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Central Ground Water Board

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Ministry of Jal Shakti

Government of India

AQUIFER MAPPING AND MANAGEMENT OF GROUND WATER RESOURCES

HAVERI TALUK,

HAVERI DISTRICT, KARNATAKA

दक्षिण पश्चिमी क्षेत्र, बैंगलोर

South Western Region, Bengaluru

AQUIFER MANAGEMENT PLAN OF HAVERI TALUK, HAVERI DISTRICT, KARNATAKA STATE

CONTENTS

AQUIFER MANAGEMENT PLAN OF HAVERI TALUK, HAVERI DISTRICT, KARNATAKA STATE

1. SALIENT INFORMATION

Name of the taluk : **HAVERI**
District : Haveri
State : Karnataka
Area : 800 sq.km.
Population : 2, 80,362
Annual Normal Rainfall : 799mm

1.1 Aquifer management study area

Aquifer mapping studies were carried out in Haveri taluk, Haveri district of Karnataka, covering an area of 800 sq.kms under National Aquifer Mapping Project. Haveri taluk of Haveri district is located between north latitude 14°42'03.0" and14°59'40.0" & east longitude 75°16'27.0" and 75°44'20.0", and is covered in parts of Survey of India Toposheet Nos. 48 N/5, 48 N/6, 48 N/9and 48 N/10. Haveri taluk is bounded by Savanur taluk and Shirhatti taluk of Gadag district on north, Byadgi and Ranebennur taluks on south, Hadagali taluk of Bellary district on east and Hanagal taluk on western side. Location map of Haveri taluk is presented in **Fig-1**.

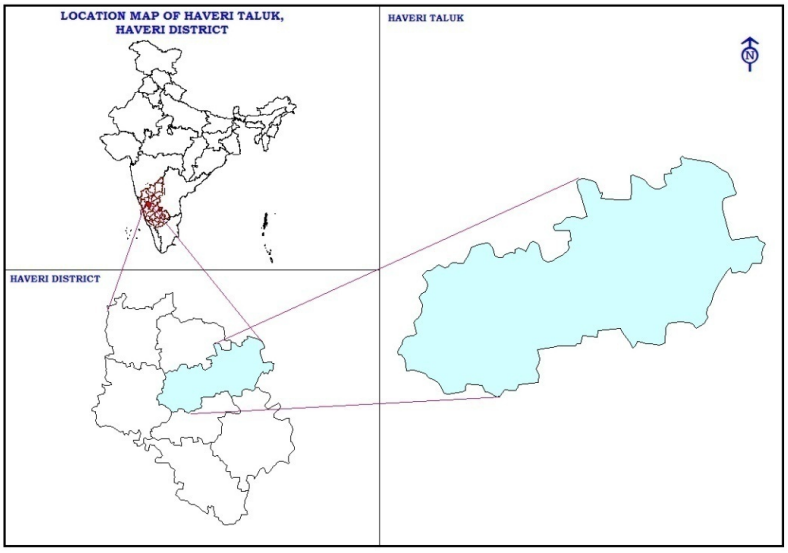

Fig.1: Location Map of Haveri taluK, Haveri district, Karnataka

Haveri taluk has a population of about 2.80 lakh. The taluk administration of Haveri taluk is divided into 3 Hoblies and 34 Gram Panchayaths. Haveri is the largest

town in the taluk, which is the taluk and district, headquarter also. There are 90 inhabited villages and has no uninhabited village in the taluk. The entire taluk lies in the valley of the Varada River, with the Tungabhadra River flowing in the southeast.

1.2 Population

According to 2011 census, the population in Haveri taluk is 2, 80,362 of which rural population is 2,13,260 constituting about 76%, and the urban population is 67,102, constituting about 24% of the total population, basically due to Haveri City. The taluk has an overall population density of 350 persons per sq.km and showed a decadal increase of about 11.1% during 2001-2011.

1.3 Hydrometeorology

Haveri taluk enjoys arid climate. Dryness and hot weather prevails in major part of the year. The area falls under Northern Transition agro-climatic zone of Karnataka state and is categorized as drought prone.

The climate of the study area is quite agreeable and free from extremes. The year is usually divided into four seasons: summer from March to May; rainy season or south-west monsoon season from June to September; post-monsoon season covering the months of October and November and dry or winter Season from December to February.

There is one rain gauge station located in Haveri taluk **(Table: 1.3.1).** The data in respect of this station from the year 1981 to 2010 is analysed and presented in **Table: 1.3.2.** The data pertaining to these gauges is of longterm nature and are well maintained. It is presumed that they are representative of the taluks and the same is used for analysis. Normal annual rainfall in Haveri taluk for the period 1981 to 2010 is 799 mm.

Table 1.3.1: Rain gauges and its location in Haveri taluk

Sl.No	Station	Latitude	Longitude	Altitude
1	Haveri	14°50’	75°30’	577

Statistical analysis

Computations were carried out for the 30 year blocks of 1981- 2010 on Mean, Standard deviation and coefficient of variation of each month pre monsoon, monsoon, post monsoon and annual and are shown in **Table 1.3.2**.

The mean monthly rainfall at Haveri taluk is ranging between 1mm during January and February to 161mm during July. The CV percent for pre monsoon, monsoon and post monsoon season is 55, 37 & 66 percent respectively. Annual CV at this station works out to be 29 percent.

Table 1.3.2: Statistical Analysis of Rainfall Data of Haveri Taluk, Haveri District, for the Period 1981 to 2010

STATION		JAN	FEB	MAR	APR	MAY	PRE	JUN	JUL	AUG	SEP	SW	OCT	NOV	DEC	NE	Annual
HAVERI	NRM	1	1	7	43	71	123	127	161	131	106	525	103	40	7	150	799
	STDEV	3	2	18	38	50	67	69	102	59	67	192	62	64	14	99	228
	CV%	291	358	258	89	70	55	54	63	45	63	37	60	163	194	66	29

Assessment of Drought

Rainfall data of Haveri taluk has been analysed for 101 years using IMD method to assess the drought condition in Haveri taluk. The results of the classification are listed in the **Table 1.3.3**. It is observed that the Haveri taluk has experienced alternating no drought to moderate drought conditions over the years.

Table 1.3.3: Classification of drought and its periodicity (IMD, 1971)

% Deviation		>0	0 to -25	-25 to -50	Probability of drought occurrences
Category		No drought	Mild (Normal)	Moderate	
		Years			
Taluk	Haveri	53	33	15	Once in 6 years

The details of the drought assessment are discussed as herein under. Out of 101 years of analysis in Haveri taluk, “No Drought” condition in the is experienced in 53 years, “Mild Drought” condition is 33 years and “Moderate Drought” condition experienced in 15 years. Based on occurrence and frequency of past drought events, the probability of occurrence of various intensities of drought at each station has been studied. It has been observed that the frequency of occurrence of drought is **once in 6 years** at Haveri taluk.

1.4 Agriculture and Irrigation

Agriculture is the main occupation in Haveri taluk. Maize is major crop, grown in 37% of the total crop area followed by cotton, jowar, sugarcane and oilseeds covering about 31%, 13%, 6% and 7% of the total crop area respectively. Vegetables and fruits are some other crops grown in the taluk.

Table1.4.1: Cropping pattern in Haveri taluk 2014-2015(Ha)

Year	Paddy	Maize	Ragi	Jowar	Pulses	Fruits	Vegetables	Oilseeds	Sugarcane	Cotton
	Area under cultivation (in ha)									
2014-2015	637	25427	21	9272	1761	585	1519	4138	4477	21548

It is observed that net sown area accounts for about 80% of total geographical area, while area sown more than once is 10% of total geographical area in the taluk **(Table-1.4.2)**. Ground water is the main source for irrigation in the taluk. 12313 hectares Irrigated area is catered through bore wells and 7151 hectares area is irrigated through other sources **(Table-1.4.3).**

Table1.4.2: Details of land use in Haveri taluk 2014-2015(Ha)

Taluk	Total Geographical Area	Area under Forest	Area not available for cultivation	Fallow land	Net sown area	Area sown more than once
Haveri	79985	3849	5985	3328	63889	8378

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

Table1.4.3: Irrigation details in Haveri taluk (Ha)

Source of Irrigation	Net area irrigated (Ha)	% of area
Canals	0	0
Tanks	0	0
Wells	0	0
Bore wells	12313	63
Lift Irrigation	0	0
Other Sources	7151	37
Total	**19464**	

Source: District at a Glance 2014-15, Government of Karnataka

1.5 Geomorphology, Physiographic and Drainage

The geomorphology of the taluk is characterized by vast stretches of undulated plains **(Fig.2).** The entire taluk lies in the valley of the Varada River, with the Tungabhadra River flowing in the east. The Haveri taluk, falls under Krishna River basin. The important river of the taluk is Varada, which is a tributary of Tungabhadra. Drainage pattern in the taluk is dendrite to sub-dendrite **(Fig.3).**

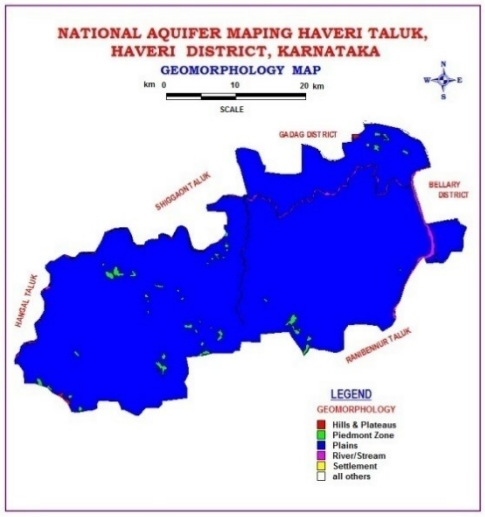

Fig.2: Geomorphology Map

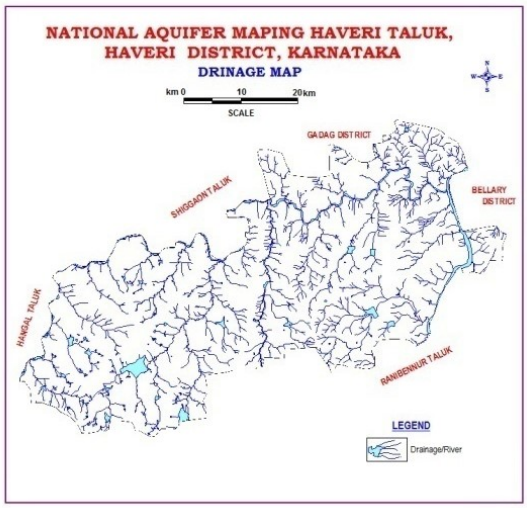

Fig.3: Drainage Map

1.6 Soil

The taluk is having predominantly fertile black soil with varying clayey and clayey skeletal mixtures and it is shown in **Fig. 4**.

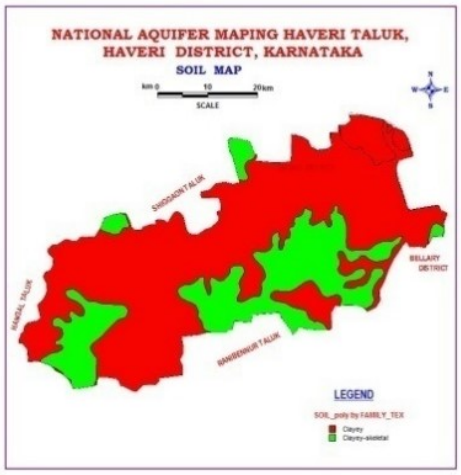

Fig.4: Soil map

1.7 Ground water resource availability and extraction

Aquifer wise total ground water resources up to 200 m depth are given in **Table- 1.7.1**

Table 1.7.1: 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+ Phreatic in-storage+ fractured
Haveri	6568	1988	12791	21347

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

Net ground water availability for future irrigation development: 2484 Ham

Domestic and Industrial sector demand for next 25 years : 331Ham

1.9 Water level behaviour

(a)Depth to water level

Aquifer-I **

Pre-monsoon: 3.13-18.10 mbgl **(Fig. 5)**

Post-monsoon: 3.24 -18.10 mbgl **(Fig. 6)**

******This aquifer-I is totally de-saturated due to over-exploitation and has become totally dry. However, isolated patches in topographical lows are seen yielding for very short durations.

Aquifer-II

Pre-monsoon: 3.60- 27.60 mbgl **(Fig. 7)**

Post-monsoon: 4.30- 39.80 mbgl **(Fig. 8)**

(b)Water level fluctuation

Aquifer-I

Seasonal Fluctuation: **(Fig. 9)**

Fall ranges from 0.70 - 12.20m

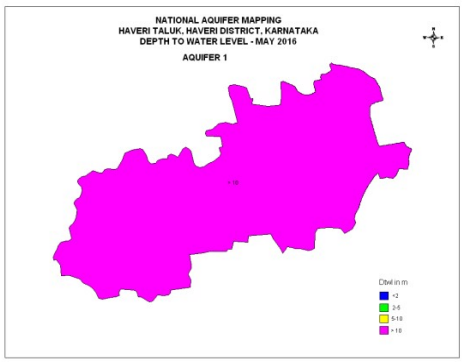

Fig 5: DTW May 2016 Aquifer I

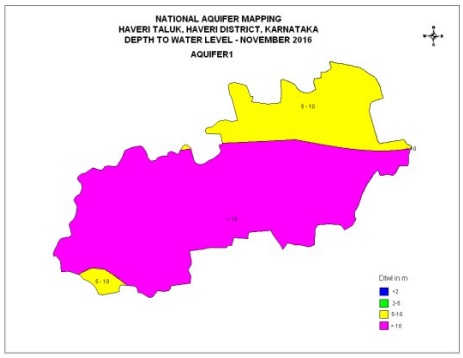

Fig 6: DTW Nov 2016 Aquifer T

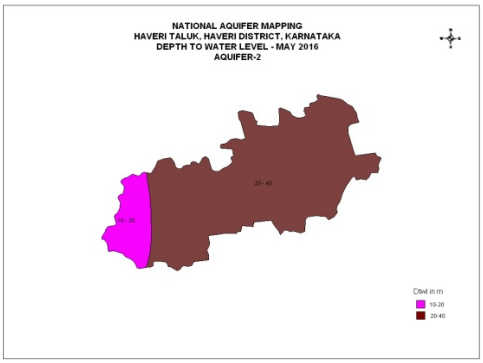

Fig 7: DTW May 2016 Aquifer II

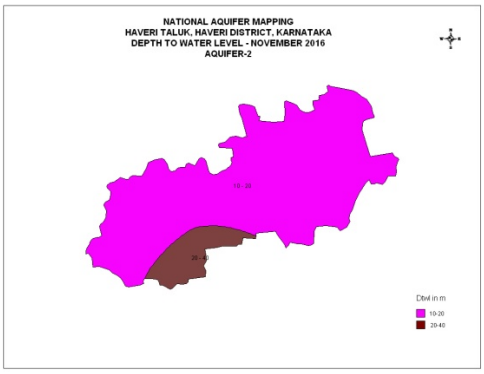

Fig 8: DTW Nov 2016 Aquifer II

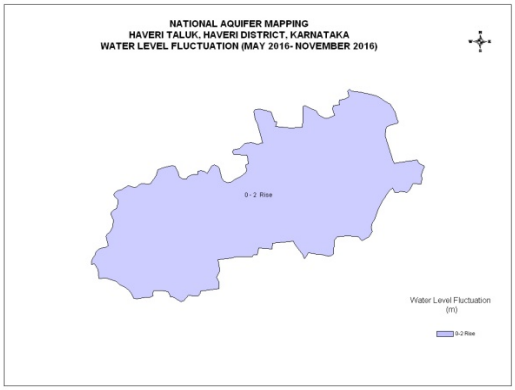

Fig .9: Water level fluctuation Aquifer I

2. AQUIFER DISPOSITION

2.1 Number of aquifers: In Haveri taluk, there are mainly two types of aquifer systems;

i. Aquifer-I (Phreatic aquifer) comprising weathered schist and basalt

ii. Aquifer-II (Fractured aquifer) comprising fractured schist and basalt

In Haveri taluk, fractured hornblende-schist is the main water bearing formation and basalt forms water bearing formation in a negligible area **(Fig.10).** Ground water occurs within the jointed and fractured schist and basalt under semi-confined to confined conditions. In Haveri taluk, generally the bore wells are drilled up to a maximum of 200mbgl **(Table 2.1).** Depth of weathered zone (Aquifer-I) ranges from 7.10 mbgl to 29.80 mbgl. This aquifer-I or Phreatic aquifer is totally de-saturated due to over-exploitation and has become totally dry. Ground water exploration reveals that aquifer-II fractured formation was encountered between the depth ranges of 18 to 61 mbgl. Yield ranges from 4.0 to 5.7 lps. Transmissivity ranges from 36 to 319 m^2/day. The basic characteristics of each aquifer are summarized in **Table-2.2**.

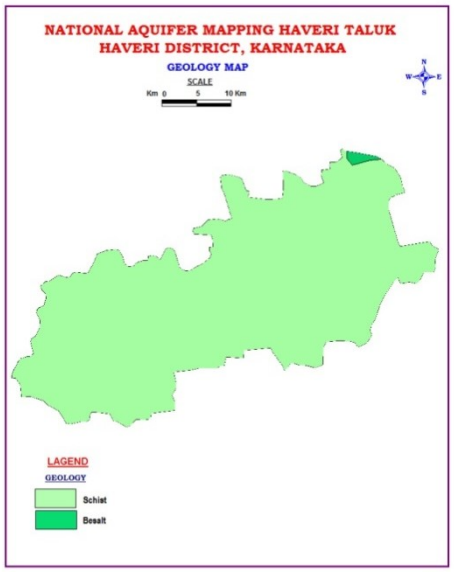

Fig.10: Geology Map

Table 2.1: Details of Ground water Exploration

Sl.No	Location	Latitude	Longitude	Depth Drilled (m bgl)	Casing Depth (m bgl)	Lithology	Fracture Zones (mbgl)	SWL (mbgl)	Q (lps)	DD (m)	T m^2/day
1.	BELLIRIGI EW	14°55'12"	75°39'00"	142.10	23.0	Gr Gneiss	34,61	13.13	4.00	1.74	42
2.	BELLIRIGI OW	14°55'12"	75°39'00"	117.00	29.80	Do	18,40,61	12.84	5.70	2.26	150
3.	KABBUR EW	14°45'00"	75°20'15"	200.05	7.10	Do	-	46.25	-	-	-
4.	HOSARITTI EW	14°54'43.2"	75°33'30"	123.80	13.60	Greywacke	-	15.84	5	3.42	36
5.	HOSARITTI OW	14°54'43.2"	75°33'30"	123.80	16.80	Do	-	13.06	5.25	1.72	319
6.	BELVIGI EW	14°55'12"	75°33'00"	132.95	25.2	Do	-	13.12	5.40	1.73	42
7.	BELVIGI OW	14°55'12"	75°33'00"	117.70	29.25	Do	-	12.7	5.70	1.70	150

Table 2.2: Basic characteristics of each aquifer

Aquifers	**Weathered Zone (Aq.-I)**	**Fractured Zone (Aq.-II)**
Prominent Lithology	Weathered Schist/ Basalt	Jointed /Fractured Schist, Basalt
Thickness range (mbgl)	29.00	Fractures down to 200 mbgl depth
Depth range of occurrence of fractures (mbgl)	18.00 - 61.00	-
Range of yield potential (lps)	De-saturated, almost Dry now	4.0 - 5.7
Specific Yield	-	-
T(m^2/day)	-	36-319
Quality, Suitability for Irrigation	-	Suitable
Suitability for Domestic purposes	-	Suitable
Remarks	Safe block	Groundwater potential fractures, 1to3 sets likely up to the depth of 200 mbgl.

3. GROUND WATER RESOURCES, EXTRACTION, CONTAMINATION AND OTHER ISSUES

a. Aquifer wise resource availability and extraction

(a) Present Dynamic Ground Water Resource (2017)

Taluk	Net Annual Ground Water Availability (Ham)	Existing Gross Ground Water Draft for Irrigation(Ham)	Existing Gross Ground Water Draft For Domestic and Industrial Water Supply (Ham)	Existing Gross Ground Water Draft for all Uses (Ham)	Allocation For Domestic and Industrial Use for Next25Years (Ham)	Net Ground Water Availability for Future Irrigation Development (Ham)	Existing Stage Of Ground Water Development (%)	Category
Haveri	6569	3784	276	4060	331	2484	62	SAFE

(b) Present total Ground Water Resource (in ham)

Taluk	Annual Replenishable GW Resources	Fresh In-storage GW Resources		Total availability of GW Resource
		Phreatic	Fractured	Dynamic+phreatic in-storage+ fractured in-storage
Haveri	6568	1988	12791	21653

(c) Comparison of Ground Water Availability and Draft Scenario in Haveri taluk

Taluk	GW Availability (Ham)	GW Draft (Ham)	Stage of GW Development	GW Availability (Ham)	GW Draft (Ham)	Stage of GW Development	GW Availability (Ham)	GW Draft (Ham)	Stage of GW Development
	2011			**2013**			**2017**		
Haveri	7927.15	5456.36	69	7756.85	5259.83	68	6569	4060	62

b. Chemical Quality of Ground Water and Contamination

In general, ground water quality in Haveri taluk is good for drinking purpose as per "Indian Standard Drinking Water Specification 2009".

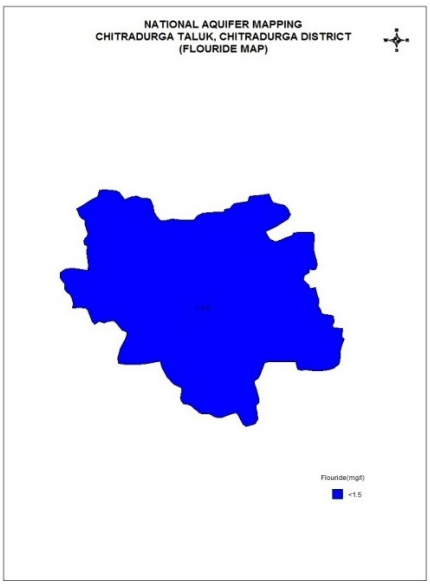

Fig .11: Fluoride Map

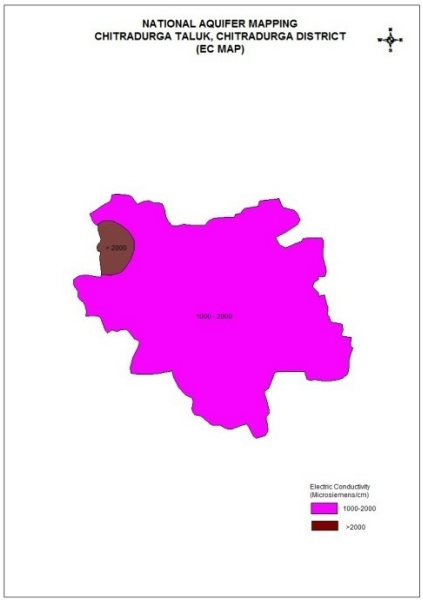

Fig.12: Electrical Conductivity Map

4. GROUND WATER RESOURCE ENHANCEMENT

4.1 Aquifer wise space available for recharge and proposed interventions

Recharge dry phreatic aquifer (Aq-I) in the taluk, through construction of artificial recharge structures, viz., checkdams, percolation tanks & point recharge structures **(Table-4.1.1)**.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 4.1.1: Quantity of non-committed surface runoff and expected recharge through AR structures

Artificial Recharge Structures Proposed	Haveri Taluk
Non committed monsoon runoff available (Ham)	1760
Number of Check Dams	814
Number of Percolation Tanks	153
Number of Point Recharge structures	0
Tentative total cost of the project(Rs in lakhs)	11204
Excepted recharge(MCM)	132

4.2 Improvement in GW availability due to Recharge, Haveri taluk

Taluk	Net annual ground water availability	Existing gross ground water draft for all uses	Existing stage of groundwater development	Expected recharge from proposed artificial recharge structures	Additional potential from proposed irrigation development schemes through inter-basin transfer	Cumulative annual groundwater availability	Expected improvement in stage of groundwater development after the implementation of the project	Expected improvement in overall stage of groundwater development
	HAM	HAM	%	HAM	HAM	HAM	%	%
Haveri	6569	4060	62	1320	-	7889	11	51

After implementation of Artificial Recharge structures for GW recharge, the annual ground water availability will increase from 6569 to 7889 ham and the expected improvement in stage of development is11% i.e., from 62% to 51%.

5. DEMAND SIDE INTERVENTIONS

5.1 Advanced irrigation practices

It is observed that presently, ground water through bore wells is the lone source for irrigation in the taluk. Water use efficiency measures are need of the hour. Adopting these measures will contribute in ground water resource enhancement in the long run.

Efficient irrigation practices like Drip irrigation and sprinkler need to be adopted by the farmers in the existing 18,053 ha of gross irrigated area. Presently, draft through irrigation is 6799 ham.

5.2 Change in cropping pattern

In Haveri taluk, no water intensive crop, like Paddy or Sugarcane is being grown, and hence, it may not be of any consequence to apply any modifications in cropping pattern. Hence, change in cropping pattern is not suggested.

5.3 Regulations and Control

Haveri taluk has been categorized as **Safe** since the Stage of groundwater development is 62 **%** (GE March 2013). More area can be brought under irrigation by drilling of bore wells in the taluk.

5.4 Other interventions proposed:

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

5.5 Summary

The summary of Management plan of Haveri taluk is given in **Table-5.5.1**.

Table 5.5.1: Summary of Management plan of Haveri taluk

Haveri taluk is Safe and present stage of GW Development (2017)	62%
Net Annual Ground Water Availability (MCM)	65.69
Existing Gross Ground Water Draft for all uses (MCM)	40.60
Total GW Resources (Dynamic & Static up to the depth of 200 mbgl (MCM)	216.53
Expected additional recharge from monsoon surplus runoff (MCM)	132
Change in Stage of GW development, %	64 to 51