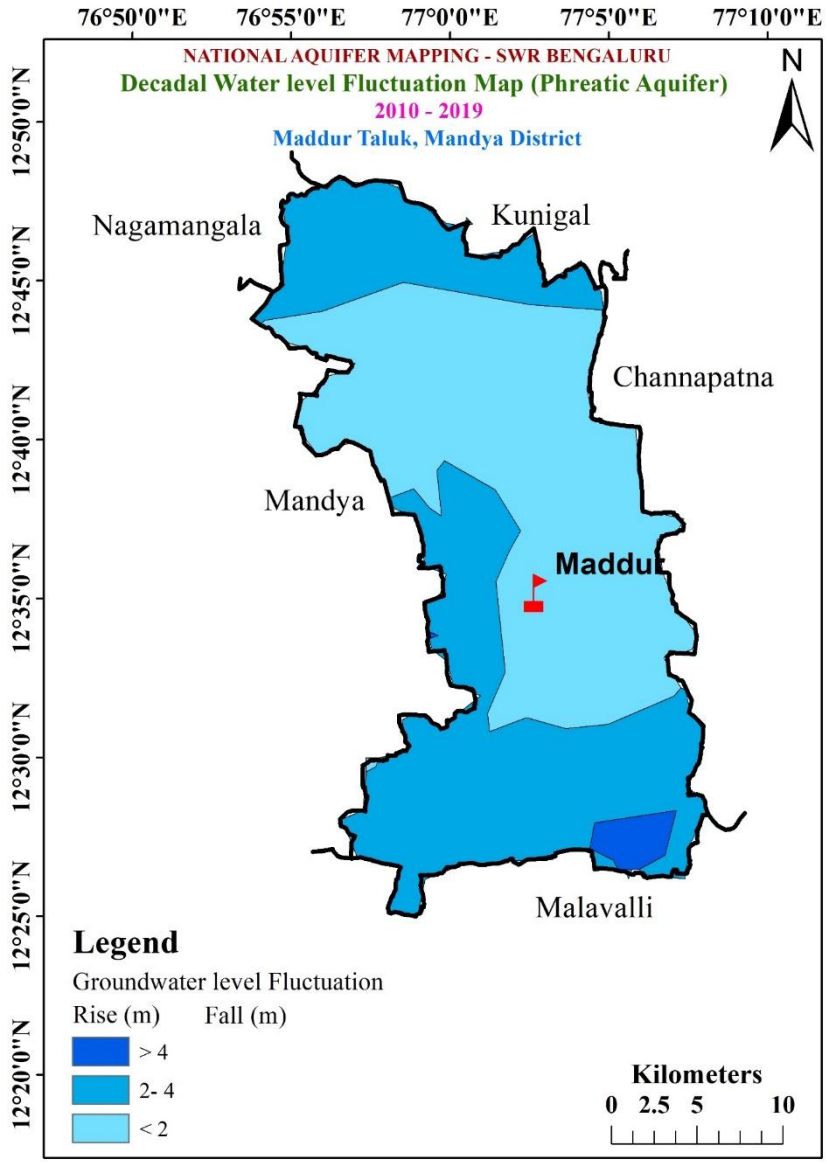

Fig. 10: Decadal Fluctuation Map of Phreatic aquifer

2 AQUIFER DISPOSITION

2.1 Aquifer Types

In Maddur taluk, there are two types of aquifer systems

i. Aquifer-I (Phreatic aquifer) comprising weathered Granite and banded gneissic complex

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

Geologically, Maddur taluk is predominantly underlain by granites and gneisses of Archaean age, popularly designated as hard rocks. These gneisses are often found to be intruded by basic dykes. The dominant strike direction is northwest– southeast with a subsidiary east-north-east strike. These hard rocks are fractured and fissured, and have undergone extensive and chemical decomposition in the plains and valleys. The resulting weathered mantle ranges in thickness generally from 6 to 21 meters.

In Maddur taluk, fractured granite and gneiss are the major water bearing formations **(Fig.11)**. Groundwater occurs within the jointed and fractured Granite and Gneiss under semi-confined to confined conditions. 2 Exploratory borewells and one observation well were drilled in this taluk by CGWB from a minimum depth of 123 mbgl to a maximum of 202mbgl. Depth of weathered zone (Aquifer-I) ranges from 6 mbgl to 21mbgl **(Fig.12)**. Ground water exploration reveals that aquifer-II, the fractured formation was encountered between the depth of 30 to 180m bgl.Yield islow to medium and ranges from 0to 5 lps. The details of the Exploratory wells drilled by CGWB are given in **Table 10** and Litholog details of Halehalli EW drilled during 2019 is shown in **Table 11.**

Table 10: Details of Ground water Exploration in Maddur Taluk by CGWB

Sl.No	Location	Coordinates	Depth (m)	Casing	Q lps	SWL	DD	T m^2/day	Formation
1	Maddur	12˚ 35'10" 77˚ 02' 30"	200	20.5	5	6.17	11.65	25.56	Granite gneiss
2	Maddur	12˚ 35'10" 77˚ 02' 30"	123.24	20.8	4.05	4.92	11.07	14.07	Granite gneiss
3	Halehalli	12˚ 45'36" 76˚ 58' 26"	202.3	19.4	dry				Granite gneiss

The 3D Aquifer disposition models, 2D aquifer sections and 3D aquifer fence diagrams have been prepared and presented in **Fig. 13 (a) to 13(c).**

Table 11: Litholog of Halehalli EW, Maddur Taluk

Depth Range (mbgl)		Thickness (m)	Lithology
0	1	1	Top weathered soil, Pale Grey color
1	39	38	Granitic Gneiss powdery grey color
39	45	6	Greyish Banded Gniessic complex
45	84	39	Powdery Banded Gniess with charnokite
84	99	15	Granitic gneiss, Dark Black color
99	129	30	Granite gneiss, Greyish white in color
129	202.3	73	MelanocraticGniessic complex

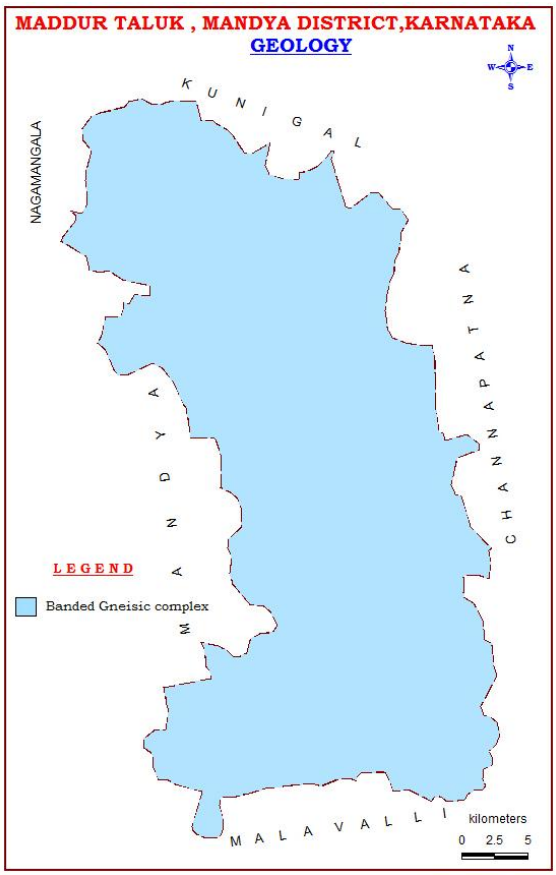

Fig.11: Geology Map

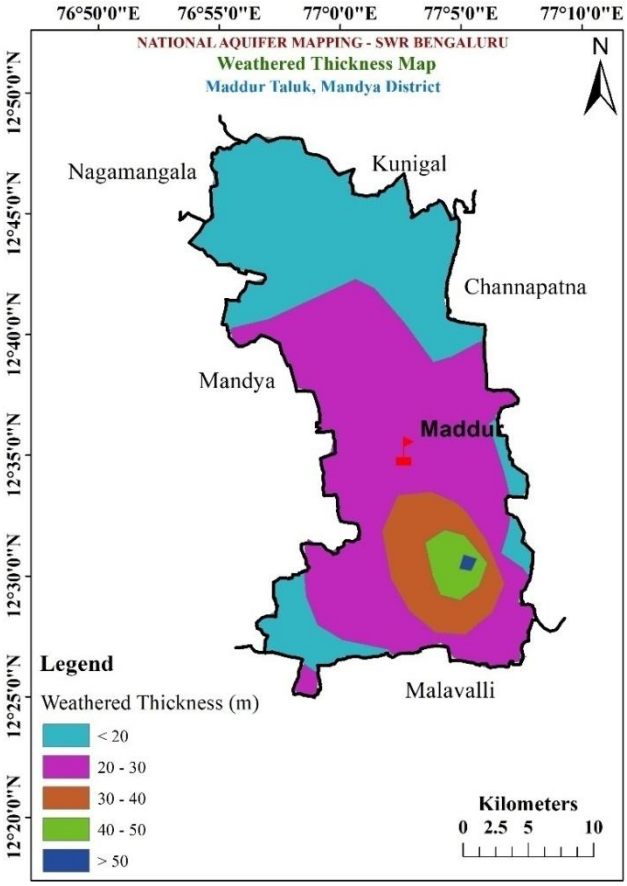

Fig. 12: Weathered thickness Map

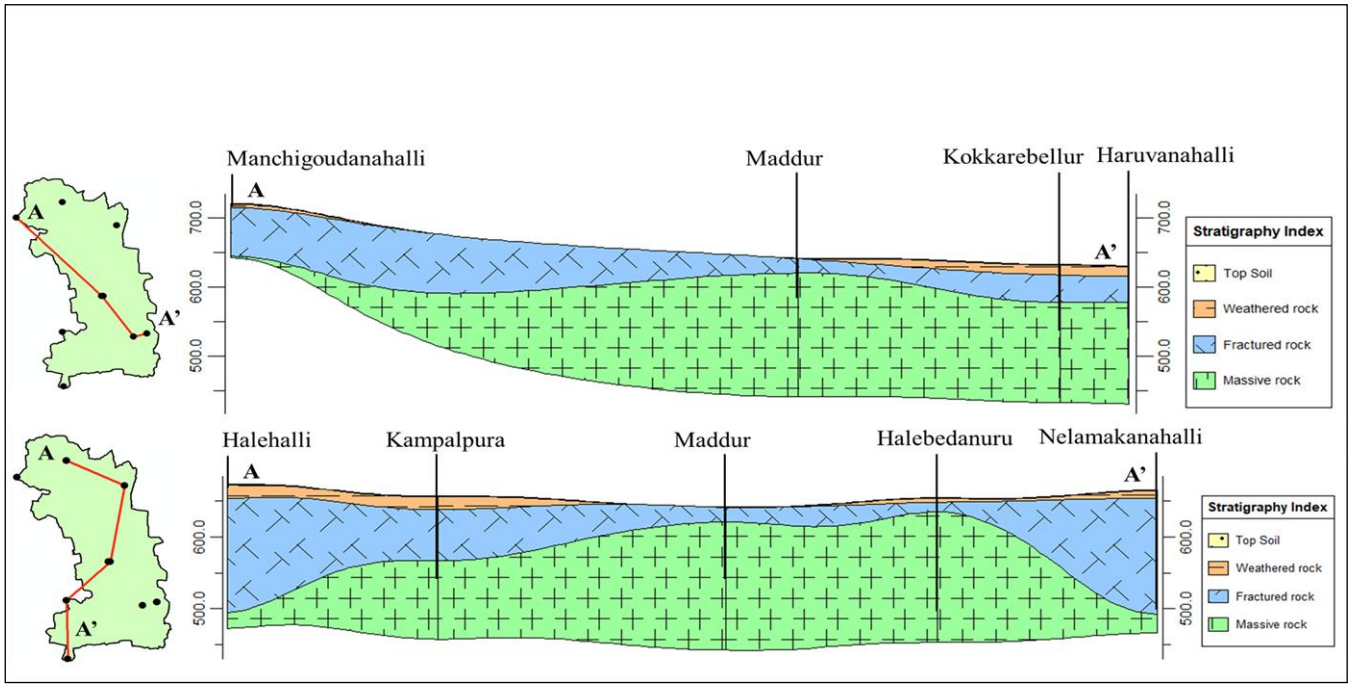

Fig.13 (a): 2D Aquifer section

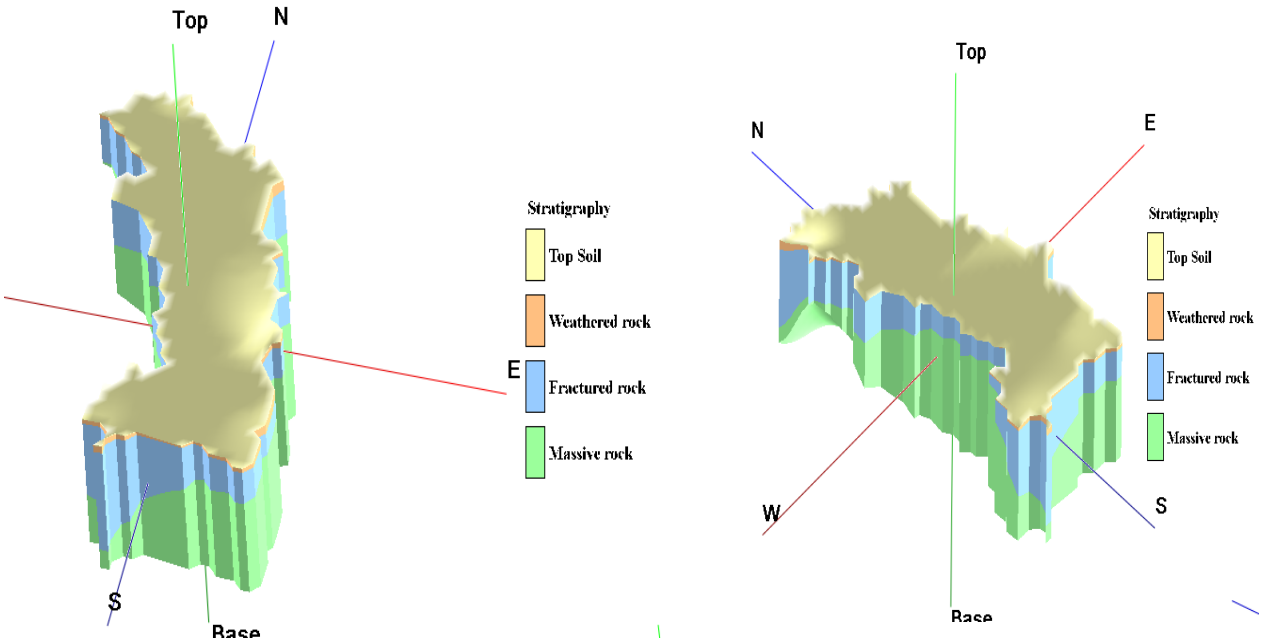

Fig.13(b): 3D Aquifer section

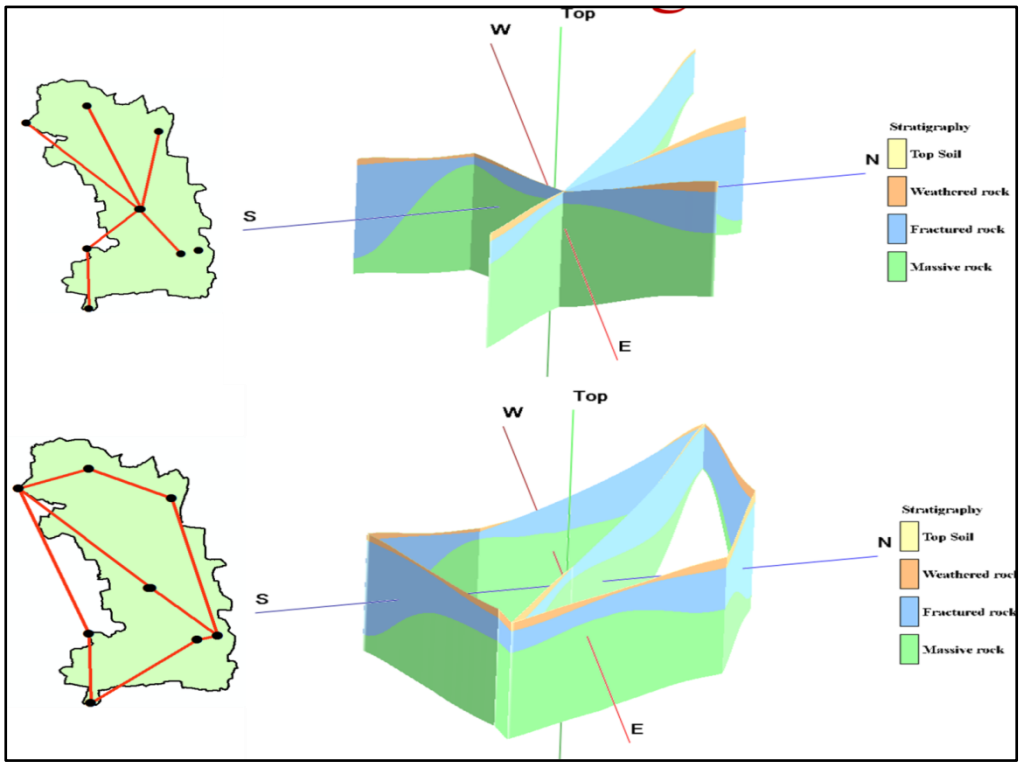

Fig.13(c): Aquifer Fence Diagram

3 GROUND WATER RESOURCE, EXTRACTION, CONTAMINATION AND OTHER ISSUES

3.1 Aquifer wise groundwater resource availability and extraction

The ground water resource as on 2017 and as on 2020 are shown in **Table.12.** The comparison of groundwater availability and draft scenario between 2017 and 2020 is presented in **Table.13**

Table 12: Present Dynamic Ground Water Resource (ham)

Assessment year	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
As on March 2017	9893	5170	367	5537	615	4196	**56**	**Safe**
As on March 2020	8154	4040	453	4493	488	3625	**55**	**Safe**

Table 13: Comparison of groundwater availability and draft scenario (in ham)

2017			**2020**		
GW Availability	**GW Extraction**	**Stage of GW Extraction**	**GW Availability**	**GW Extraction**	**Stage of GW Extraction**
9893	5537	**56%**	8154	4493	**55%**

From the above Table, it is seen that the stage of ground water extraction remained more or less in the same level between 2017 and 2020 with 56% and 55% respectively.

3.2 Chemical quality of ground water and contamination

To evaluate the quality of ground water, water samples collected from various panchayats of Maddur taluk during February 2022were analysed for major chemical constituents at the chemical laboratory in CGWB, SWR, Bangalore. The results are given in **Table 14** and the water quality maps are shown in **Fig. 14.** Suitability of ground water for domestic purposes was evaluated with the concentration ranges recommended by IS: 10400, BIS, 2012 and ICMR drinking water standards. The water sample collection for quality analysis in the study area is shown in **Photo.2.**

The electrical conductivity in water samples is an indication of total dissolved ions. Thus, higher the EC, the higher the levels of dissolved ions in the sample. The perusal of the data indicates that the distribution of electrical conductivity in the taluk shows wide variations from 550 to 2050µS/cm at 25˚ C. The BIS has recommended a drinking water standard for total dissolved solids a limit of 500mg/l (corresponding to about EC of 750 µS/cm at 25^0C) can be extended to a TDS of

2000mg/l (corresponding to about 3000 µS/cm at 25^0C) in case of an alternate source. Water samples having TDS more than 2000mg/l are not suitable for drinking purpose**.**

Nitrate is a problem as a contaminant in drinking water (primarily from groundwater and wells) due to its harmful biological effects. High concentrations can cause methemoglobinemia and have been cited as a risk factor in developing gastric, an intestinal cancer. The distribution of nitrate in the taluk indicated that the values are in the range of 0.67 mg/l to 48.6 mg/l. Nitrate in drinking water should not exceed 45 mg/l as per BIS (ISO: 10500: 2012) standard**.**

One of the essential elements for maintaining normal development of healthy teeth and bones is Fluoride. Lower concentrations of fluoride usually below 0.6mg/l may contribute to dental caries. However, continuing consumption of higher concentrations, above 1.2mg/l however cause dental fluorosis and in extreme cases even skeletal fluorosis. Most of the fluoride found in groundwater is of geogenic origin. Distribution of fluoride in the taluk ranges from 0.28 mg/l to 1 mg/l. Thus, majority of samples in the taluk shows fluoride concentration below 1.5 mg/l rendering them suitable for drinking purpose**.**

Table 14: Hydro chemical data of water samples from Maddur Taluk

Sl No	SITE_NAME	LAT	LONG	PH	EC µS/cm	TH	Ca	Mg	Na	K	CO3	HCO3	Cl	SO4	NO3	F
						<.....mg/L.....>										
1	Somanahalli	12.613	77.0597	7.94	1340	680.99	83	55	106.32	4.84	0	467	135	68	11.45	0.74
2	Maddur	12.5869	77.0425	7.97	1050	522.95	67	38	84.23	8.40	0	368	99	46	12.13	0.66
3	Nidaghatta	12.6194	77.0919	7.87	1950	969.23	131	112	75.32	8.44	0	503	287	109	43.39	0.28
4	Kadaloor	12.6355	77.0733	8.12	640	342.42	30	36	42.41	1.85	0	184	35	107	1.67	0.64
5	Atagur	12.6611	77.0675	8.42	1170	587.99	71	38	81.86	52.55	15	442	103	10	44.17	0.42
6	Dundanahalli	12.7194	77.0561	8.14	1575	763.99	69	63	148.23	23.36	0	460	174	61	44.42	0.99
7	Mallanakuppe	12.7369	77.0597	7.99	2010	1032.3	135	107	106.23	17.66	0	460	266	175	48.60	0.32
8	Hoothegere	12.73	77.03	8.16	2000	1106.3	109	57	124.36	168.00	0	510	241	157	46.46	0.33
9	Mathakanakoppalu	12.7219	77.0347	8.03	1530	830.82	75	45	160.15	30.35	0	368	167	173	24.63	0.43
10	Thagahalli	12.7197	76.9805	8.32	1040	535.22	61	38	90.59	5.26	24	313	82	81	0.67	0.46
11	Kowdley	12.7858	76.9308	8.09	550	258.4	44	24	28.03	1.08	0	221	21	32	25.38	0.4
12	Hosagavi	12.7336	76.9222	8.55	2050	1068.4	152	58	115.36	110.11	21	553	216	125	6.41	0.95
13	Panaidoddy	12.6408	77.0055	8.11	780	361.53	55	16	75.36	8.68	0	301	39	20	32.55	0.57
14	Kuduruhundi	12.5619	77.0125	7.93	1280	627.53	67	12	155.23	1.90	0	160	301	12	45.51	0.58
15	Ckikkaasinakere	12.5111	77.0444	8.13	1270	598	53	22	152.36	3.10	0	546	57	43	43.35	0.58
16	Bommandoddi	12.5133	77.0633	8.18	1040	507.56	57	32	108.73	1.50	0	417	60	44	35.02	0.85
17	D A Kere	12.5052	77.0169	8.17	1250	631.28	85	53	62.83	42.89	0	344	145	74	41.12	0.79
18	D A Kere	12.5052	77.0169	8.47	1350	676.36	73	51	124.56	9.10	15	430	121	72	41.90	1
19	K M Doddi	12.4855	77.0188	8.03	980	459.71	44	52	66.8	4.34	0	393	53	47	41.36	1
20	K Shettihalli	12.4772	76.988	8.05	900	413.16	55	64	20.31	1.41	0	356	67	31	8.99	0.63

Photo.2.Water sample collection from borewell in Maddur taluk

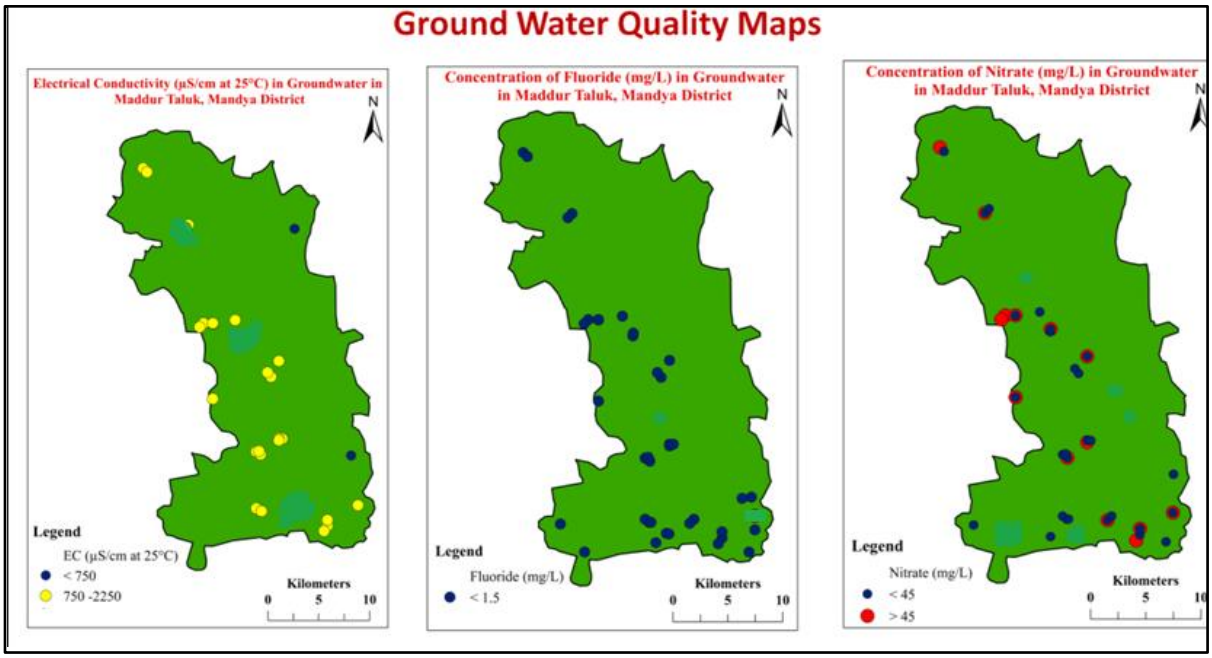

Fig.14: Groundwater Quality Maps

In addition to this, chemical analytical data of dug well/bore well samples collected by Ground Water Directorate, Govt. of Karnataka during 2018-19 from Maddur taluk is also presented in the following **Table 15**.

Table 15: Hydro-chemical data of dugwells/borewells in Maddur taluk

Location	Concentration in mg/L			Latitude	Longitude
	F mg/L	NO_3 mg/L	TH (as $CaCO_3$) mg/L		
Kesturu	0.58	35	572	77.0603	12.6941
Maddur	0.37	18	320	77.0381	12.5825
H.Doddi	0.51	17	452	77.0322	12.5214
T.B.Halli	0.43	21	492	77.0911	12.4731
Budanuru	0.43	103	580	7644 38	123818

Alternate Source

Not Potable

Source: GWD. Govt. of Karnataka

4 GROUND WATER RESOURCE ENHANCEMENT

4.1 Resource Enhancement by Supply Side Interventions

The Master Plan for Artificial recharge to ground water prepared by CGWB (2020) recommendedto recharge the de-saturated and dried-up phreatic aquifer r(Aq-I) in the taluk, through construction of artificial recharge structures such as Check dams and Percolation tanks **(Table.15).** As of now, recharging dried-up phreatic aquifer in the taluk, through construction of artificial recharge and watershed treatment structures has already been taken up by state Government agencies and are being implemented under MGNREGA.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. Area feasible for artificial recharge in Maddur taluk is shown in **Fig.16.**

Table 16: Quantity of non-committed surface runoff and expected recharge through AR structures proposed

Maddur taluk	
Area Feasible for Artificial Recharge	236 sq km
Non committed monsoon runoff available (Ham)	2.452
Number of Check Dams	8
Number of Point Recharge Structures	-
Number of Percolation Tanks	2
Number of Sub Surface Dykes	-
Tentative total cost of the project (Rs. In lakhs)	126.247
Expected recharge(Ham)	66

Table 17: Improvement in GW availability due to Recharge

Sl.no.	**Resource Details**	**As per GWRA 2020 Estimation**
1.	Annual extractable GW resource in HAM	8154.38
2.	Total GW extraction for all uses in HAM	4493.30
3.	Existing stage of groundwater extraction in percentage	55
4.	Expected recharge from artificial recharge structures in HAM	66
5.	Cumulative groundwater availability for extraction in HAM	8220.38
6.	Expected improved stage of groundwater extraction in percentage	54.66

After implementation of artificial recharge structures for groundwater recharge, the net annual groundwater availability will increase from 8154.38 ham to 8220.38 ham and the expected improvement in stage of development is 0.44% from 55.10% to 54.66 % (**Table 17**).

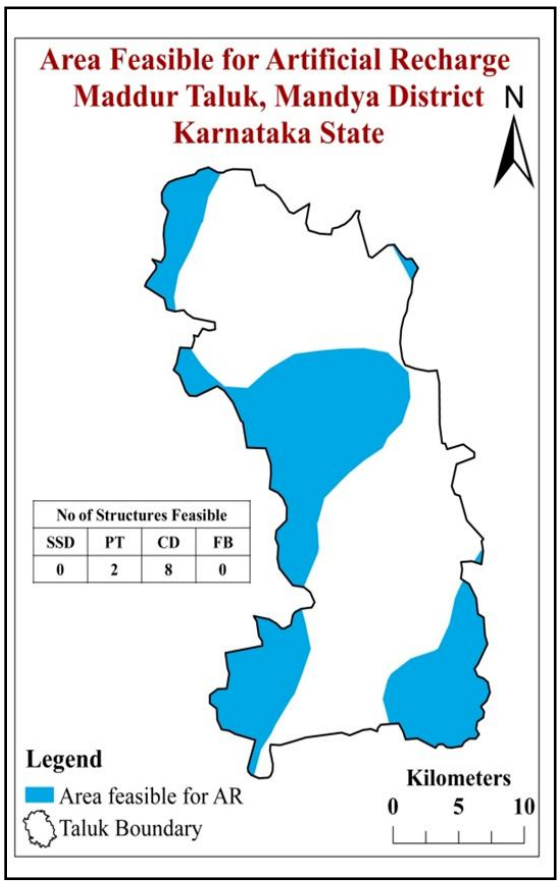

Fig.15: Area feasible for Artificial Recharge Structures

4.2 DEMAND SIDE INTERVENTIONS

4.2.1 Advanced irrigation practices

The important crops grown are Paddy, Pulses, Oilseeds, Maize, and Raggi. Presently, major portion of the net area irrigated (about 74% is being met by surface water from canals, and about 16% is contributed by ground water (Source: District at a Glance 2015-16 and CADA 2021). 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.

4.2.2 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.

Table 18: Details of Resource Enhancement in Maddur taluk

Sl. No.	**Resource Details**	**As per 2020 Estimation**
1	Net Ground Water Availability in Ham	8154.38
2	Existing ground water draft for all uses in Ham	4493.30
3	Existing Stage of Ground Water Development in percentage %	**55.10**
4	Expected Recharge from Artificial Recharge sources in Ham	66
5	Cumulative Ground water availability in Ham	8220.38
6	Expected improvement in stage of ground water development %	**54.66**
8	Saving due to adopting Water Use Efficiency in Ham	899
9	Ground water availability after WUE in Ham	9119.38
10	Expected improved stage of ground water development after implementation of WUE %	**49.27**
12	Cumulative improved stage of ground water development after all implementation %	**6%**

4.3 Regulation and Control

- As per the resource estimation – 2020, Maddur taluk falls under **Safe** category with the stage of ground water extraction of **55%**. 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.

4.4 Ground Water Development Plan

In Maddurtaluk, the present stage of ground water extraction (2020) is 55% with net ground water availability for future use is 3625 ham and total extraction is 4493 ham (2020) The ground water draft for irrigation purpose is 4040 ham, thus indicating that ground water irrigation needs to be encouraged in the area after considering the “Safe” level of extraction of 70%. For this, it is imperative to have a robust ground water resource development plan for the area, which can be implemented in scientific manner. The implementation of the plan needs to be based on site specific detailed hydrogeological, geophysical and scientific surveys for pinpointing the sites for construction of dug wells and bore wells.

As per the conservative estimate and after considering the average unit draft figure for the taluk, about 500 dug wells (10-15 m depth; 3 to 5 m diameter) are recommended to be constructed in feasible areas. Further. as per the estimate about, 2000 borewells (100 to 180 m depth; 150 mm dia) are also recommended to be drilled in feasible areas so as to maintain the safe category of the

taluk. The likely additional irrigation potential which can be created considering prevailing crop water requirement for the area is will be 3000 ha.

4.5 Other interventions proposed

- Remedial measures need to be adopted in the areas affected by Fluoride, Nitrate and EC, like nitrate rich groundwater through artificial recharge and water conservation etc.
- 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.
- Periodical maintenance of artificial recharge structures should be incorporated in the Recharge Plan.
- Augmenting surface water supply from Cauvery River.
- Intense monitoring of water level is recommended to keep an eye on water level trend in theTaluk.
- Awareness programmes and practice of participatory approach needs to be strengthened with the involvement of all the stake holders for sustainable management.

5 SUMMARY AND RECOMMENDATIONS

The main ground water issues are Limited Ground Water Potential / Limited Aquifer Thickness / Sustainability, Deeper Water Levels particularly in Aquifer-II in some parts, Inferior Ground Water Quality due to nitrate contamination in some pockets and water logging in canal command area.

Table 19: Summary of Management plan

Stage of GW Extraction and Category (2020)	55 %, Safe
Annual Extractable GW Resource (Ham)	8154
Total Extraction (Ham)	4493
Ground Water Draft for Irrigation (Ham)	4040.45
Ground Water Resource Enhancement by Supply side Interventions	
No of Proposed AR structures SSD PT CD Filter Beds	 0 2 8 0
Expected Additional Recharge to GW due to AR (Ham)	66
Ground Water Resource Savings by Demand side Interventions	
Expected Saving due to adopting WUE (Ham)	899
Change in Stage of GW development (%)	55 to 49
Ground Water Quality – Nitrate contamination	Improving quality by proper drainage of sewage and Limited usage of Nitrogenous fertilizers

As per the resource estimation – 2020, Maddur taluk falls under Safe category with the stage of ground water extraction 55%. However, there is need to formulate management strategy to tackle the 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 2.452 MCM. This can be used to recharge the aquifer through Percolation tanks (2) and Check dams (8). The volume of water expected to be recharged is 66 ham through these AR structures. The approximate cost estimate for construction of these AR structures is Rs. 126.247 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: The important crops grown are Paddy, Pulses, Oilseeds, Maize, and Raggi. Presently, major portion of the net area irrigated (about 74% is being met by surface water from canals, and about 16% is contributed by ground water (Source: District at a Glance 2015-16 and CADA 2021). 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.