



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

Shiggaon Taluk, Haveri District, Karnataka

दक्षिण पश्चिमी क्षेत्र, बेंगलुरु
South Western Region, Bengaluru

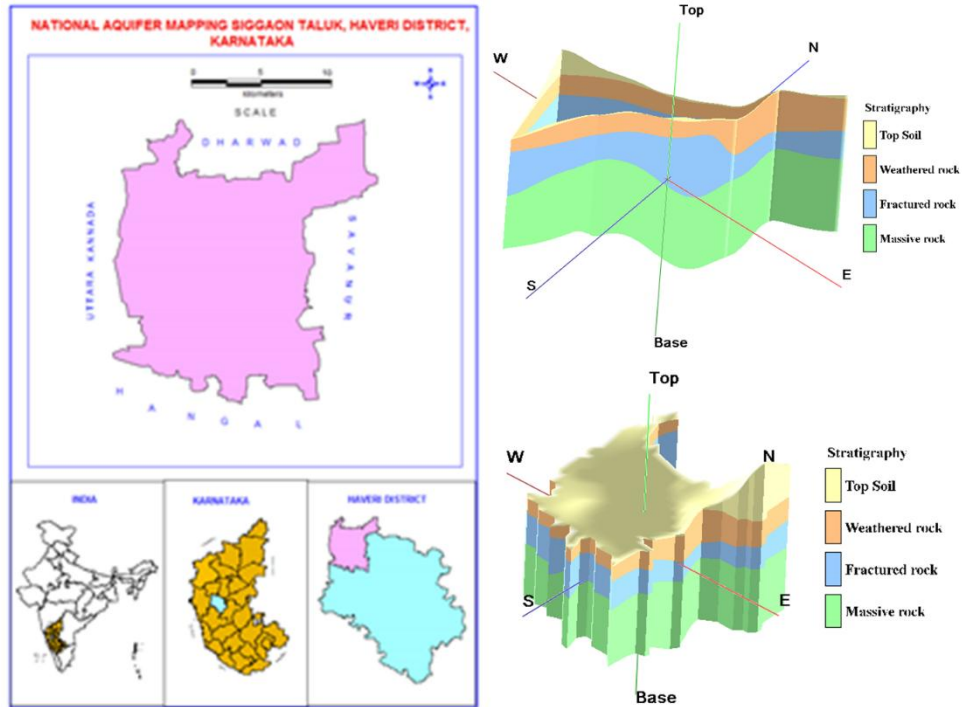
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AQUIFER MAPS AND MANAGEMENT PLAN, SHIGGAON TALUK, HAVERI DISTRICT, KARNATAKA STATE

(AAP – 2021-2022)



By

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September-2022

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

1 SALIENT FEATURES

Name of the taluk	: SHIGGAON
District	: Haveri
State	: Karnataka
Area	: 584 sq.km
Population	: 1,87,910
Annual Normal Rainfall	: 921 mm (2020)

1.1 Study area

Aquifer mapping studies have been carried out in Shiggaon taluk, Haveri district of Karnataka, covering an area of 584 sq.kms under National Aquifer Mapping Project. The Shiggaon taluk is located between North Latitudes 14° 52' 00" and 15° 10' 00" and East Longitudes between 75° 04' 00" to 75° 21' 00" and is falling in Survey of India Toposheets No forms parts of 48M/4, 48M /8, 48N/1, 48N/5. The study area is bounded on the East by Savanur Taluk, on the North by Dharwad District Taluk, on the South by Hangal Taluk and on the West by Uttara Kannada District. Location map of Shiggaon taluk of Haveri district is presented in **Fig-1**. There are 92 villages in this taluk.

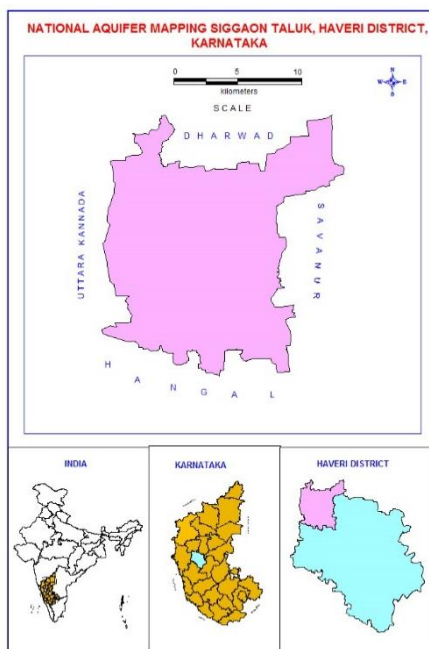


Fig 1: Location map

1.2 Population

According to 2011 census, the population in Shiggaon taluk is 1,87,910. Out of which 96,735 are males while 91,175 are females. The average sex ratio of Shiggaon taluk is 1061. The Shiggaon taluk has an overall population density of 322 persons per sq.km. The decadal variation in population from 2001-2011 is 12.70% in Shiggaon taluk. The population details are given in **Table-1**.

Table-1: Population details (2011)

Total Population	187910
Number of Male	96735
Number of Female	91175
Share of the district population (%)	11.8
Total Number of Rural populations	137174
Total Number of Urban populations	50736
Decadal change in population (2001-2011) (%)	12.7
Decadal change in rural population (%)	12.35
Decadal change in urban population (%)	13.63

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

1.3 Rainfall and Climate

Shiggaon taluk experiences semi-arid, sub-tropical climate. The area falls under Northern transitional agro-climatic zone of Karnataka state. The normal annual rainfall in Shiggaon taluk for the period 1961 to 2010 is 814 mm.

Actual annual rainfall data of Shiggaon 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 531 to 1329 mm. The decadal average rainfall at Shiggaon taluk is 756.88 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 748, Standard Deviation is 166, and coefficient of variation is 450 %. 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 Shiggaon taluk, Haveri district (2011 to 2020)

Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Decadal Average
Rainfall in mm	534	589	809	977	670	531	581	792	1329	921	756.88

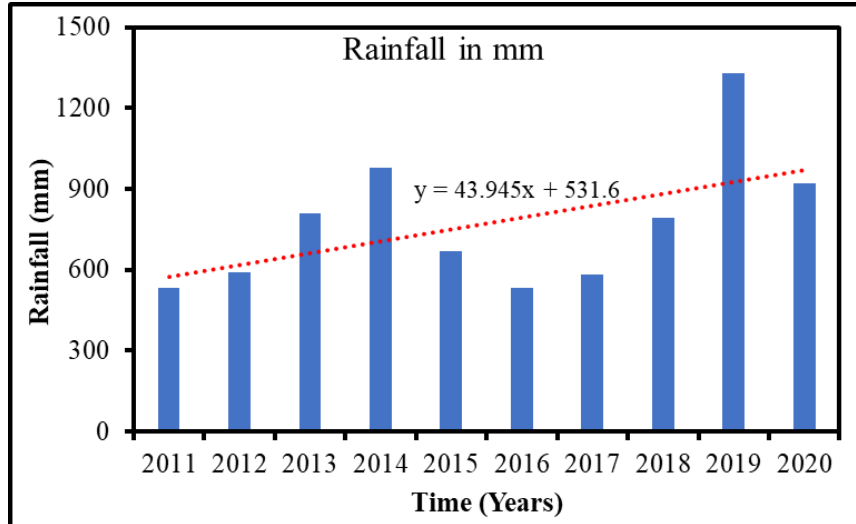


Fig 2: Annual Rainfall trend map of Shiggaon taluk of Haveri district

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

Period	Normal	Standard Deviation	Coefficient of Variation (%)
January	1	3	33
February	1	4	25
March	9	20	46
April	41	36	116
May	63	45	141
PRE-MONSOON	116	63	182
June	125	55	226
July	141	54	262
August	125	43	291
September	90	42	214
SOUTH WEST-MONSOON	481	127	380
October	105	59	178
November	40	58	69
December	6	12	48
NORTH EAST-MONSOON	151	90	168
Annual	748	166	450

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

Year	Jan	Feb	Mar	Apr	May	PRE	Jun	Jul	Aug	Sep	MON	Oct	Nov	Dec	POST	Annual
2010	1	0	30	66	71	168	110	167	126	77	479	108	132	0.0	240	887
2011	0	0	0	65	58	123	104	154	114	76	448	223	8	0	231	802
2012	0	0	0	148	42	190	108	91	92	82	373	98	94	0	192	755
2013	5	0	10	55	0	70	108	91	92	82	373	98	94	0	192	635
2014	0	0	3	127	159	289	113	337	254	70	774	105	113	13	231	1294
2015	0	0	47	2	53	102	214	72	149	57	492	47	20	0	67	661
2016	1	0	0	19	44	64	195	140	73	40	448	6	12	1	19	531
2017	0	0	0	3	65	68	79	156	71	128	434	139	2	0	141	643
2018	0	0	0	21	303	324	121	136	130	32	419	128	35	0	163	906
2019	0	0	2	24	22	49	92	215	497	115	919	382	37	1	420	1387

1.4 Agriculture & Irrigation

Agriculture is the main occupation in Shiggaon taluk. Major Kharif crops are Maize, Jowar, Pulses and Oil seeds. Main crops of Rabi season are Maize, and Jowar (**Table-5**). Water intensive crops like paddy & sugarcane is are grown in a 12.21% of total sown area. Maize is grown in 32.6% and Jowar in 9.6% of total sown area of taluk. Pulses are grown in 3.7% & oil seeds account 11.7% of total sown area.

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

Crops		Area (ha)	Total area (ha)	Total area (ha)
Cereals	Paddy	5942	29572	53356
	Jowar	5230		
	Bajra	0		
	Maize	17609		
	Ragi	57		
	Wheat	540		
	Other	194		
Pulses	Tur	124	2010	
	Horse gram	117		
	Black gram	16		
	Green gram	1063		
	Avare	149		
	Cow pea	93		
	Bengal gram	444		

	Other	4	
Fruits			1490
Vegetables			152
Oil Seeds	Groundnuts	4919	6613
	Sunflower	2	
	Safflower	135	
	Castor	1	
	Sesamum	1	
	Niger Seed	1	
	Soyabean	1540	
	Linseed	6	
Commercial crops			13519

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 70% and area sown more than once is 21.4% of total geographical area in Shiggaon taluk (**Table-6**). Area not available for cultivation 7.26% of total geographical area. Whereas, area covered by fallow land is very less. Almost all of the net area irrigated is only from bore wells (**Table-7**).

Table-6: Details of land use in Shiggaon 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
58920	9951	4284	1416	41335	12626	58920

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

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

S.No	Source	Number of Structures	Gross area irrigated (ha)	Net area irrigated (ha)
1	Surface water	Canals	0	0
		Tanks	254	0
		Lift irrigation	1	0

		Total (I)		0	0
2	Ground water	Dug wells	10	0	0
		Bore wells	5589	5190	3647
		Other Source		0	0
		Total (II)		5190	3647
Grand Total (I + II)				5190	3647

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

1.5 Geomorphology, Physiography & Drainage

Shiggaon taluk is a plateau region formed by schistose rocks, which represents “Dharwar Schists”. The central and eastern parts exhibit overall “peneplane terrain” having sparsely distributed NW-SE trending ridge lineaments and tors. The elevation in the plains varies from 625 m in the North western part to 586 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 Shiggaon taluk is drained by tributaries joining to 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).

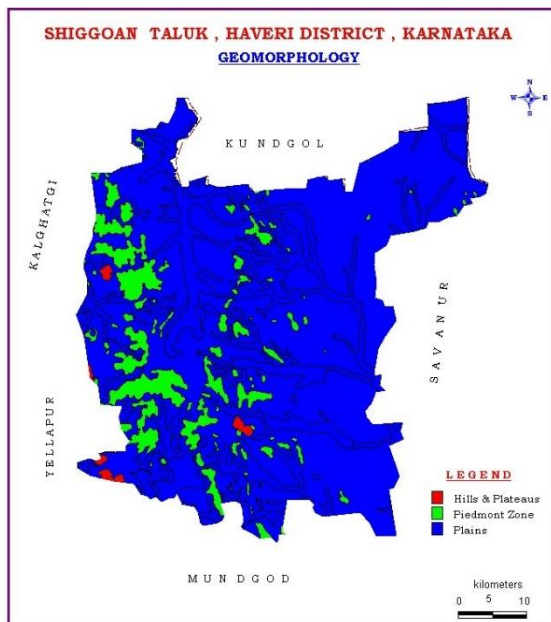


Fig-3: Geomorphology Map

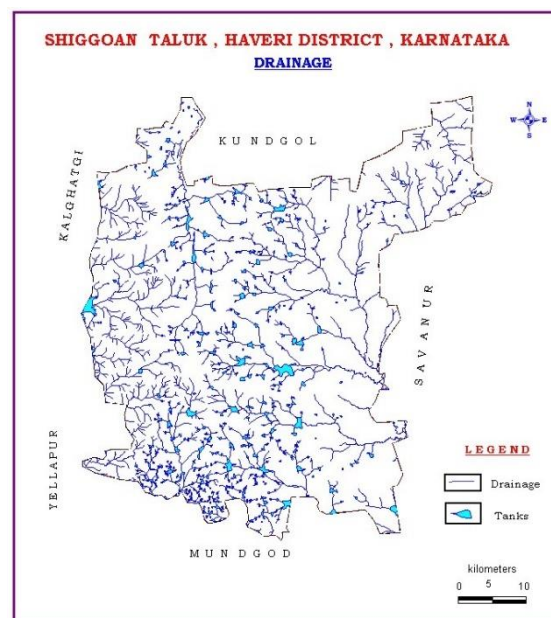


Fig-4: Drainage Map

1.6 Soil and Landuse

The soils of Shiggaon 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. A Western part of the taluks was covered by forest.

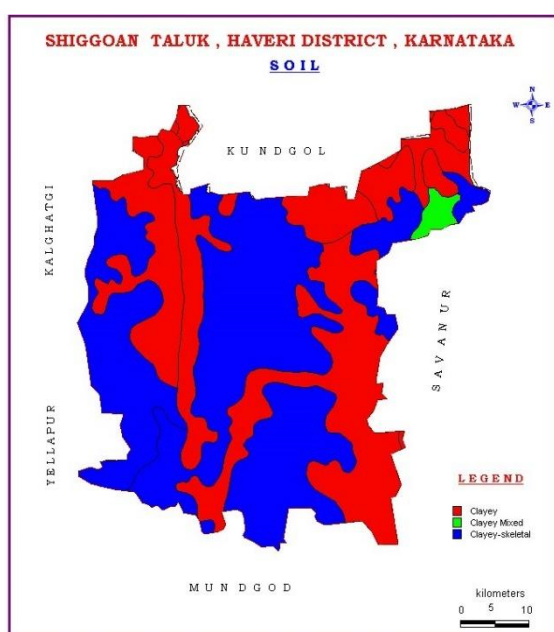


Fig-5: Soil Map

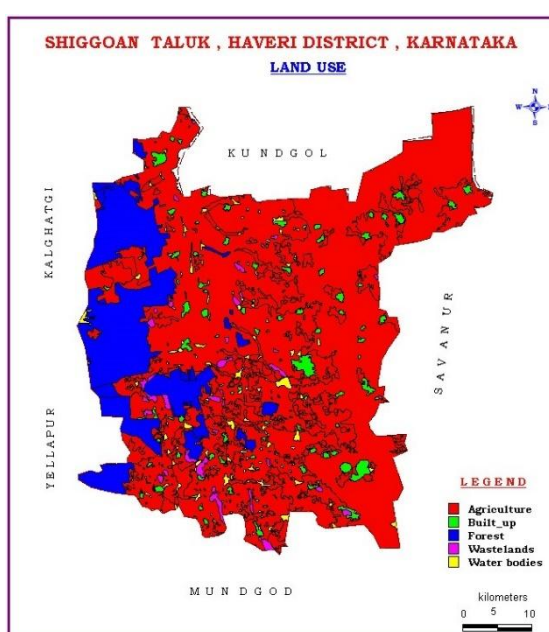


Fig-6: Landuse Map

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
Shiggaon	5870	Phreatic	Fractured(Down to 200m)	Dynamic +phreatic in-storage + fractured
		14484	1075	21429

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

Net Annual Ground Water Availability	4759.415
Existing Gross Ground Water Draft for Irrigation	1420.540
Existing Gross GW Draft For Domestic And Industrial Water Supply	109.955
Existing Gross Ground Water Draft For All Uses	1530.495
Allocation For Domestic And Industrial Use For Next 25 Years	120.986
Net Ground Water Availability For Future Irrigation Development	3217.890
Existing Stage of Ground Water Development	32.157
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 4759.415ham and the total ground water draft for all uses is 1530.495Ham with stage of development at 32.157% and the taluk falls in Safe category. Thus there is further scope for future irrigation development 3217.890Ham. The domestic (Industrial sector) demand for next 25 years is estimated at 120.986Ham.

The details of dynamic (Phreatic) ground water resources for Shiggaon 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 32.157% to 30.16% from 2017 to 2020 with an increase in the net ground water availability during 2020 with a figure of 5869.90Ham.

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

Net Annual Ground Water Availability	5869.90
Existing Gross Ground Water Draft for Irrigation	1642.97
Existing Gross GW Draft For Domestic And Industrial Water Supply	0.00
Existing Gross Ground Water Draft For All Uses	1770.62
Allocation For Domestic And Industrial Use For Next 25 Years	137.65
Net Ground Water Availability For Future Irrigation Development	4089.29
Existing Stage of Ground Water Development	30.16
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 Shiggaon 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	Dundasi	13.55	11.50	6.80	9.50	12.00	15.05	11.85	13.53	9.40	8.90
2	Banakapur	9.45	13.50	10.60	7.50	9.30	23.80	17.30	13.90	4.90	6.20
3	Hulagur	18.15	26.40	22.50	24.50	33.00	38.00	22.35	21.40	4.05	5.70
4	Shiggaon	9.15	15.80	6.50	8.00	10.70	17.90	5.38	6.68	2.83	3.60
5	Konanakere	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-	12.20	12.00

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	Dundasi	5.90	2.20	4.80	5.30	9.80	7.85	6.95	4.55	3.27	2.10
2	Banakapur	6.10	7.00	3.00	5.10	7.60	8.20	6.35	1.65	2.45	2.78
3	Hulagur	22.50	13.00	17.30	23.40	31.90	21.25	13.95	1.30	1.40	2.20
4	Shiggaon	3.90	3.70	3.00	4.80	6.00	8.45	2.88	2.01	2.41	1.38
5	Konanakere	0.00	9.70	9.85	10.00	0.00	12.50	9.80	4.00	5.50	5.85

The long-term data of Depth to Water level is analysed to interpret the behaviour of groundwater over period of time (**Table-11 & Table-12**). 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-I					
1	Dhundashi	Dug Well	11.9	6.8	5.1
2	Konankere	Dug Well	2.0	8.3	-6.2
Aquifer-II					
3	Banakapur	Borewell	11.3	5.7	5.6
4	Hulagur	Borewell	19.9	17.4	2.5
5	Shiggaon	Borewell	8.9	4.8	4.1

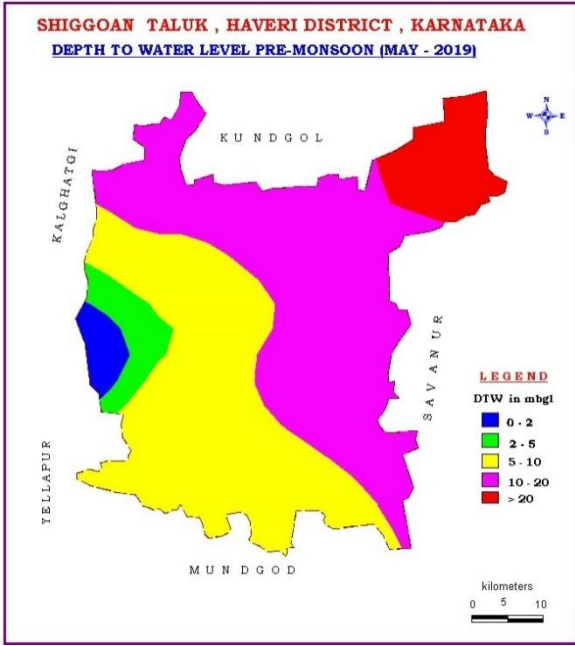


Fig-7: Pre-monsoon Depth to Water Level

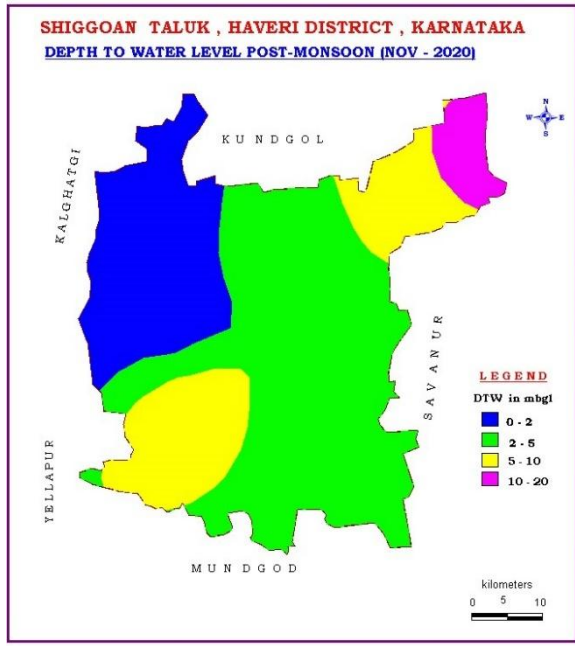


Fig-8: Post-monsoon Depth to Water Level

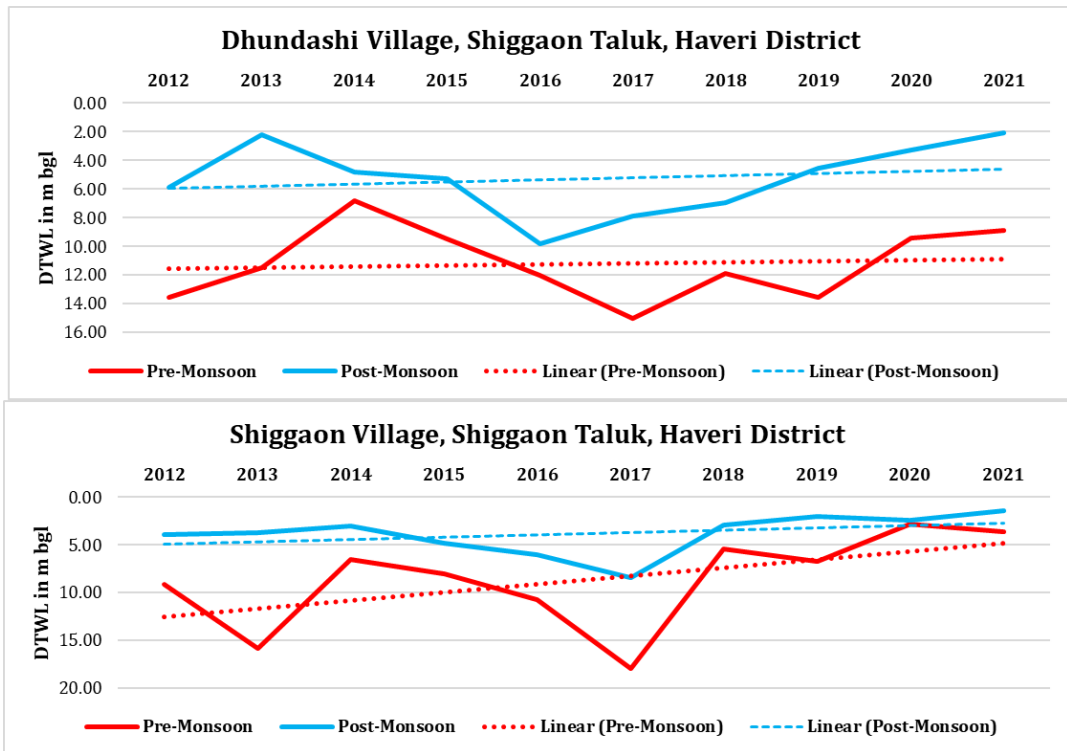


Fig-9: Groundwater level Fluctuation in the villages of Shiggaon taluk

To uphold the assumption acquired for overall Taluk, the analysis was done on finer resolution i.e., based on monitoring location. Therefore, depth to water level monitored at Hanumankoppa and Akki Alur villages were plotted against the time period of a decade. Which again lead to the result of increasing trend of groundwater level in Shiggaon Taluk, Haveri District.

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 Shiggaontaluk, there are mainly two types of aquifer systems have encountered

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

In Shiggaon 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 Shiggaon taluk bore wells were drilled from a minimum depth of 102.7mbgl to a maximum of 179mbgl. The details of groundwater exploration carried out in the Shiggaon taluk is given in **Table-14**. Depth of weathered zone ranges from 11 mbgl to 28mbgl. Ground water exploration reveals that aquifer-II fractured formation was encountered between the depth of 40 to 143mbgl. Yield ranges from 1.2 to 14.3 lps. The basic characteristics of each aquifer are summarized in **Table-15**.

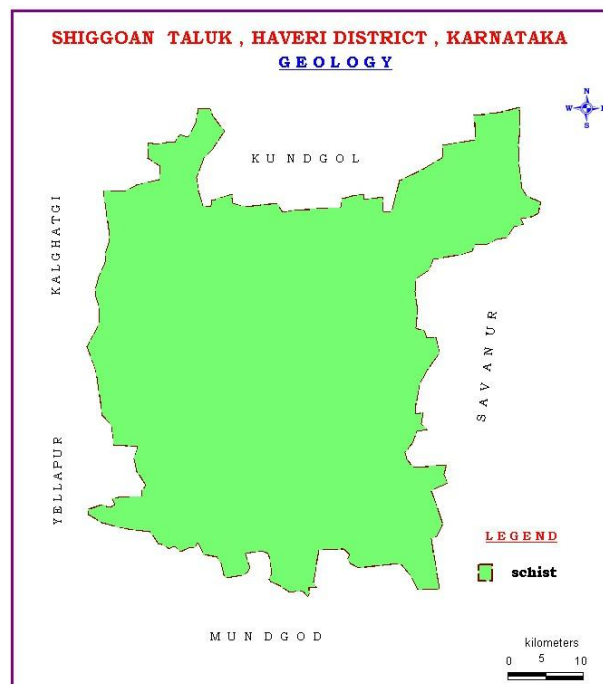


Fig-10: Geology of the Shiggaon taluk

Table-14: Details of Groundwater exploration in Shiggaon taluk

S.No	Location	Depth (mbgl)	Casing (m)	Lithology	SWL (mbgl)	Q (lps)	DD (m)	T (m ² /day)
1	Shiggaon EW	102.7	11	Schist	11.52	4.3	14.3	-
2	Konankeri EW	151.5	28	Schist	12.2	4	4.49	-
3	Hulgur EW	179	13.7	Schist	27.04	0.31	2.18	-

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)	28	Fractures upto 143 mbgl
Depth range of occurrence of fractures (mbgl)	11 to 28	40 to 143
Range of yield potential (lps)	Poor yield	1.2 – 14.3
Specific Yield (%)	-	-
Transmissivity (m ² /day)	-	-
Quality Suitability for Domestic & Irrigation	Suitable	Suitable

2D AQUIFER DISPOSITION

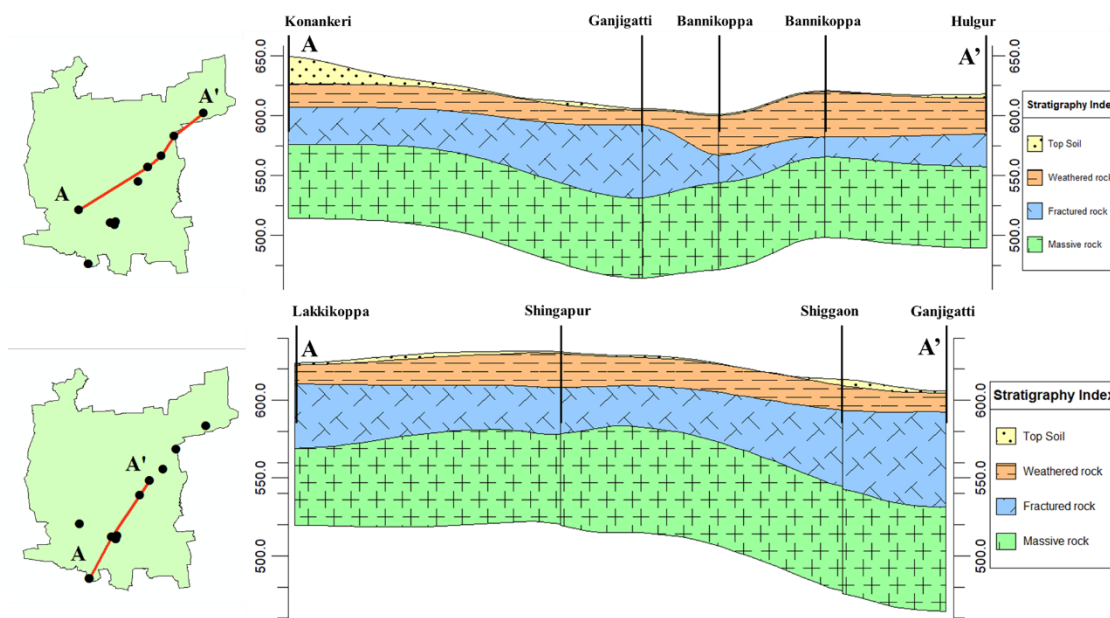


Fig.11:2-D Cross Sections of Shiggaon Taluk

3D AQUIFER DISPOSITION

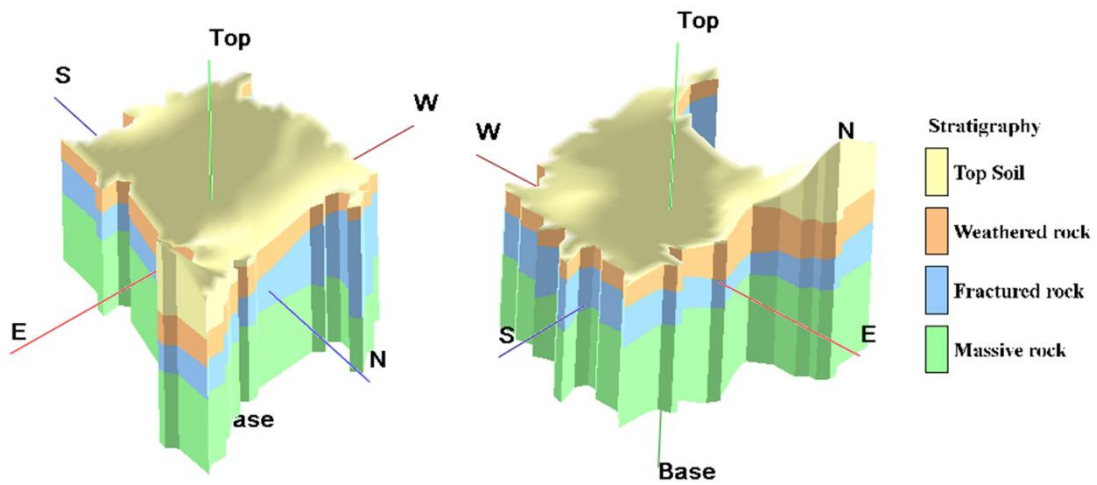


Fig.12: 3-D Aquifer Disposition model of Shiggaon Taluk

3D FENCE DIAGRAM

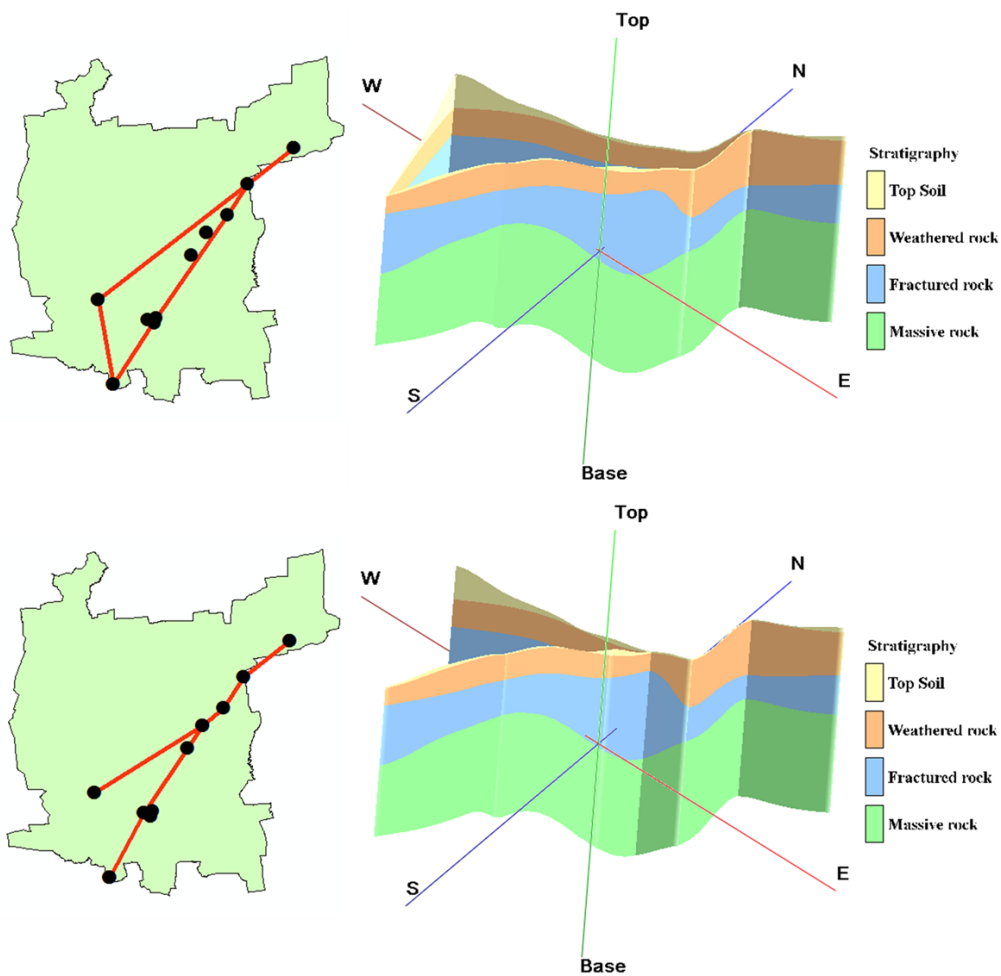


Fig.13: 3D Fence Diagram of Shiggaon Taluk

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 Shiggaon 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 Shiggaon 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		
SHIGGAON	3337	1242	37	4759	1530	32	5870	1771	30

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 Shiggaon 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 700 to 1700 µmhos/cm in the aquifer-I and from 490 to 2920 µmhos/cm for aquifer-II at 25°C (**Fig-14a**).
- **CHLORIDE:** Chloride concentration in ground water ranges between 71 and 255 mg/l in the aquifer-I and from 43 to 411 mg/l for aquifer-II(**Fig-14b**).
- **NITRATE:** Nitrate concentration in ground water ranges from 4 and 75 mg/l in the aquifer –I and from 3 and 274 mg/l in the aquifer –II (**Fig-14c**).

- **FLUORIDE:** Fluoride concentration in ground water ranges between 0.04 and 0.14 mg/l in the aquifer-I and between 0.05 and 0.22 mg/l in the aquifer-II (Fig-14d).

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

Monsoon	Village	Well Type	pH	NO3	Cl	F
Pre-Monsoon	Dhundshi	BW	7.82	22.78	410.93	1.07
	Hulgur	BW	7.94	4.12	117.12	0.9
	Bankapura	BW	7.82	40.4	268	0.87
	Shiggaon	BW	8.06	42.89	402.99	1.15
Post-Monsoon	Dhundshi	BW	7.43	5.374	35.47	0.532
	Hulgur	BW	7.92	38.815	275.94	0.633
	Bankapura	BW	7.53	22.261	297.62	0.1

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

S.No	Village	Well Type	PH	EC	Cl	NO3	F
1	Adavisomapur	DW	7.69	1700	255	75	0.13
2	Kunnur	DW	7.41	700	71	15	0.14
3	Silamsomapur	DW	7.03	830	177	4	0.04
4	Hosur	DW	7.25	880	138	24	0.05
5	Kalkatti	DW	7.74	850	106	5	0.11
6	Tadas	BW	7.10	830	163	37	0.05
7	Kunnur	BW	7.63	490	53	17	0.22
8	Dhundshi	BW	7.34	520	43	5	0.20
9	Hosur	BW	7.10	980	117	18	0.06
10	Kalkatti	BW	7.62	870	74	3	0.10
11	Hulgur	BW	7.37	2920	411	274	0.11
12	Bannikoppa	BW	7.50	1830	277	49	0.13

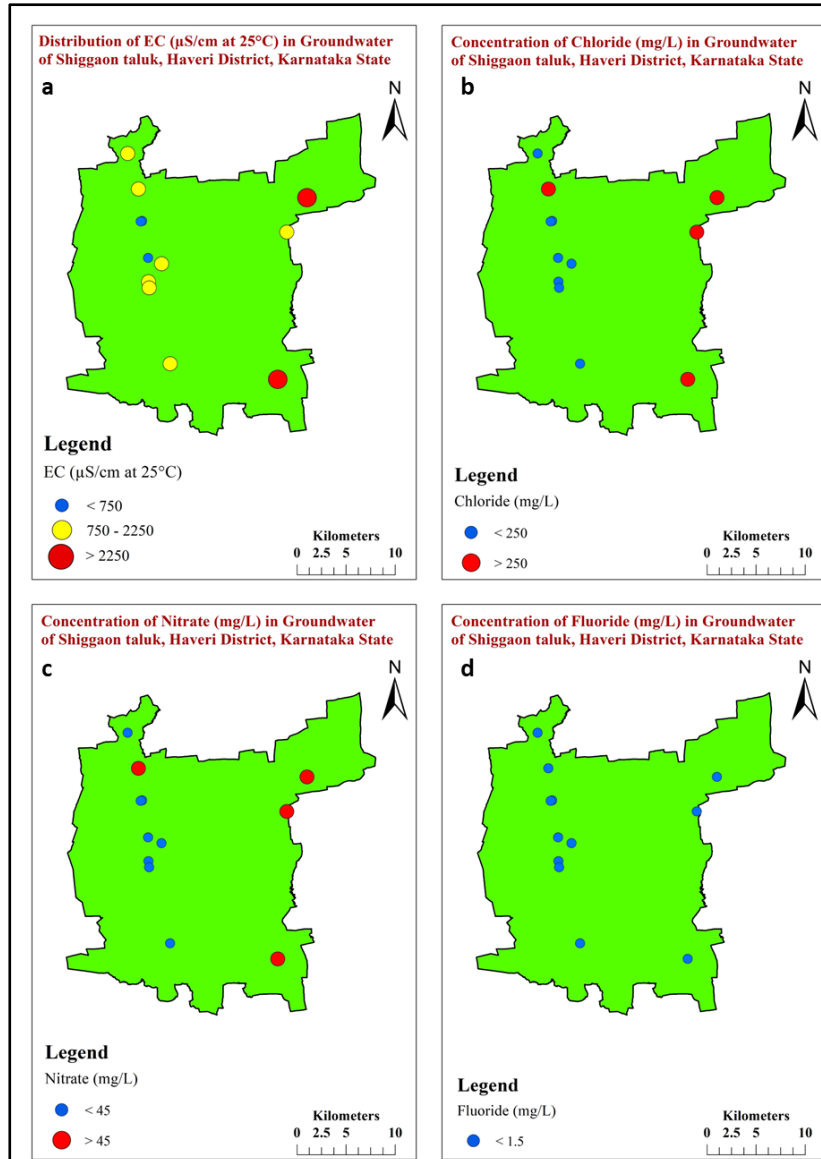


Fig.14 a-d: Ground water quality of the Shiggaon taluk

In general, ground water quality in Shiggaon 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 32.157% as per GEC 2017 and 30.16% 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 Shiggaon taluk

S.No	Artificial recharge structures proposed	
1	Non committed monsoon runoff available in (MCM)	14
2	Number of Existing Artificial Recharge Structure	295
3	Number of Check Dams	-
4	Number of Percolation tanks	-
5	Number of Sub Surface Dyke	-
6	Tentative total cost of the project (Rs in lakhs)	8
7	Expected Recharge in (MCM)	11

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 Shiggaon taluk is given in **Table-20**.

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

Present stage of GW Development (2020)	30%
Shiggaon Taluk Category	Safe
Net Annual Ground Water Availability (MCM)	58.70
Existing Gross Ground Water Draft for all uses	17.71
Total GW Resources (Dynamic & Static upto the depth of 200 mbgl) (MCM)	214.29
Expected additional recharge from monsoon surplus runoff (MCM)	11
Change in Stage of GW development, %	30 to 25.4
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.