



## केंद्रीय भूमि जल बोर्ड

जल संसाधन, नदी विकास और गंगा संरक्षण मंत्रालय

भारत सरकार

Central Ground Water Board

Ministry of Water Resources, River Development and Ganga

Rejuvenation

Government of India

Report on

## **AQUIFER MAPPING AND MANAGEMENT PLAN**

**Raibagh Taluk, Belgaum District, Karnataka**

दक्षिण पश्चिमी क्षेत्र, बेंगलोर

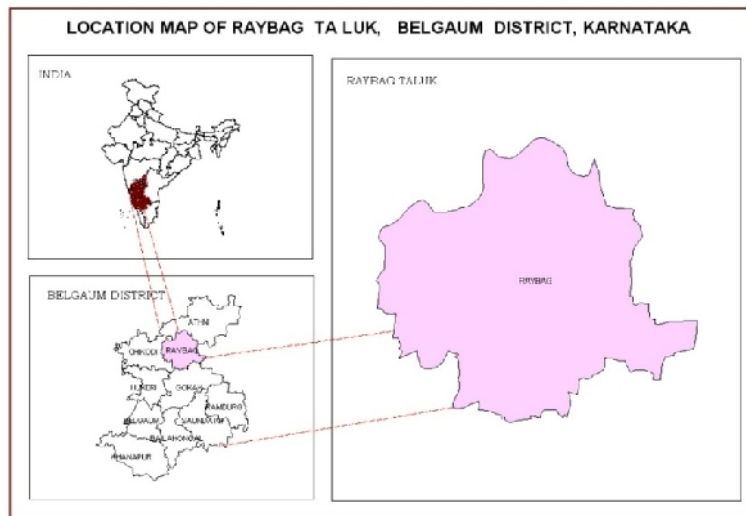
South Western Region, Bengaluru

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Government of India  
Ministry of Water Resources,  
River Development & Ganga Rejuvenation  
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**RAIBAG TALUK AQUIFER MAPS AND MANAGEMENT PLANS,  
BELGAUM DISTRICT,  
KARNATAKA STATE**



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DISTRICT, KARNATAKA STATE**

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# AQUIFER MANAGEMENT PLAN OF RAIBAG TALUK, BELGAUM DISTRICT, KARNATAKA STATE

## 1.0 SALIENT INFORMATION

**Name of the taluk:** RAIBAG  
**District:** Belgaum  
**State:** Karnataka  
**Area:** 959 sq.km.  
**Population:** 4,05,489  
**Annual Normal Rainfall:** 501 mm

### 1.1 Aquifer management study area

Aquifer mapping studies have been carried out in Raibag taluk, Belgaum district of Karnataka, covering an area of 959 sq.kms under National Aquifer Mapping Project. Raibag taluk of Belgaum district is located between north latitude  $16^{\circ} 18' 50.9''$  and  $16^{\circ} 34' 22.7''$  & east longitude  $74^{\circ} 40'22.5''$  and  $75^{\circ} 04'39.9''$ , and is covered in parts of Survey of India Toposheet Nos. 47L/10, 47L/11, 47L/14, 47L/15 and 47P/3. Raibag taluk is bounded by Athani taluk on north, Gokak taluk on south, Bagalkot district on eastern side and Chikkodi taluk on west. Location map of Raibag taluk of Belgaum district is presented in Fig.1.

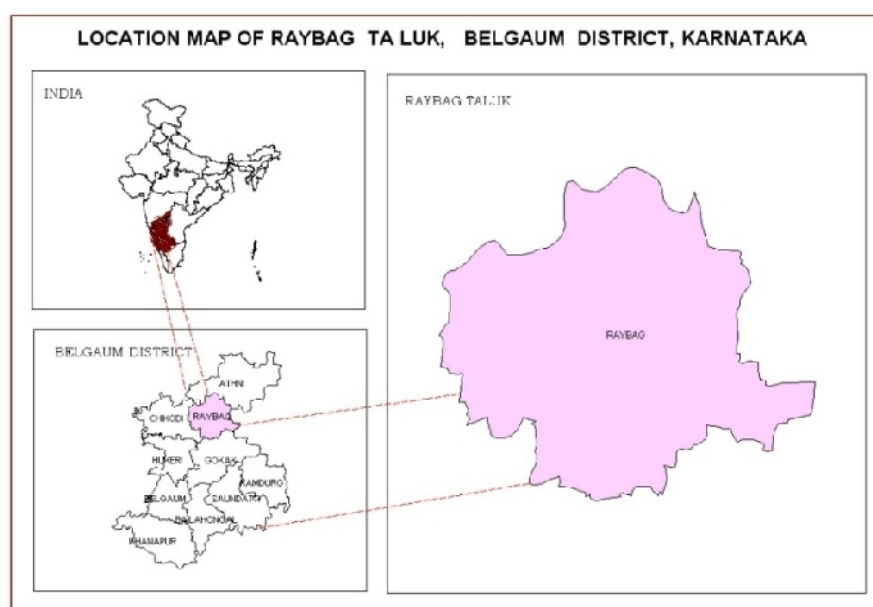


Fig.1: Location map of Raibag taluk

Taluk administration of Raibag taluk consists Raibag as taluk head quarter and there are two town municipalities in this taluk. There are 59 inhabited and no uninhabited villages in Raibag taluk.

## 1.2 Population

According to 2011 census, the population in Raibag taluk is 4,05,489, out of which 3,63,599 constitute the rural population and 41,890 constitute the urban population. The study area has an overall population density of 423 persons per sq.km. The decadal variation in population from 2001-2011 is 16.65% in Raibag taluk.

## 1.3 Rainfall

Raibag taluk enjoys semi-arid climate. Dryness and hot weather prevails in major part of the year. The area falls under Northern Dry 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 Raibag taluk (Table-1). The data in respect of this station from the year 1981 to 2010 is analysed and presented in Table-2. The data pertaining to these gauges is of long term 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 Raibag taluk for the period 1981 to 2010 is 501 mm.

Table-1: Raingauge location in Raibag taluk

Sl. No	Station	Latitude	Longitude	Altitude
1	Raibag	16° 29'	74° 46'	581

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-2.

Table 2: Statistical Analysis of Rainfall Data of Raibag Taluk, Belgaum District, Karnataka for the Period 1981 to 2010

STATION		JAN	FEB	MAR	APR	MAY	PRE	JUN	JUL	AUG	SEP	SW	OCT	NOV	DEC	NE	Annual
Raibag	NRM	1	1	7	13	34	56	88	70	67	115	340	84	18	3	105	501
	STDEV	3	3	24	20	42	51	62	48	45	108	161	65	28	9	72	170
	CV%	368	314	340	158	121	92	70	68	68	94	47	77	159	275	68	34

The mean monthly rainfall at Raibag taluk is ranging between 1mm during January and February to 115 mm during September. The Coefficient of Variation (CV) for pre-monsoon, monsoon and post monsoon season is 92, 47 and 68 percent respectively. Annual CV at this station works out to be 34 percent.

#### 1.4 Agriculture & Irrigation

Agriculture is the main occupation in Raibag taluk. Major Kharif crops are maize, bajra, jowar, tur and vegetables. Main crops of Rabi season are maize, horse gram, groundnut, and sunflower (Table-3). Water intensive crops like sugarcane is grown in 71.54 % of total crop area. Maize is grown in 35.7% and oil seeds in 2.3% of total crop area of taluk. Bajra & jowar account 2% of total crop area.

Table-3: Cropping pattern in Raibag taluk 2014-2015 (Ha)

Year	Paddy	Maize	Bajra	Jowar	Pulses	Fruits	Vegetables	Oil seeds	Sugarcane	Cotton
	Area under cultivation (in ha)									
2014-15	0	19353	135	937	1238	289	720	1255	38777	464

It is observed that net sown area accounts 50.18% and area sown more than once is 21.50% of total geographical area in Raibag taluk (Table-4). Area not available for cultivation and Fallow land cover 10% & 34.5% of total geographical area respectively. 50.73% of the net area irrigated is through canals, 15.32% of the net area is irrigated through dug wells, 18.01% of net area irrigated is from borewells and 15.93% from lift irrigation (Table-5).

Table-4: Details of land use in Raibag taluk, 2014-15 (Ha)

Taluk	Total Geographical Area	Area under Forest	Area not available for cultivation	Fallow land	Net sown area	Area sown more than once
Raibag	95900	2647	9657	33096	48127	20617

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

Table-5: Irrigation details in Raibag taluk (in ha)

Source of Irrigation	Net area irrigated (Ha.)	% of area
Canals	24750	50.73
Tanks	0	0
Wells	7475	15.32
Bore wells	8789	18.01
Lift Irrigation	7771	15.93
Other Sources	0	0
<b>Total</b>	<b>48,785</b>	

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

### 1.5 Geomorphology, Physiography and Drainage

Raibag taluk is a plateau region formed by basaltic lava flows, which represents “Deccan peneplain”. The elevation in the plains varies from 534 m in to 820 m amsl in the taluk. This has its bearing on the regional slope which is towards northeast (Fig.3).

The river Krishna, along with its tributaries Ghataprabha and Malaprabha are perennial and effluent in nature and flow in easterly direction. The drainage in the district is dendritic to sub-dendritic in nature. The drainage density varies from 0.80 to 3.4km/sq.km (Fig.3).

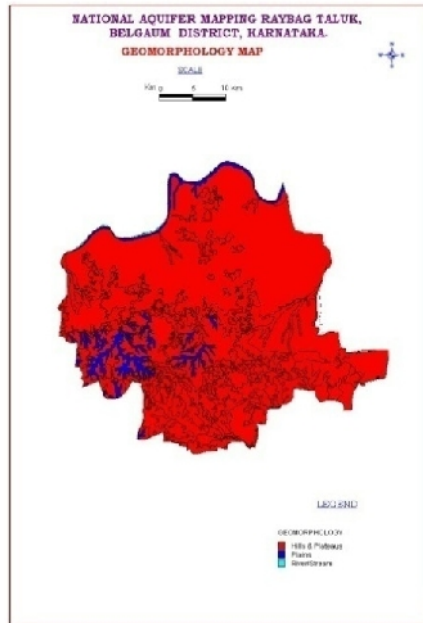


Fig.2: Geomorphology

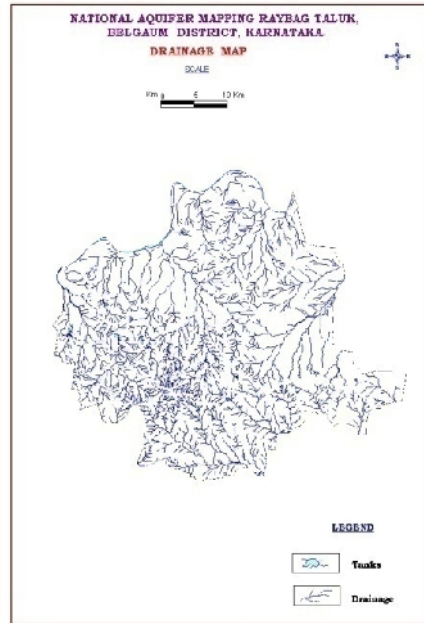


Fig.3: Drainage

### 1.6 Soil

By and large, black soils predominate in Raibag taluk which is in the Deccan Trap terrain. They are dark greyish-brown to very dark greyish-brown with clayey texture. These are derived from the weathered products of basalts and limestone and are darker in valleys than in high lands. Their texture varies from loam to clay, with low to moderate infiltration characteristics.

### 1.7 Ground water resource availability and extraction

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

Table-6: Total Ground Water Resources (2013) in Ha m

Taluk	Annual Replenishable GW resources	Fresh In-storage GW resources		Total availability of fresh GW resources
		Phreatic	Fractured (Down to 200 m)	Dynamic + Phreatic in-storage + fractured
Raibag	16,416	5,545	2,400	24,360

## 1.8 Existing and future water demands (as per GEC-2013)

- Net ground water availability for future irrigation development : 5,854 Ha m
- Domestic (Industrial sector) demand for next 25 years : 948 Ha m

## 1.9 Water level behavior

### (a) Depth to water level

#### Aquifer - I

- Pre-monsoon: 4.90 – 16.75 m bgl (Fig.4)
- Post-monsoon: 2.08 – 12.42 m bgl (Fig.5)

#### Aquifer - II

- Pre-monsoon: 10.23 – 28.37 m bgl (Fig.6)
- Post-monsoon: 3.19 – 8.73 m bgl (Fig.7)

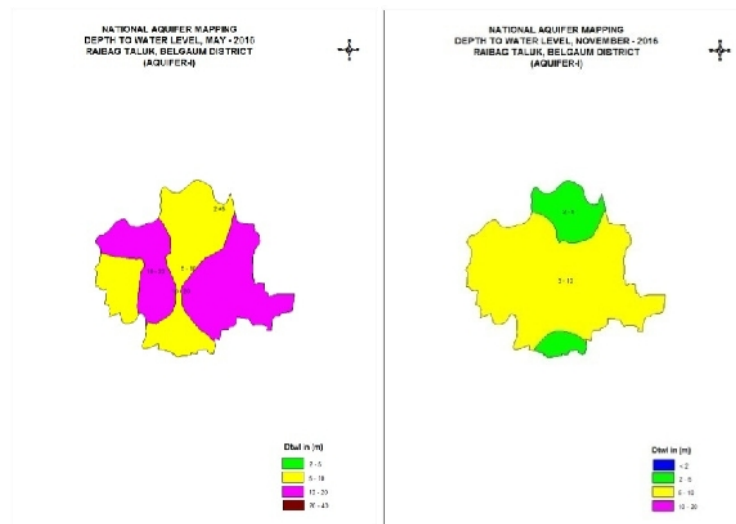


Fig 4: Pre-monsoon DTW (Aq-I)

Fig 5: Post-monsoon DTW (Aq-I)

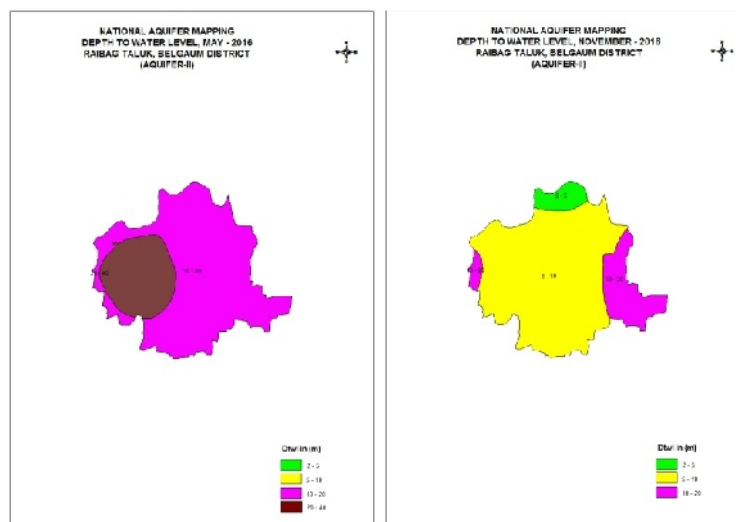


Fig 6: Pre-monsoon DTW (Aq-II)

Fig 7: Post-monsoon DTW (Aq-II)



## (b) Water level fluctuation

### Aquifer-I (Fig.8)

- Seasonal Fluctuation: Rise ranges 0.16 – 6.82 m;

### Aquifer-II (Fig.9)

- Seasonal Fluctuation: Rise shows 7.04 m;

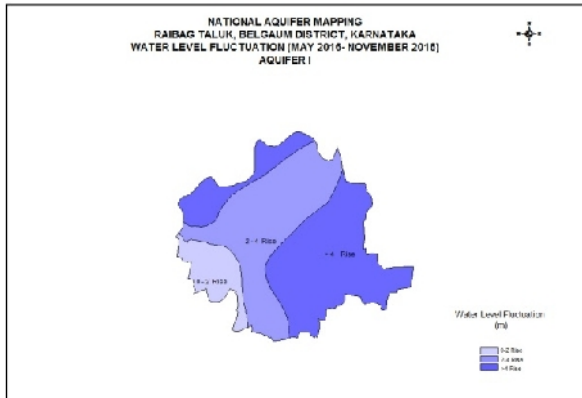


Fig 8: Pre-monsoon DTW fluctuation (Aq-I)

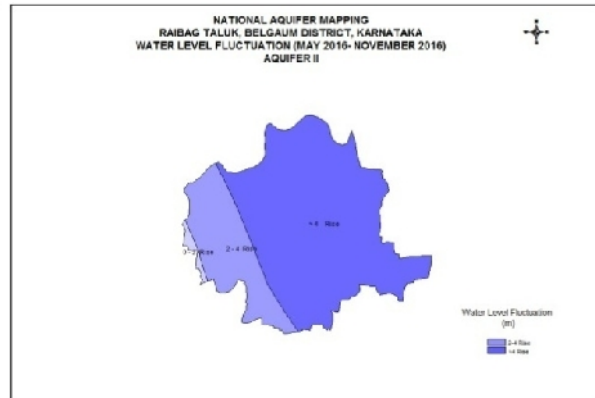


Fig 9: Post-monsoon DTW fluctuation (Aq-II)

## 2.0 AQUIFER DISPOSITION

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

- Aquifer-I (Phreatic aquifer)** comprising Weathered Basalt
- Aquifer-II (Fractured aquifer)** comprising Fractured Basalt

Hard rocks occupy a major part of the Raibag taluk, majority of which are basaltic lava flows. Most of these rocks have poor capacity of storing and transmitting water, except through favourable zones and at favourable locations. Aquifer systems encountered are therefore limited in nature. Ground water occurs both in weathered and fractured zones. Deccan basalts act as a multi-layer aquifers having low to medium permeability. In Deccan basalts that comprise different flows, fractures and interstitial pore spaces of vesicular zones, are good repositories of ground water. Groundwater occurs under phreatic conditions in weathered zone of these basalts and under semi-confined to confined conditions in inter-trapeans and also in joints and fractures at deeper levels. Geology of Raibag taluk is given in Fig.10.

In Raibag taluk bore wells were drilled from a minimum depth of 25 m bgl to a maximum of 80 mbgl under ground water exploration (Table-7). Ground water exploration reveals that aquifer-II fractured formation was encountered between the depths of 6 to 77 mbgl. Yield ranges from 0.03 to 7.58 lps.

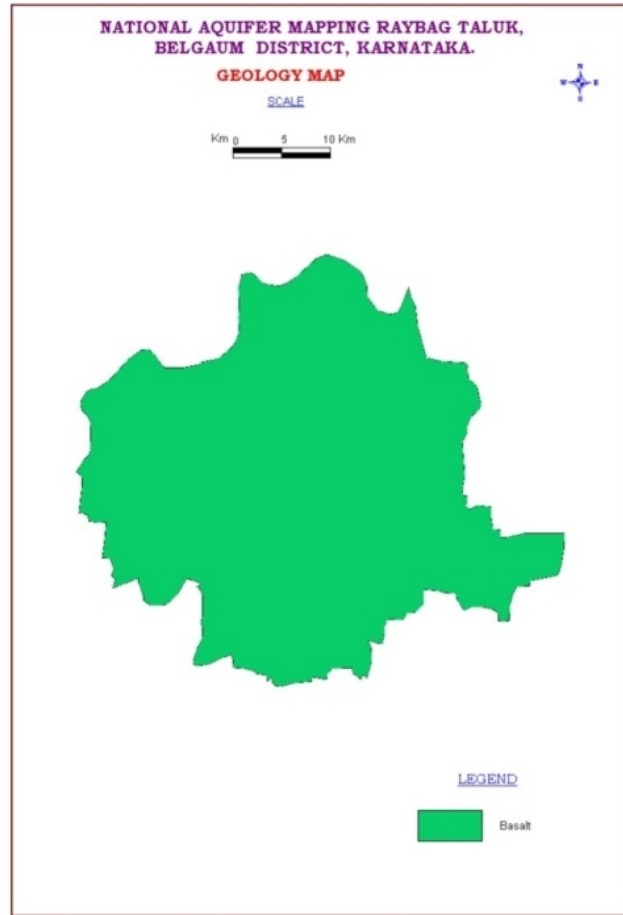


Fig.10: Geology

Table-7: Details of Ground water Exploration

Sl. No.	Location	Latitude	Longitude	Depth Drilled (m bgl)	Depth to Water (m bgl)	Q (lps)	DD (m)	T (m <sup>2</sup> /day)
1	Chinchali	15°33'45"	74°48'57"	80	7.14	6.66	2.64	2220
2	Chinchali	16°33'45"	74°48'57"	40	7.38	4.75	1.84	1350
3	Kankanwadi	16°20'56"	74°54'9"	80	7.41	1.2	15.7	15
4	Yelparhatti	16°33'15"	74°56'33"	65	6.75	7.58	4.96	143
5	Yelparhatti	16°33'50"	74°56'33"	65	6.73	7	4.99	323
6	Raibag Pz	16°29'20"	74°46'40"	58.2	3	0.07		8
7	Kudachi Pz			35.15	7.39	0.03		5
8	Chinchali	16°33'15"	74°48'30"	25	6.51	2.75	0.265	781

### 3.0 GROUND WATER RESOURCE, EXTRACTION, CONTAMINATION AND OTHER ISSUES

#### a. Aquifer wise resource availability and extraction

(a) Present Dynamic Ground Water Resource (2013) in ha m

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 Next 25 Years (Ham)	Net Ground Water Availability for Future Irrigation Development (Ham)	Existing Stage Of Ground Water Development (%)	Category
Raibag	16,416	11,175	642	11,817	948	5854	72	Semi- Critical

(b) Present total Ground Water Resource in ha m

Taluk	Annual replenishable GW resources	Fresh In-storage GW resources		Total availability of GW resource
		Phreatic	Fractured	Dynamic + phreatic in-storage + fractured in-storage
Raibag	16,416	5545	2400	24360

(c) Comparison of ground water availability and draft scenario in Raibag taluk

Taluk	GW Availability (Ha m)	GW Draft (H am)	Stage of GW Development	GW Availability (Ha m)	GW Draft (Ha m)	Stage of GW Development	GW Availability (Ha m)	GW Draft (Ha m)	Stage of GW Development
	2009			2011			2013		
Raibag	18242	19300	106	16219	11343	70	16416	11817	72

#### b. Chemical Quality of Ground water and Contamination

Interpretation of Chemical Analysis results of ground water from phreatic aquifer in Raibag taluk is mentioned as under:

**Electrical Conductivity:** In general, EC values range from 470 to 2700  $\mu$ /mhos/cm at 25°C which are within the permissible limit.

**Fluoride:** Fluoride concentration in ground water is of geogenic origin and F value ranges in general between 0.1 – 1.2 mg/l. One sample has shown the value of 1.8 mg/l which is more than the permissible limit of 1.5 mg/l.

**Nitrate:** Nitrate value ranges between 4.5 to 42 mg/l which are within the permissible limit of 45 mg/l.

In general ground water quality in Raibag taluk is good for drinking purpose except in some areas. Ground water samples have also been tested and found suitable for agriculture & irrigation purposes.

#### 4.0 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; check dams, percolation tanks & point recharge structures (Table-8). 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-8: Quantity of non-committed surface runoff & expected recharge through AR structures

Artificial Recharge Structures Proposed	Raibag taluk
Non committed monsoon runoff available (MCM)	7.57
Number of Check Dams	47
Number of Percolation Tanks	3
Number of Point Recharge structures	5
Tentative total cost of the project (Rs. in lakhs)	182.44
Expected recharge (MCM)	4.29
Expected rise in water level (m)	0.23
Cost Benefit Ratio (Rupees/ cu.m. of water harvested)	4.26

##### 4.2 Improvement in GW availability due to Recharge, Raibag taluk

Taluk	Net annual ground water availability	Existing gross ground water draft for all uses	Existing stage of ground water development	Expected recharge from proposed artificial recharge structures	Additional potential from proposed irrigation development schemes through inter-basin transfer	Cumulative annual ground water availability	Expected improvement in stage of ground water development after the implementation of the project	Expected improvement in overall stage of ground water development
	HAM	HAM	%	HAM	HAM	HAM		%
Raibag	16416	11817	72	429	0	16844	02	70

After implementation of Artificial Recharge structures the annual ground water availability will increase from 16,416 to 16,844 ha m and the expected improvement in stage of development is 2% i.e., from 72% to 70%

## 5.0 DEMAND SIDE INTERVENTIONS

### 5.1 Advanced irrigation practices

It is observed that presently, ground water through borewells 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 16,264 ha of gross irrigated area by dug wells and bore wells. Presently, draft through irrigation is 11,175 ha m. Efficient irrigation techniques will contribute in saving ground water by 725 ha m and thus, will improve stage of development by 3% from 70% to 67% (Table-9).

Table-9: Improvement in GW availability due to saving by adopting water use efficiency

Taluk	Cumulative annual ground water availability after implementing ar structures & irrigation development schemes	Existing gross ground water draft for all uses	Stage of ground water development after implementing ar structures & Yettinahole project	Saving due to adopting WUE measures	Cumulative annual ground water availability	Expected improvement in stage of ground water development after the implementation of the project	Expected improvement in overall stage of ground water development
	Ham	Ham	%	Ham	Ham		%
Raibag	16844	11817	70	725	17569	03	67

### 5.2 Change in cropping pattern

In Raibag taluk, Water intensive crop i.e., sugarcane is being grown in 71.54% of total cropped area by surface water in the Raibag taluk. Hence, change in cropping pattern has not been suggested.

### 5.3 Regulation and Control

- Raibag taluk has been categorized as **Semi-critical**, since the Stage of ground water development has reached 72% (GE March 2013). Hence, ground development has to be taken up with caution.
- Ground water recharge component needs to be made mandatory in the non-command area of the taluk for further development of ground water.

### 5.4 Other interventions proposed

- Periodical maintenance of artificial recharge structures should also be incorporated in the Recharge Plan.
- Excess fluoride concentration is found in ground water samples in some pockets which require remedial measures viz., dilution of fluoride rich ground water through artificial recharge and water conservation.
- Roof top rain water harvesting.
- Micro irrigation.

### Summary

The summary of Management plan of Raibag taluk is given in Table-10.

Table-10: Summary of Management plan of Raibag taluk

Raibag taluk is semi critical and present stage of GW Development (2013)	72%
Net Annual Ground Water Availability (MCM)	164.16
Existing Gross Ground Water Draft for all uses	118.17
Groundwater development feasibility	58.54
Total GW Resources (Dynamic & Static up to the depth of 200 m bgl) (MCM)	243.60
Expected additional recharge from monsoon surplus runoff (MCM)	7.57
Change in Stage of GW development, %	72 to 70
Expected Saving due to adopting WUE measures (MCM)	7.25
Change in Stage of GW development, %	70 to 67

