



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

Savanur Taluk, Haveri District, Karnataka

दक्षिण पश्चिमी क्षेत्र, बेंगलुरु
South Western Region, Bengaluru

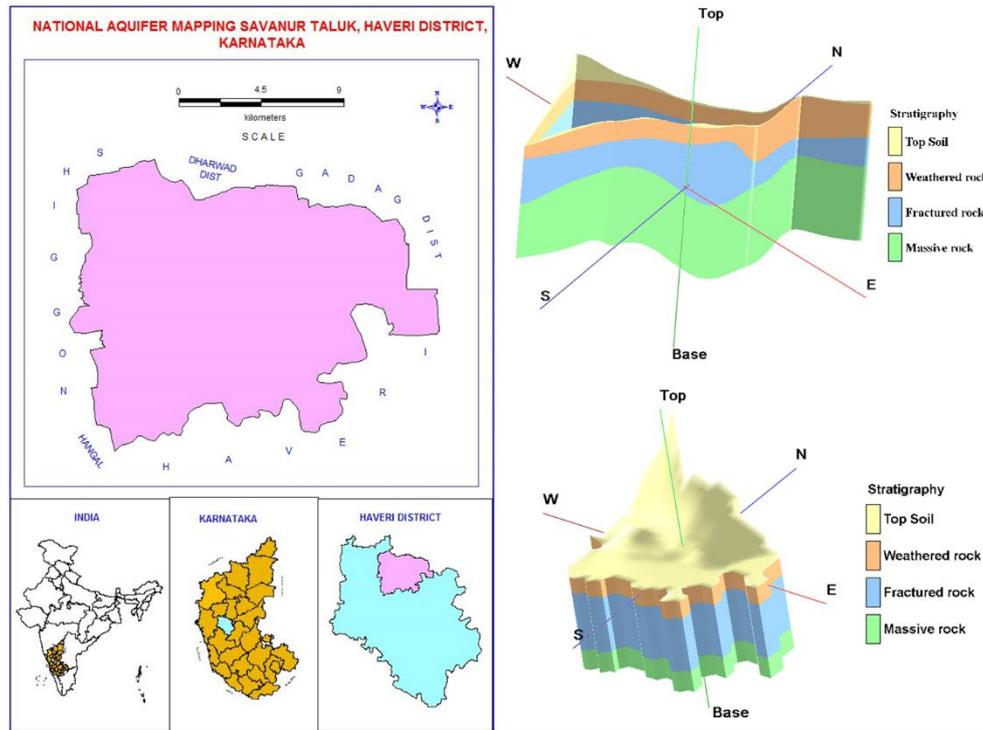
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AQUIFER MAPS AND MANAGEMENT PLAN, SAVANUR TALUK, HAVERI DISTRICT, KARNATAKA STATE

(AAP – 2021-2022)



By

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AQUIFER MAPS AND MANAGEMENT PLAN, SAVANUR TALUK, HAVERI DISTRICT, KARNATAKA STATE

1 SALIENT FEATURES

Name of the taluk	: SAVANUR
District	: Haveri
State	: Karnataka
Area	: 537 sq.km
Population	: 1,61,521
Annual Normal Rainfall	: 690 mm (2020)

1.1 Study area

Aquifer mapping studies have been carried out in Savanur taluk, Haveri district of Karnataka, covering an area of 537 sq.kms under National Aquifer Mapping Project. The Savanur taluk is located between North Latitudes $14^{\circ} 50' 30''$ and $15^{\circ} 05' 00''$ and East Longitudes between $75^{\circ} 15' 00''$ to $75^{\circ} 33' 30''$ and is falling in Survey of India Toposheets No forms parts of 48M/8, 48M/12, 48N/5, 48N/9. The study area is bounded on the East by Gadag District, on the North by Dharwad District, on the South by Hangal and Haveri Taluk and on the West by Shiggaon Taluk. Location map of Savanur taluk of Haveri district is presented in **Fig-1**. There are 65 villages in this taluk.

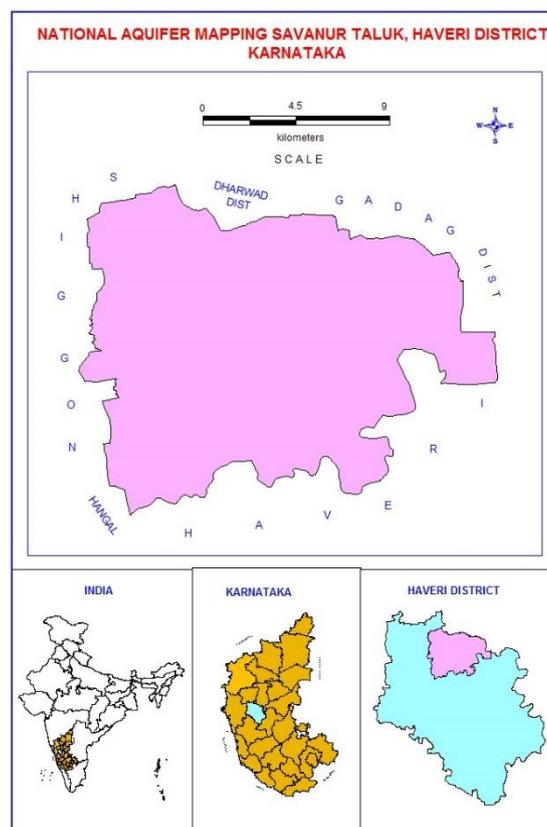


Fig 1: Location map

1.2 Population

According to 2011 census, the population in Savanur taluk is 1,61,521. Out of which 83,150 are males while 78,371 are females. The average sex ratio of Savanur taluk is 1060. The Savanur taluk has an overall population density of 301 persons per sq.km. The decadal variation in population from 2001-2011 is 12.26% in Savanur taluk. The population details are given in **Table-1**.

Table-1: Population details (2011)

Total Population	161521
Number of Male	83150
Number of Female	78371
Share of the district population (%)	10.10
Total Number of Rural populations	120954
Total Number of Urban populations	40567
Decadal change in population (2001-2011) (%)	12.28
Decadal change in rural population (%)	11.66
Decadal change in urban population (%)	14.07

Source: As Per 2011 Census at District at a glance 2019-20, Govt. of Karnataka

1.3 Rainfall and Climate

Savanur taluk experiences semi-arid, sub-tropical climate. The area falls under Northern transitional agro-climatic zone of Karnataka state. The normal annual rainfall in Savanur taluk for the period 1961 to 2010 is 699 mm.

Actual annual rainfall data of Hangal Taluk from 2011 to 2020 was analyzed (**Table-2**). The data were plotted and derived the rainfall trend line (**Fig-2**) and it was noted that the rainfall had increased slightly in last 10 years. Precipitation for the analyzed decadal ranges from 442 to 955 mm. The decadal average rainfall at Hangal taluk is 683.66 mm, The statistical analysis of the rainfall variation among the period 1981-2010 has given in **Table-3**, and it was noted as the normal rainfall is 683, Standard Deviation is 171, and coefficient of variation is 400 %. The annual rainfall of the monthly basis during the period of 2010 to 2019 decadal years were given in **Table-4**.

Table-2: Actual Annual Rainfall Data of Savanur taluk, Haveri district (2011 to 2020)

Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Decadal Average
Rainfall in mm	552	442	741	809	597	847	553	657	955	690	683.66

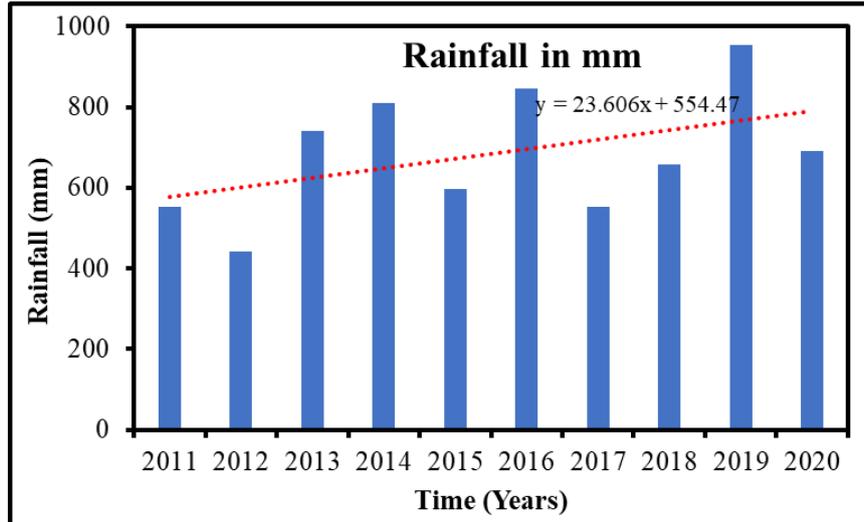


Fig 2: Annual Rainfall trend map

Table-3: Statistical analysis of Normal annual rainfall of Savanur taluk, Haveri District (1981-2010)

Period	Normal	Standard Deviation	Coefficient of Variation (%)
January	0	1	38
February	1	2	37
March	11	27	42
April	33	32	104
May	67	42	158
PRE-MONSOON	112	59	191
June	99	44	224
July	107	44	242
August	110	73	151
September	97	59	165
SOUTH WEST-MONSOON	413	136	303
October	111	62	178
November	37	61	61
December	10	31	32
NORTH EAST-MONSOON	158	81	195
Annual	683	171	400

Table-4: Annual rainfall of Savanur taluk, Haveri District (2010-2019)

Year	Jan	Feb	Mar	Apr	May	PRE	Jun	Jul	Aug	Sep	MON	Oct	Nov	Dec	POST	Annual
2010	0	3	4	20	80	107	161	124	106	133	524	48	211	0.0	259	890
2011	0	0	0	52	69	121	111	104	80	53	348	168	0	0	168	637
2012	0	0	0	57	53	110	85	55	79	93	312	61	98	0	159	581
2013	26	0	16	84	0	126	85	55	79	93	312	61	98	0	159	597
2014	0	0	42	52	103	197	44	176	196	187	603	138	38	17	193	993
2015	0	0	40	12	80	132	161	43	87	86	377	71	11	0	82	591
2016	0	0	22	51	108	181	88	140	135	142	505	103	49	9	161	847
2017	0	0	1	8	132	141	41	114	56	184	395	107	0	0	107	643
2018	0	0	0	41	153	194	73	85	101	47	306	93	30	0	123	623
2019	0	0	2	16	38	55	117	239	424	90	870	382	5	1	388	1313

1.4 Agriculture & Irrigation

Agriculture is the main occupation in Savanur taluk. Major Kharif crops are Maize, Jowar and Oil seeds. Main crops of Rabi season are Maize, and Jowar (**Table-5**). Water intensive crops like paddy & sugarcane are grown in a very small portion (<1%) of total sown area. Maize is grown in 20.3% and Jowar in 14.9% of total sown area of taluk. Cotton is grown in 40.6% & oil seeds account 15.3% of total sown area.

Table-5: Cropping pattern in Savanur taluk 2018-2019 (Ha)

Crops		Area (ha)	Total area (ha)	Total area (ha)
Cereals	Paddy	39	21291	58972
	Jowar	8879		
	Bajra	2		
	Maize	12088		
	Ragi	20		
	Wheat	150		
	Other	113		
Pulses	Tur	514	1456	
	Horse gram	0		
	Black gram	2		
	Green gram	327		
	Avare	5		
	Cow pea	249		
	Bengal gram	359		

	Other	0	
Fruits			145
Vegetables			464
Oil Seeds	Groundnuts	8376	9115
	Sunflower	26	
	Safflower	124	
	Castor	0	
	Sesamum	2	
	Niger Seed	0	
	Soyabean	582	
	Linseed	0	
	Other	5	
Commercial crops			26501

Source: As per Annual Season Crop Report 2018-19 in District at a glance 2019-20, Govt. of Karnataka

It is observed that net sown area accounts 87% and area sown more than once is 23.3% of total geographical area in Savanur taluk (Table-6). Area not available for cultivation 5.9% of total geographical area. Whereas, area covered by fallow land is 3.8%. 95.7 % of net area irrigated is only from bore wells (Table-7).

Table-6: Details of land use in Savanur taluk 2018-2019 (Ha)

Geographical area	Area under Forest	Area not available for cultivation	Fallow land	Area Sown		
				Net sown area	Area sown more than once	Total sown/ Cropped area
53901	801	3225	2054	46918	12598	53901

Source: As per Annual Season Crop Report 2018-19 in District at a glance 2019-20, Govt. of Karnataka

Table-7: Irrigation details in Savanur taluk (Ha)

S.No	Source	Number of Structures	Gross area irrigated (ha)	Net area irrigated (ha)
1	Surface water	Canals	0	0
		Tanks	18	0
		Lift irrigation	931	0
		Total (I)	0	0
2	Ground	Dug wells	0	0

	water	Bore wells	6116	5560	4880
		Other Source		215	215
		Total (II)		5775	5095
Grand Total (I + II)				5775	5095

Source: As per Annual Season Crop Report 2018-19 in District at a glance 2019-20, Govt. of Karnataka

1.5 Geomorphology, Physiography & Drainage

Savanur taluk is a plateau region formed by schistose rocks, which represents “Dharwar Schists”. The overall taluk exhibits “peneplane terrain” having sparsely distributed NW-SE trending ridge lineaments and tors in the central part. The elevation in the plains varies from 625 m in the North western part to 554 m amsl in the Southern part of the taluk. This has its bearing on the regional slope which is towards south. The differential altitude is significant as it is responsible to cause irregular ground water flow patterns on the micro scale (Fig.-3). Topography is dominantly controlled by geological structures.

The entire Savanur taluk is drained by Dharma tributary of Vardha (Varada) river which is contributes to Tungabhadra upper sub-basin which is a part of major Krishna River Basin. The Drainage pattern is dendritic to sub-dendritic (Fig.-4).

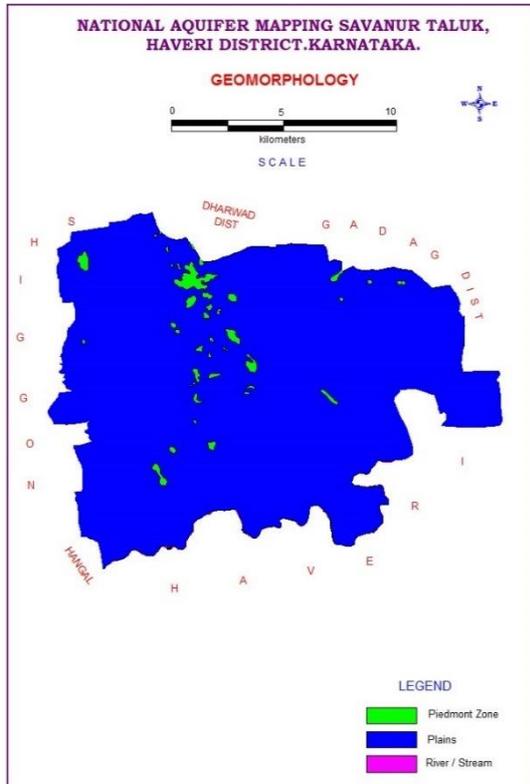


Fig-3: Geomorphology Map

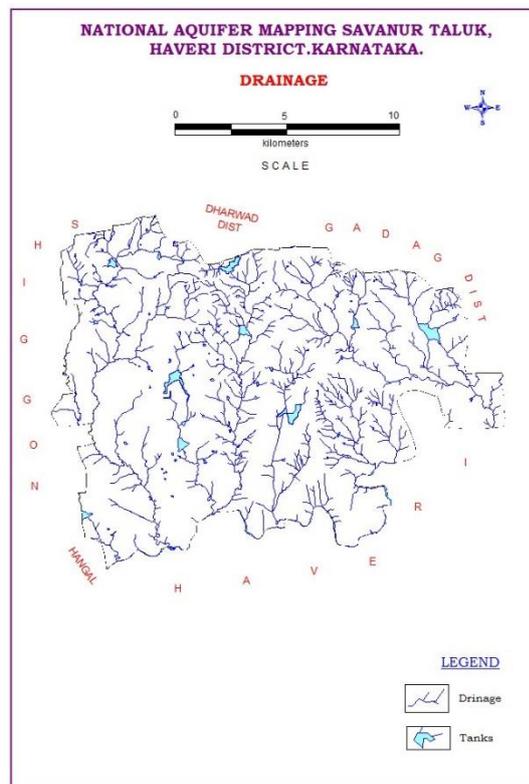


Fig-4: Drainage Map

1.6 Soil and Landuse

The soils of Savanur taluk can broadly be classified into greyish brown to dark reddish brown soils. These soils are derived from schistose rocks in semi-arid, sub-tropical climate and these vary in depth and texture, depending on the parent rock type, physiographic settings and climatic conditions. Reddish brown clayey soils cover major part of the taluk, followed by the greyish brown sandy soil. These soils have clay loam to sandy(skeletal) clayey texture (**Fig-5**). The soils are overlapped by alluvial clayey materials along the tributaries.

The landuse pattern of the taluk is derived in (**Fig-6**), it shows that the agriculture is the major practice in most part of the region.

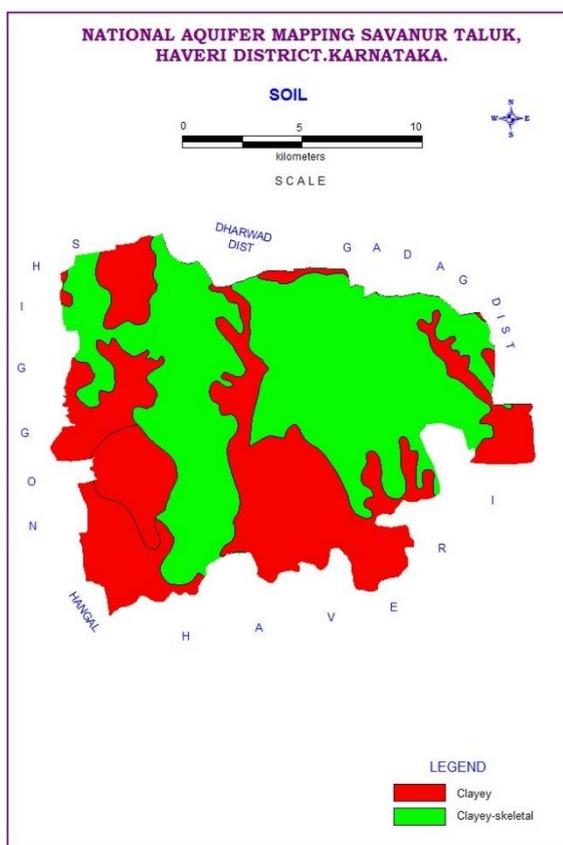


Fig-5: Soil Map

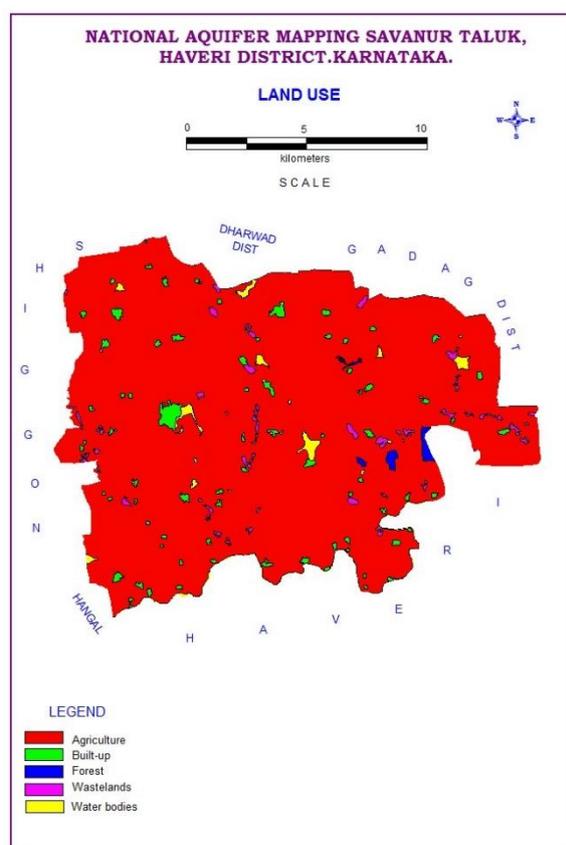


Fig-6: Landuse Map

1.7 Ground Water Resource Availability and Extraction

Aquifer wise total ground water resources up to 200 m depth is given (**Table-8**) as per 2017 estimations. The details of dynamic (phreatic) ground water resources of 2017 is shown in (**Table-9**).

Table-8: Total Ground Water Resources (2017) (Ham)

Taluk	Annual replenishable GW resources	Fresh In-storage GW resources		Total availability of fresh GW resources
		Phreatic	Fractured(Down to 200m)	
Savanur	6680			Dynamic +phreatic in-storage + fractured
		11689	857	19226

Table.9: Dynamic Ground Water Resource, Savanur taluk - 2017(Ham)

Net Annual Ground Water Availability	4123.961
Existing Gross Ground Water Draft for Irrigation	1332.334
Existing Gross GW Draft For Domestic And Industrial Water Supply	107.123
Existing Gross Ground Water Draft For All Uses	1439.458
Allocation For Domestic And Industrial Use For Next 25 Years	117.062
Net Ground Water Availability For Future Irrigation Development	2674.565
Existing Stage of Ground Water Development	34.905
Category	Safe

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

As per the GWRA 2017, the net ground water availability was 4123.961ham and the total ground water draft for all uses is 1439.458 Ham with stage of development at 34.905% and the taluk falls in Safe category. Thus there is further scope for future irrigation development 1439.458Ham. The domestic (Industrial sector) demand for next 25 years is estimated at 117.062Ham.

The details of dynamic (Phreatic) ground water resources for Savanur taluk as on March 2020 is shown in **Table-10**. It is observed that the stage of ground water extraction has been lowered in the taluk from 34.905% to 31.98% from 2017 to 2020 with an increase in the net ground water availability during 2020 with a figure of 6679.61Ham.

Table.10: Dynamic Ground Water Resource, Savanur taluk – 2020 (Ham)

Net Annual Ground Water Availability	6679.61
Existing Gross Ground Water Draft for Irrigation	2014.56
Existing Gross GW Draft For Domestic And Industrial Water Supply	0.00
Existing Gross Ground Water Draft For All Uses	2136.00
Allocation For Domestic And Industrial Use For Next 25 Years	130.39
Net Ground Water Availability For Future Irrigation Development	4534.67
Existing Stage of Ground Water Development	31.98
Category	Safe

1.9 Water level behaviour

The ground water level data have been monitored from the representative wells for pre and Post-monsoon seasons for the years 2012 to 2021 has given in (Table-11 and Table-12) respectively. The Water level fluctuations to the pre and post monsoon of the 2019 year has given in (Table-13), it has found that the water level fluctuates between 2.7 to 7.7mbgl in Aquifer-2, The ground water level maps prepared to the Savanur taluk Pre and post monsoon are given in Fig 7 and Fig 8 respectively.

Table 11: Depth to water level of Pre Monsoon – State Groundwater Department

S.No	Village	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
1	Karadagi	22.50	19.50	19.40	17.50	22.20	30.90	17.25	21.05	21.70	8.78
2	Yalavagi	19.10	16.20	14.50	17.40	15.80	20.00	10.05	14.35	9.60	10.00
3	Kadakol	30.10	42.10	41.60	40.00	41.50	52.65	57.55	53.75	21.55	16.30

Table 12: Depth to water level of PostMonsoon – State Groundwater Department

S.No	Village	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
1	Karadagi	19.40	14.90	11.00	16.00	21.30	18.60	18.25	8.12	9.25	9.65
2	Yalavagi	13.80	10.10	8.30	9.00	13.20	12.90	11.15	2.95	3.96	3.32
3	Kadakol	37.20	35.00	32.10	35.00	41.60	51.75	47.05	8.33	6.72	5.91

The long-term data of Depth to Water level is analysed to interpret the behaviour of groundwater over period of time. The groundwater level is observed to show an increasing trend. Which directly means that, the availability of groundwater is enhanced over the last decade. The pre-monsoon period as well as post-monsoon period shows the increasing trend of groundwater level.

Table 13: Depth to water level of Pre and Post-Monsoon (2019), CGWB-SWR

S. No	Village	Source	Pre-monsoon Depth to water May-2019 (mbgl)	Post-monsoon Depth to water Nov-2019 (mbgl)	Water level Fluctuation
Aquifer-II					
1	Karadagi	Borewell	20.7	16.1	4.7
2	Savanur	Borewell	30.0	22.3	7.7
3	Yalavagi	Borewell	13.6	11.0	2.7
4	Kadakol	Borewell	40.1	33.7	6.4

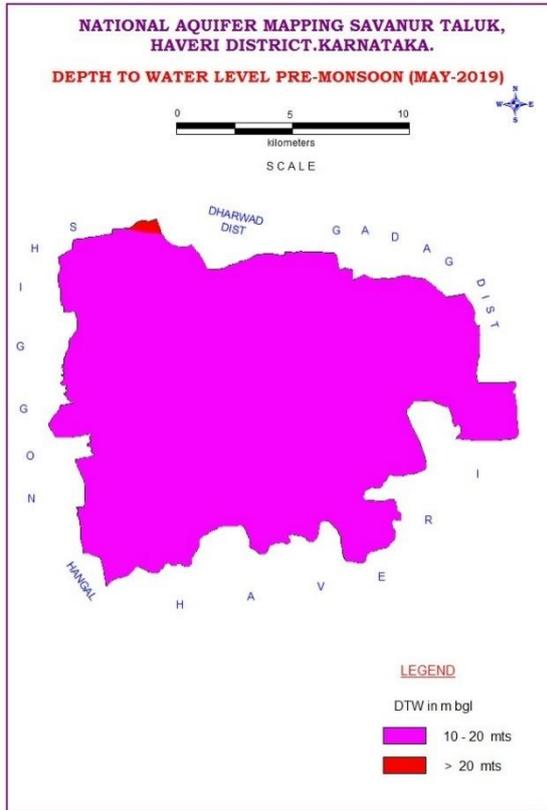


Fig-7: Pre-monsoon Depth to Water Level

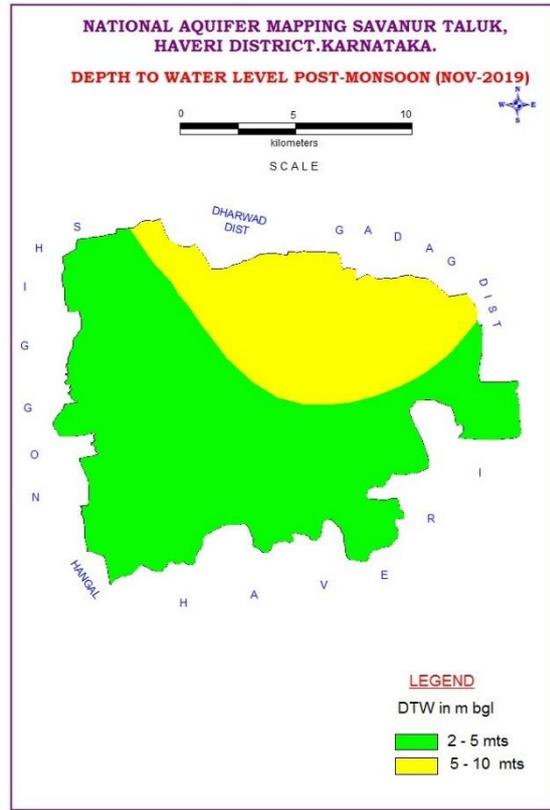


Fig-8: Post-monsoon Depth to Water Level

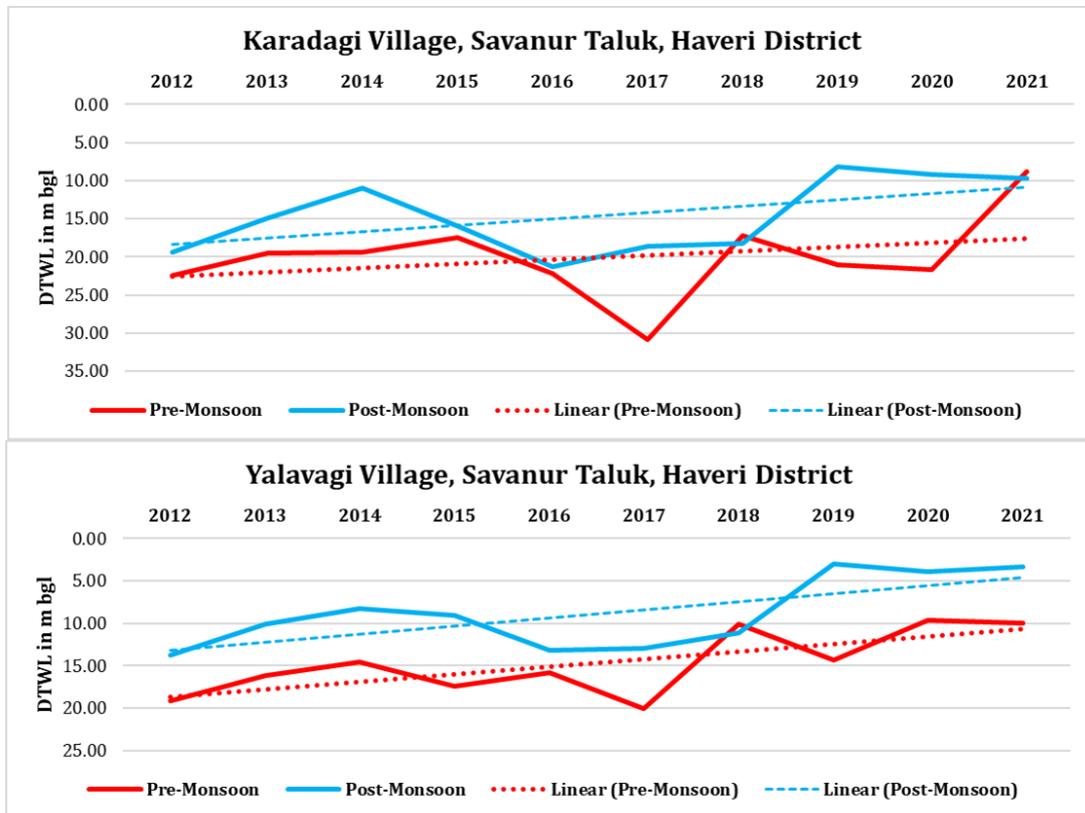


Fig-9: Groundwater level Fluctuation in the villages of Savanur taluk

2 AQUIFER DISPOSITION

The occurrence and movement of water in the subsurface is broadly governed by geological frameworks i.e., nature of rock formations including their porosity (primary and secondary) and permeability. The principal aquifers in the area is Schist, the occurrence and movement of ground water in this rock is controlled by various factors and it primarily depends on the degree of interconnection of secondary pores/voids developed by fracturing and weathering in the hard rock.

2.1 Aquifer Types

In Savanur taluk, there are mainly two types of aquifer systems have encountered

- **Aquifer-I (Phreatic aquifer)** comprising Schist
- **Aquifer-II (Fractured aquifer)** comprising Schist

In Savanur taluk, Schist are the main water bearing formations (**Fig-10**). Ground water occurs within the weathered and fractured Schist unconfined condition and semi-confined condition. In Savanur taluk bore wells were drilled from a minimum depth of 105.8mbgl to a maximum of 132.2mbgl. The details of groundwater exploration carried out in the Savanur taluk is given in **Table-14**. Depth of weathered zone ranges from 5.1mbgl to 11.5mbgl. Ground water exploration reveals that aquifer-II fractured formation was encountered between the depth of 34.5 to 103mbgl. Yield ranges from 2.82 to 8.15lps. The basic characteristics of each aquifer are summarized in **Table-15**.

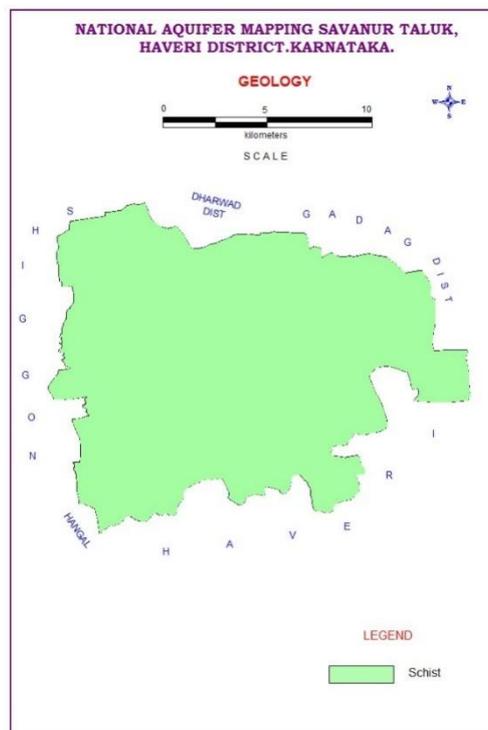


Fig-10: Geology of the Savanur taluk

Table-14: Details of Groundwater exploration in Savanur taluk

S.No	Location	Depth (mbgl)	Casing (m)	Lithology	SWL (mbgl)	Q (lps)	DD (m)	T (m ² /day)
1	Allipur EW	132.2	5.1	Schist	18.34	2.82	-	-
2	Mannur EW	105.8	8.2	Schist	4.2	8.15	-	-
3	Old Gundur	127.6	11.5	Schist	6.505	6.98	-	-

Table-15: Basic characteristics of each aquifer

Aquifers	Weathered Zone (Aq.-I)	Fractured Zone (Aq.-II)
Major Lithology	Weathered Schist	Fractured / Jointed Schist
Thickness range (mbgl)	11.5	Fractures upto 73.6 mbgl
Depth range of occurrence of fractures (mbgl)	5.1 to 11.5	34.55-103
Range of yield potential (lps)	Poor yield	2.82-8.15
Specific Yield (%)	-	-
Transmissivity (m ² /day)	-	-
Quality Suitability for Domestic & Irrigation	Suitable	Suitable

2D AQUIFER DISPOSITION

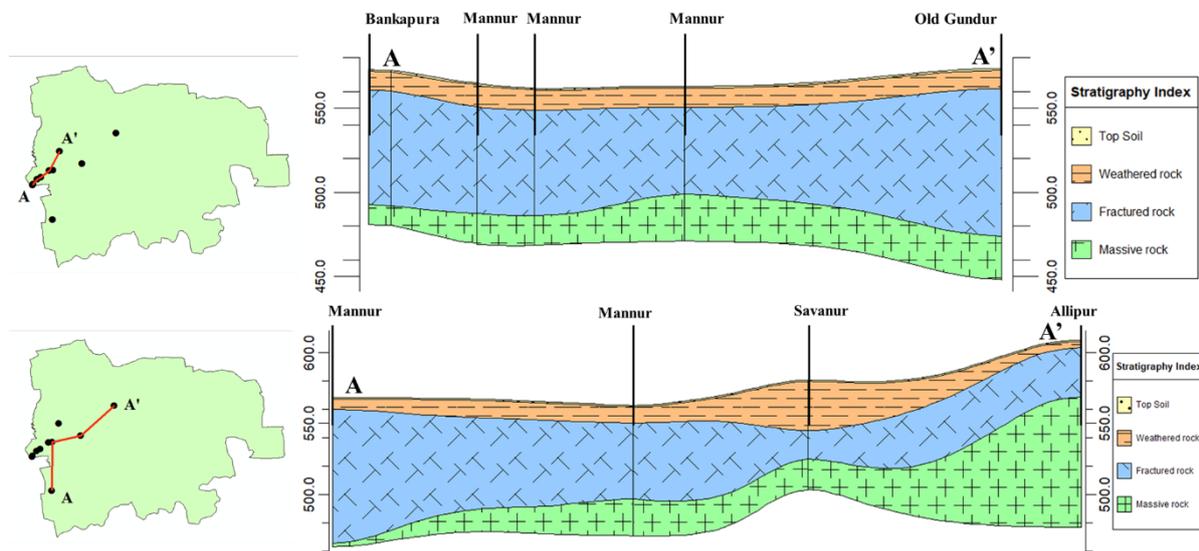


Fig.11:2-D Cross Sections of Savanur Taluk

3D AQUIFER DISPOSITION

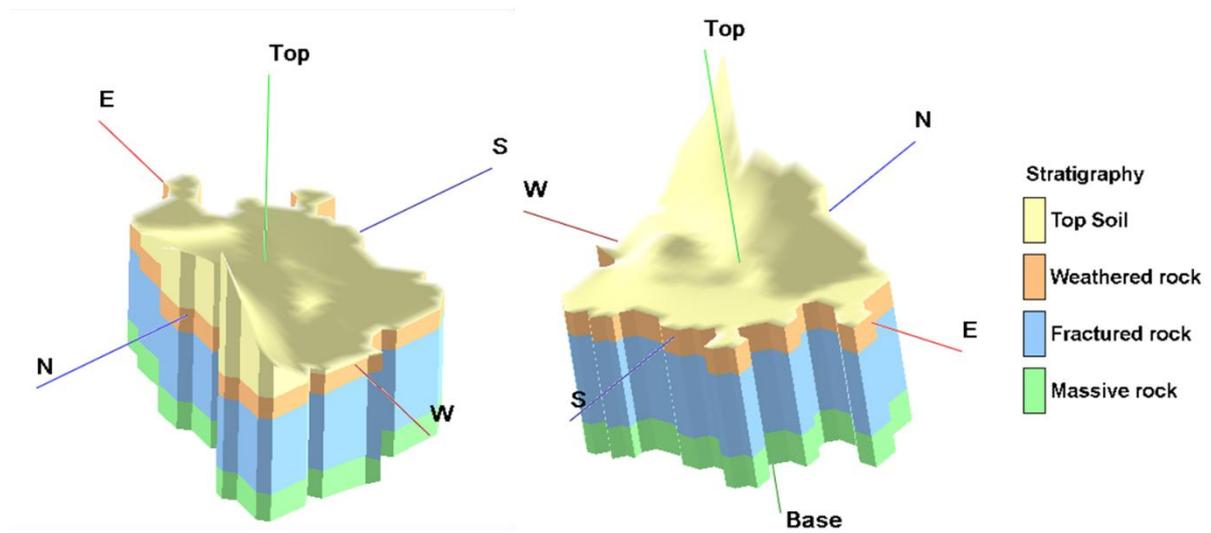


Fig.12: 3-D Aquifer Disposition model of Savanur Taluk

3D FENCE DIAGRAM

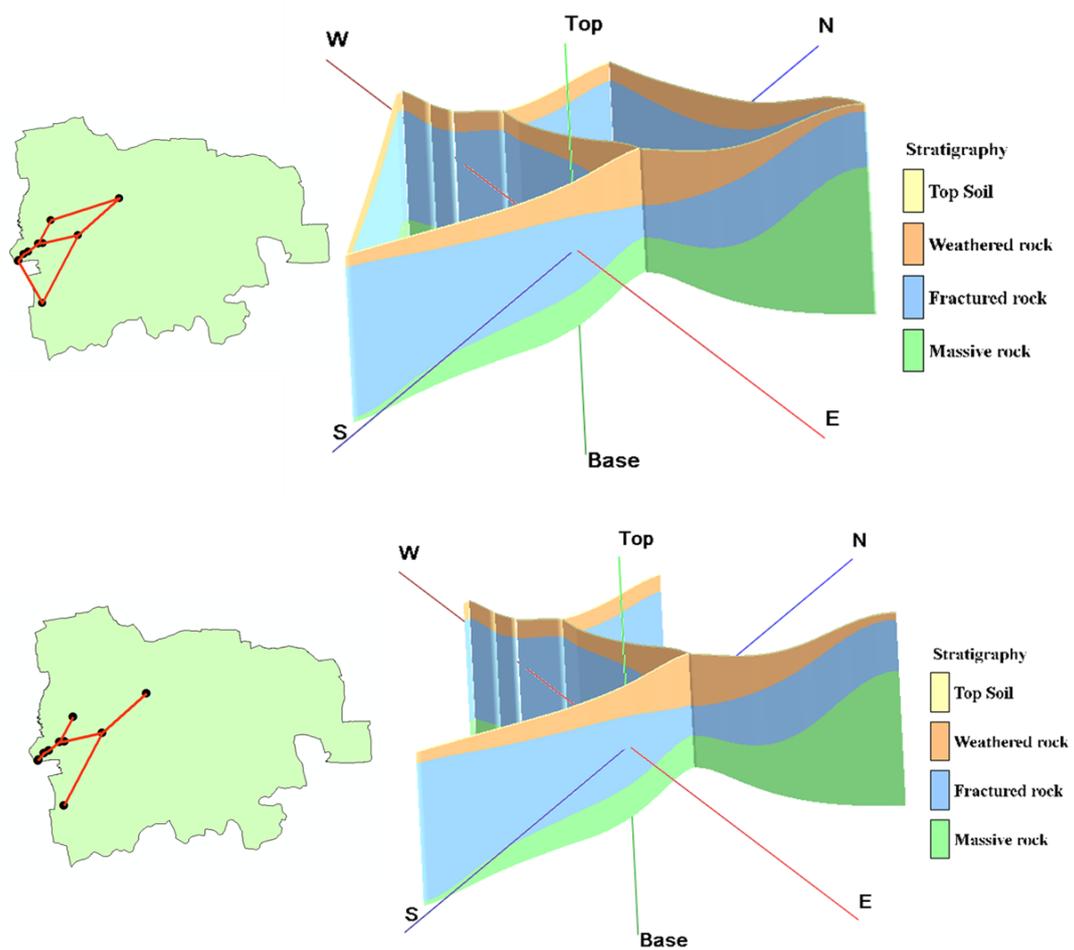


Fig.13: 3D Fence Diagram of Savanur Taluk

3 GROUND WATER RESOURCE, EXTRACTION, CONTAMINATION AND OTHER ISSUES

The main ground water issues are Limited Ground Water Potential / Limited Aquifer Thickness / Sustainability, declining water level trend are the major issues in the Savanur taluk.

3.1 Comparison of Ground Water Resource and Extraction

The Dynamic Ground Water Resource 2013, 2017 and as on 2020 has given in **Table 16**. It is observed that the ground water availability has developed drastically during these years 2013, 2017, and 2020. However, it is attributable to the improvement in the irrigation practice, influence of command area and also due to the water conservation / recharge activities carried out in the taluk by various state government and other agencies.

Table-16: Comparison of ground water availability and draft scenario in Savanur taluk

Taluk	GW availability (in ham)	GW draft (in ham)	Stage of GW development	GW availability (in ham)	GW draft (in ham)	Stage of GW development	GW availability (in ham)	GW draft (in ham)	Stage of GW development
	2013			2017			2020		
SAVANUR	3083	1315	43	4124	1439	35	6680	2136	32

It is seen that the stage of ground water extraction during 2020 has developed in the taluk in comparison with 2013 and 2017 estimations and the stage of ground water development & the taluk is categorized as "Safe".

3.2 Chemical Quality of Ground Water and Contamination

Interpretation from Chemical Analysis results in Savanur taluk is mentioned below. The groundwater quality data monitored by State groundwater department, Karnataka were given in **Table-17** and the water quality data monitored by CGWB-SWR were attached in the **Table-18**.

- **ELECTRICAL CONDUCTIVITY:** In general, EC values range from 800 to 6700 μ /mhos/cm in the aquifer-II at 25°C (**Fig-14a**).
- **CHLORIDE:** Chloride concentration in ground water ranges between 57 to 993mg/l in the aquifer-II (**Fig-14b**).
- **NITRATE:** Nitrate concentration in ground water ranges from 19 to 742 mg/l in the aquifer – II (**Fig-14c**).

- **FLUORIDE:** Fluoride concentration in ground water ranges between 0.07 and 0.97mg/l in the aquifer-II (Fig-14d).

Table-17: Ground water quality of Dug & Bore wells of Savanur taluk – State Groundwater Dept

Monsoon	Village	Well Type	pH	NO3	Cl	F
Pre-Monsoon	Karadagi	BW	7.99	40.87	438.72	1.1
	Savanur	BW	7.82	41.18	319.61	0.7
	Yelavigi	BW	7.82	40.87	432.77	0.8
	Kadakola	BW	7.46	41.02	327.55	0.65
Post-Monsoon	Karadagi	BW	7.42	23.223	187.24	0.146
	Savanur	BW	7.51	36.012	453.33	0.02
	Yelavigi	BW	7.49	38.65	285.79	0.1

Table-18: Ground water quality of Savanur taluk, CGWB-SWR

S.No	Village	PH	EC	Cl	NO3	F
1	Mannur	7.42	1430	230	19	0.48
2	Savanur	7.90	800	57	108	0.97
3	Huralikuppi	7.89	1810	259	211	0.33
4	Tallihalli	7.53	1860	369	45	0.53
5	Hattimattur	7.65	1190	142	55	0.55
6	Krishnapur	7.79	1550	269	68	0.42
7	Kadakol	7.75	2850	482	64	0.15
8	Naikerur	7.83	1510	241	24	0.21
9	Yelavigi	7.68	3000	567	99	0.18
10	Allipura	7.43	2520	326	130	0.17
11	Chillur	7.61	2550	298	217	0.2
12	Karadagi	7.50	1430	230	19	0.48

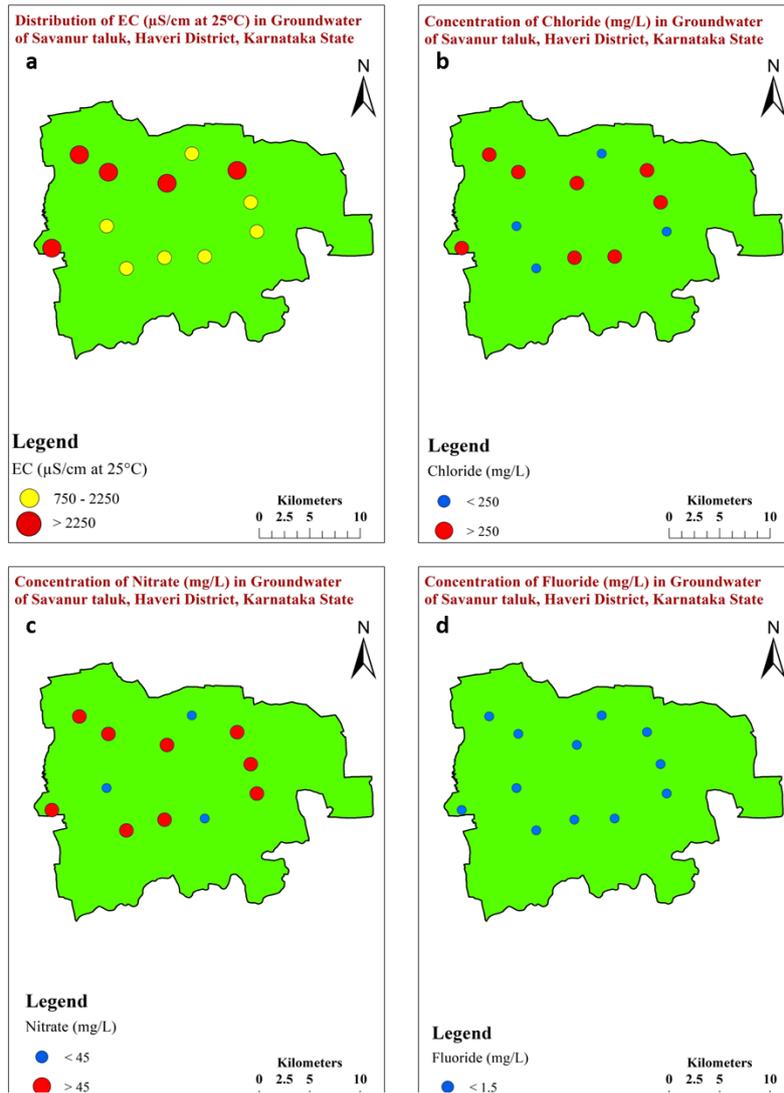


Fig.14 a-d: Ground water quality of the Savanur taluk

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

4 GROUND WATER RESOURCE ENHANCEMENT AND PROPOSED MANGEMENT STRATEGY

4.1 Resource Enhancement by Supply Side Interventions

The overall stage of ground water development is at moderate levels of 34.905 % as per GEC 2017 and 31.98% as on 2020. However, the pre-monsoon long term ground water trend shows the declining trend. During post monsoon, most part of the taluk show rise in water level in greater values.

Recharge dry phreatic aquifer (Aq-I) in the taluk, through construction of artificial recharge structures, viz; check dams, percolation tanks & Sub surface dyke (**Table-19**). The choice of recharge structures should be site specific and such structures need to be constructed in areas already identified as feasible for artificial recharge.

Table-19: Quantity of non-committed surface runoff & Proposed AR structures in Savanur taluk

S.No	Artificial recharge structures proposed	
1	Non committed monsoon runoff available in (MCM)	111
2	Number of Existing Artificial Recharge Structure	702
3	Number of Check Dams	503
4	Number of Percolation tanks	0
5	Number of Sub Surface Dyke	3
6	Tentative total cost of the project (Rs in lakhs)	5091
7	Expected Recharge in (MCM)	83

4.2 Other interventions proposed

- Periodical maintenance of artificial recharge structures should also be incorporated in the Recharge Plan.
- Excess 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.

5 SUMMARY AND RECOMMENDATIONS

The main ground water issues are Low Ground Water Development, Limited Ground Water Potential / Limited Aquifer Thickness / Sustainability, of major part of the area. The summary of ground water management plan of Savanur taluk is given in **Table-20**

Table 20: Summary of Management plan (GWRA-2020) of Savanurtaluk

Present stage of GW Development (2020)	32%
Savanur Taluk Category	Safe
Net Annual Ground Water Availability (MCM)	66.80
Existing Gross Ground Water Draft for all uses	21.36
Total GW Resources (Dynamic & Static upto the depth of 200 mbgl) (MCM)	192.26
Expected additional recharge from monsoon surplus runoff (MCM)	83
Change in Stage of GW development, %	32 to 14.53
Excess nitrate & fluoride concentration	<ul style="list-style-type: none"> • Dilution of nitrate rich ground water through artificial recharge & water conservation. • Roof top rain water harvesting.