*Draft Report*

# 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

## Gadag Taluk,Gadag District,Karnataka

दक्षिण पश्चिमी क्षेत्र, बैंगलोर

South Western Region,Bengaluru

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Government of India
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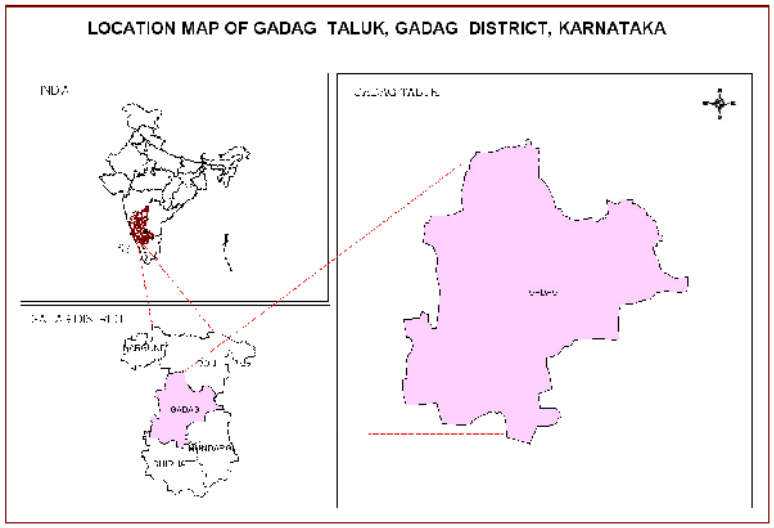
# GADAG TALUK AQUIFER MAPS AND MANAGEMENT PLANS, GADAG DISTRICT, KARNATAKA STATE

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**March 2017**

# GADAG TALUK AQUIFER MAPS AND MANAGEMENT PLANS, GADAG DISTRICT, KARNATAKA STATE

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**GADAG TALUK AQUIFER MAPS AND MANAGEMENT PLANS,**
**GADAG DISTRICT, KARNATAKA STATE**

## 1. SALIENT INFORMATION

**Name of the taluk** : **GADAG**

| | |
|---|---|
| **District** | : Gadag |
| **State** | : Karnataka |
| **Area** | : 1,095 sq.km. |
| **Population** | : 3,67,258 |
| **Annual Normal Rainfall** | : 784 mm |

### 1.1 Aquifer management study area

Aquifer mapping studies were carried out in Gadag taluk, Gadag district of Karnataka, covering an area of 1,387 sq.kms under National Aquifer Mapping Project. Gadag taluk of Gadag district is located between north latitude $15^0$12'37.4" and$15^0$38'50.2" & east longitude $75^0$26'37.4" and $75^0$51'35.6", and is covered in parts of Survey of India Toposheet Nos. 48M/10, 48M/11, 48M/12, 48M/14, and 48M/15. Gadag taluk is bounded by Ron taluk on north, Shirahatti taluk on south, Navalgund taluk on west and Mundargi and Yelbarga on eastern side. Location map of Gadag taluk of Gadag district is presented in Fig-1.

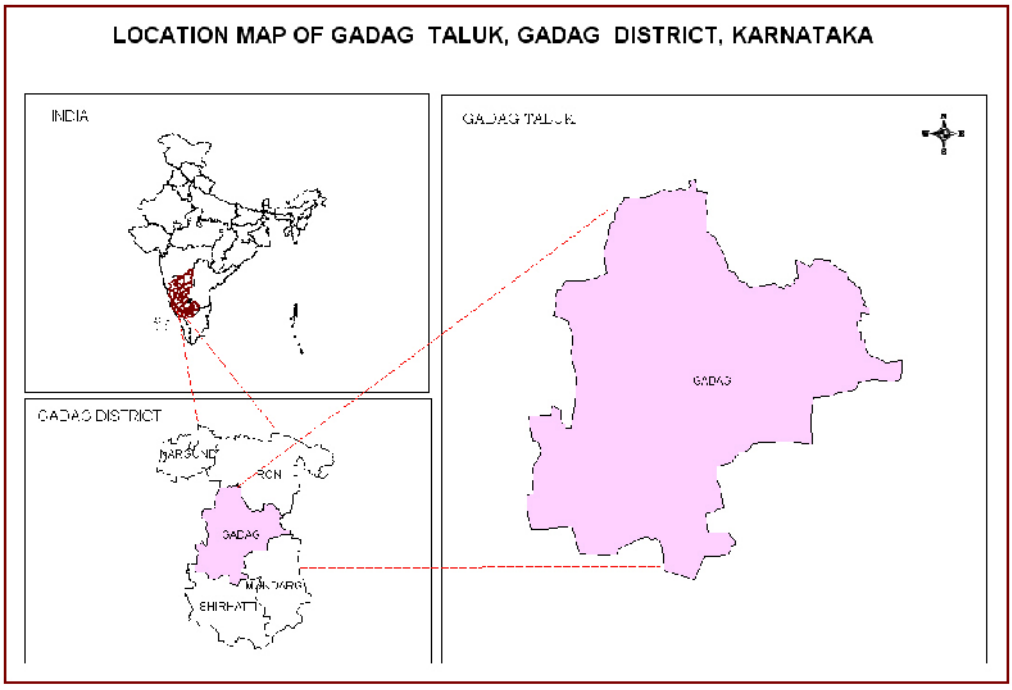


Fig-1: Location Map of Gadag taluk, Gadag district, Karnataka

Gadag taluk, located in the central part of Gadag district with a population of about 3.67 lakhs falls in semi-arid tract of Karnataka. Taluk administration of Gadag taluk is divided into 2 Hoblies and 27 Gram Panchayaths. Gadag is the largest city in taluk, which is the taluk and district headquarters also. There are 60 inhabited and 4 uninhabited villages in the taluk. The city of Gadag is the district headquarters. Gadag-Betageri City Municipal Council, comprising of original city of Gadag and its sister city Betageri have a combined city administration. The municipality of Gadag-Betageri has a population of 1,72,813 and an area of about 54 km². Kanaginahal of Gadag is the birthplace of the first co-operative society in Asia. Printing and hand looms are the primarily main business, while Gadag has lot of printing presses, Betageri is famous for hand looms. In the taluk, still, majority of population is dependent on agriculture,

### 1.2 Population

According to 2011 census, the population in Gadag taluk is 3,67,258 of which rural population is 1,75,883 constituting about 48%, and the urban population is 1,91,375, constituting about 52% of the total population, basically due to Gadag City. The taluk has an overall population density of 335 persons per sq.km and showed a decadal increase of about 10.41% during 2001-2011.

### 1.3 Rainfall

Gadag taluk enjoys semi-arid climate. Dryness and hot weather prevails in major part of the year. The area falls under Central 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.

The normal annual rainfall in Gadag taluk for the period 1981 to 2010 is 784 mm. Seasonal rainfall pattern indicates that, major amount of (496 mm) rainfall is received during South-West Monsoon seasons, which contributes to about 63% of the annual normal rainfall, followed by North-East Monsoon season (166 mm) constituting about 21% and remaining (122 mm) 16% during pre-monsoon season (Table-1). There is one rain gauge station in Gadag taluk, located at Gadag town itself. The data in respect of this station from the year 1981 to 2010 is analysed and presented in Table-1.

Computations were carried out for the 30 year blocks of 1981- 2010, the mean monthly rainfall at Gadag taluk is ranging between 1 mm during January and

February to 132 mm during June. The CV percent for pre-monsoon, monsoon and post-monsoon season is 187, 196 and 157 percent respectively. Annual CV at this station works out to be 278 percent. (Table-1).

Table-1: Statistical Analysis of Rainfall Data of Gadag Taluk, Gadag District, Karnataka (1981 to 2010)

| Station | | JAN | FEB | MAR | APR | MAY | PRE | JUN | JUL | AUG | SEP | SW | OCT | NOV | DEC | NE | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Gadag | NORM | 1 | 1 | 12 | 34 | 74 | 122 | 132 | 126 | 121 | 117 | 496 | 104 | 49 | 13 | 166 | 784 |
| | STDEV | 3 | 4 | 41 | 39 | 43 | 65 | 93 | 99 | 79 | 72 | 253 | 65 | 71 | 31 | 105 | 282 |
| | CV% | 35 | 32 | 29 | 88 | 172 | 187 | 142 | 127 | 153 | 162 | 196 | 159 | 69 | 40 | 157 | 278 |

Based on occurrence and frequency of past drought events, the probability of occurrence of various intensities of drought has been studied. It has been observed that the frequency of occurrence of drought is once in 3 years at Gadag taluk.

### 1.4 Agriculture and Irrigation

Agriculture is the main occupation in Gadag taluk. Pulses and cotton are major crops, grown in almost half of the total crop area followed by vegetables, Jowar, oilseeds and maize covering about 16%, 12%, 8% and 5% of the total crop area respectively.. Ragi and Fruits are some other crops grown in the taluk. Due to limited availability of irrigation water, water-intensive crops like Paddy and Sugarcane are grown in very small area of 3 and 162 acres respectively in the taluk.

Table 2: Cropping pattern in Gadag taluk 2014-2015 (Ha)

| Year | Paddy | Maize | Ragi | Jowar | Pulses | Fruits | Vegetables | Oil seeds | Sugarcane | Cotton |
|---|---|---|---|---|---|---|---|---|---|---|
| | Area under cultivation (in ha) | | | | | | | | | |
| 2014-2015 | 03 | 5540 | 08 | 14422 | 34300 | 51 | 18942 | 13825 | 162 | 24736 |

It is observed that net sown area accounts for about 65% of total geographical area, while area sown more than once is 17% of total geographical area in the taluk (Table-3). Ground water is the major source for irrigation in the taluk, as 93% of the 2411 hectares Irrigated area is irrigated through borewells (Table-4).

Table 3: Details of land use in Gadag 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 |
|---|---|---|---|---|---|---|
| Gadag | 1,09,751 | 1,749 | 2,163 | 3,033 | 1,01,281 | 24,243 |

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

Table 4: Irrigation details in Gadag taluk (Ha)

| Source of Irrigation | Net area irrigated (Ha) | % of area |
|---|---|---|
| Canals | 0 | 0 |
| Tanks | 0 | 0 |
| Wells | 0 | 0 |
| Bore wells | 2,411 | 93% |
| Lift Irrigation | 0 | 0 |
| Other Sources | 182 | 7% |
| **Total** | **2,593** | |

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

## 1.5 Geomorphology, Physiography and Drainage

The Gadag taluk is a typical hard rock area, characterized by vast stretches of undulated plains interspersed with sporadic ranges or isolated clusters of low ranges of rocky hills dotting the central and south-eastern parts. Drainage pattern in the taluk is dendritic to sub-dendritic (Fig-3). It lies to the east of the western ghats in the rain–shadow region. Hence receives low rainfall and generally drought prone. It is a part of Krishna major basin, as the entire Gadag district is drained by two main rivers namely Malaprabha and Tungabhadra. Malaprabha along with its tributary Bennihalla drains northern parts and two rivers join in the adjoining Ron taluk.

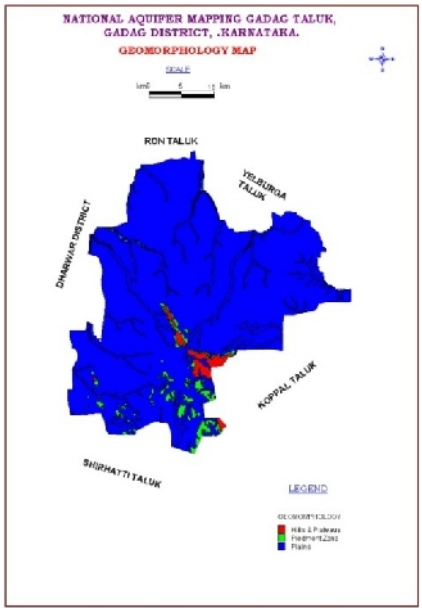


Fig 2: Geomorphology Map


Fig 3: Drainage Map

## 1.6 Soil

The taluk is predominantly covered by medium to deep black soils cover of 1.10 m deep, occasionally extending down to 1.80 m bgl depth. The constant rate of infiltration in sandy to clayey residuum ranges between 0.5 to 4.5cm/hr. Phyllitic soils are confined To hilly region.

## 1.7 Ground water resource availability and extraction

Aquifer wise total ground water resources up to 200 m depth is given in Table-5 below.

Table 5: Total GW Resources (2013) (Ham)

| 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 |
| Gadag | 5,272 | 11,693 | 2,072 | 19,038 |

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

Net ground water availability for future irrigation development : 6.61 MCM

Domestic and Industrial sector demand for next 25 years : 6.92 MCM

## 1.9 Water level behaviour

***(a) Depth to water level***

**Aquifer - I**

A. Pre-monsoon: 4.99 - 15.55 m bgl (Fig-4)

B. Post-monsoon: 4.96 - 11.15 m bgl (Fig-5)

**Aquifer - II**

C. Pre-monsoon: 8.60

D. Post-monsoon: 17.10

***(b) Water level fluctuation***

**Aquifer-I**

E. Seasonal Fluctuation: (Fig-6)

Rise ranges between 0.03 to 7.95 m;

**Aquifer-II**

F. Seasonal Fluctuation:

Fall: 8.50 m

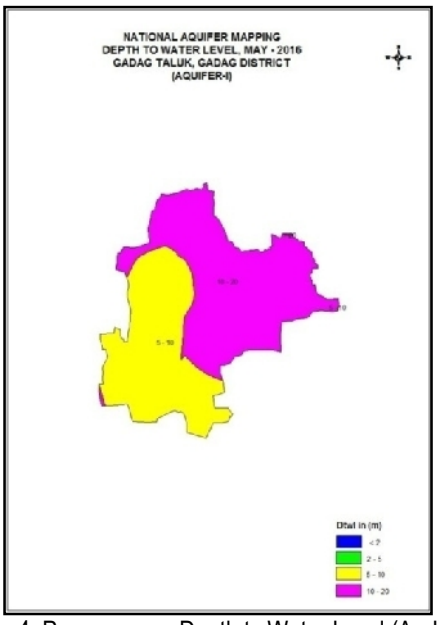


Fig.4: Pre-monsoon Depth to Water Level (Aq-I)

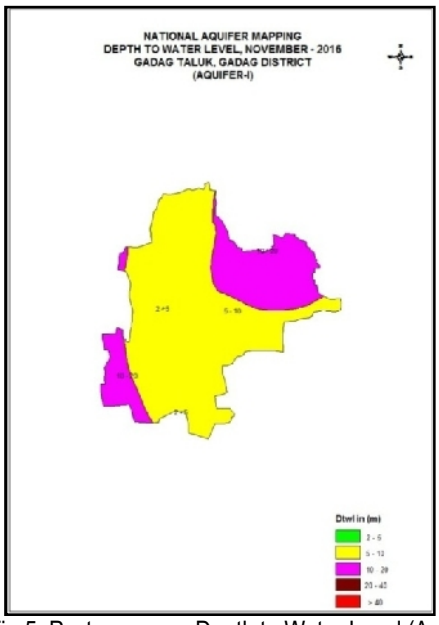


Fig.5: Post-monsoon Depth to Water Level (Aq-I)

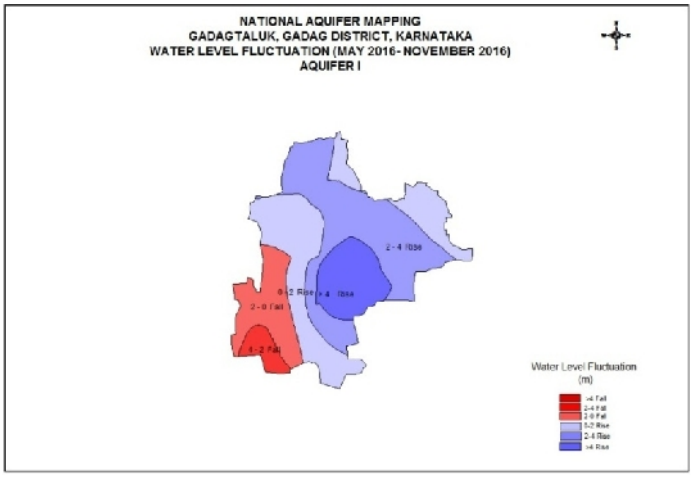


Fig.6: Water Level Fluctuation (Aq-I)

## 2. AQUIFER DISPOSITION

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

i. **Aquifer-I (Phreatic aquifer)** comprising Weathered Granite Gneiss
ii. **Aquifer-II (Fractured aquifer)** comprising Fractured Granite gneiss and, Gneiss

In Gadag taluk, fractured granite-gneiss and gneisses are the main water bearing formations (Fig-10). Ground water occurs within the jointed and fractured granite-gneisses under semi-confined to confined conditions. In Gadag district, generally the bore wells are drilled up to a maximum of 200 mbgl. Depth of weathered zone (Aquifer-I) ranges from 10 to 20 m bgl. This aquifer-I or Phreatic Aquifer is de-saturated at most of the places, due to

over-exploitation and has become totally dry. However, isolated patches in topographical lows are seen yielding seasonally, that too for very short durations. Presently, only limited data is available about aquifer-II, as exploratory drilling to the targeted depth of 200 m has to be completed in the taluk.

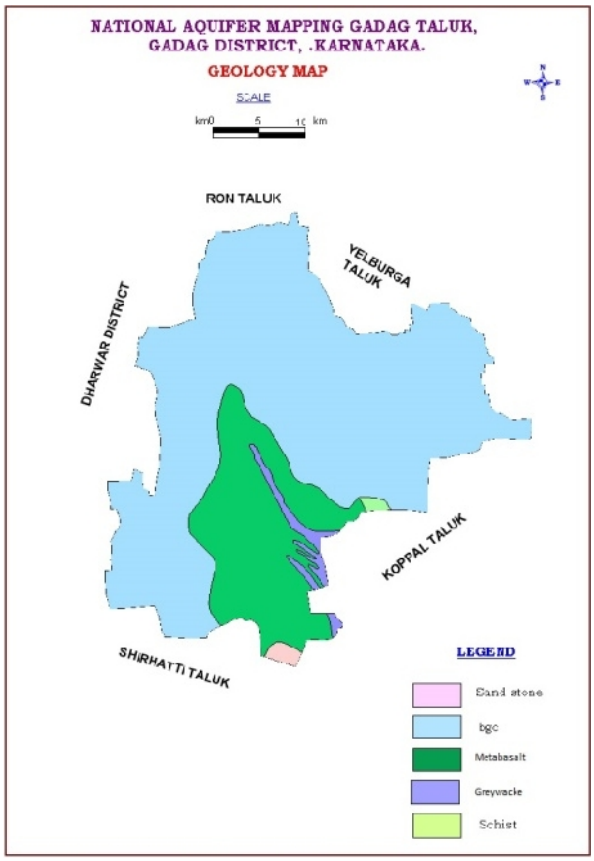

Fig 7: Geology Map

## 3. GROUND WATER RESOURCE, EXTRACTION, CONTAMINATION AND OTHER ISSUES

### a. Aquifer wise resource availability and extraction

(a) Present Dynamic Ground Water Resource (2013)

| 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 |
|---|---|---|---|---|---|---|---|---|
| Gadag | 5272 | 5265 | 590 | 5856 | 692 | 661 | 111 | OE |

(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 |
| Gadag | 5272 | -- | 2072 | 7344 |

(c) Comparison of Ground Water Availability and Draft Scenario in Gadag 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 |
|---|---|---|---|---|---|---|---|---|---|
| | **2009** | | | **2011** | | | **2013** | | |
| Gadag | 5347 | 5735 | 107 | 5160 | 5475 | 106 | 5272 | 5856 | 111 |

**b. Chemical Quality of Ground Water and Contamination**

Ground water quality in the taluk is good and potable in general. It is suitable for domestic and irrigation purposes in major parts of the area. All important parameters analysed from the water samples collected from Monitoring stations are within permissible limits, except fluoride, which is a major area of concern. It is of geogenic origin and found to be more than permissible limits (1.5 mg/litre) in almost three fourth area of the taluk. Distribution of Fluoride, and EC is presented below in Fig.8 to Fig.9.

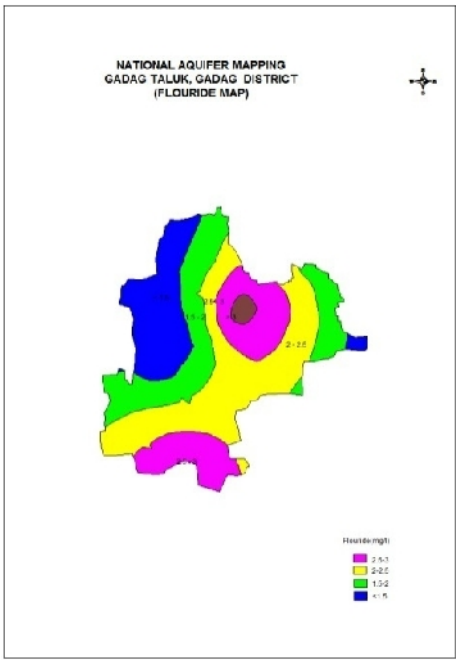


Fig 8: Fluoride Map

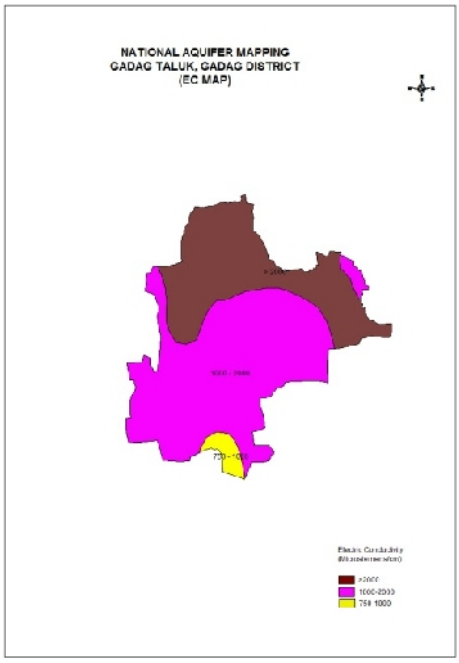


Fig 9: Electrical Conductivity Map

## 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., check dams, percolation tanks point recharge structures (Table-6). 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 6: Quantity of non-committed surface runoff and expected recharge through AR structures

| Artificial Recharge Structures Proposed | Gadag Taluk |
|---|---|
| Non committed monsoon runoff available (Ham) | 1480 |
| Number of Check Dams | 91 |
| Number of Percolation Tanks | 06 |
| Number of Point Recharge structures | 10 |
| Tentative total cost of the project (Rs. in lakhs) | 357.61 |
| Expected recharge (MCM) | 8.404 |
| Expected rise in water level (m) | 0.392 |
| Cost Benefit Ratio (Rupees / cu.m. of water harvested) | 4.26 |

After implementation of Artificial Recharge structures for GW recharge, the annual ground water availability will increase from 5272 to 6112 ham and the expected improvement in stage of development is 16% i.e., from 111% to 96%

### 4.2 Improvement in GW availability due to Recharge, Gadag 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 | 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 | % | % |
| Gadag | 5272 | 5856 | 111 | 840 | 6112 | 16 | 96 |

## 5. DEMAND SIDE INTERVENTIONS

### 5.1 Advanced irrigation practices

It is observed that presently, ground water through borewells is the main 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 2411 ha of gross irrigated area. Presently, draft through irrigation is 5265 ham. Efficient irrigation techniques will contribute in saving ground water by 1842 ham and thus, will improve stage of development by 22%, bringing stage of GW development from 96% to 74% (Table-7).

Table-7: Improvement in GW availability due to saving by adopting water use efficiency

| Taluk | Cumulative annual ground water availability after implementing AR Structures and irrigation development schemes | Existing gross ground water draft for all uses | Stage of ground water development after implementing AR structures | 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 | % | **%** |
| Gadag | 6112 | 5856 | 96 | 1842 | 7954 | 22 | 74 |

### 5.2 Change in cropping pattern

In Gadag 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 Additional area of irrigation

After adopting various water use efficiency techniques and recharge measures and its resultant savings, the stage of development is expected to be 84% in the taluk, which will bring the taluk to the **semi-critical** category. Hence bringing additional area under irrigation may not be practical with a long-term resource management point of view.

## 5.4 Regulation and Control

Gadag taluk has been categorized as **Over-Exploited**, since the Stage of ground water development has reached **111%** (GE March 2013). Hence, stringent action has to be taken up through Karnataka Ground Water Authority to control ground water exploitation in the taluk**.**

Ground water recharge component needs to be made mandatory in the taluk to save the situation from deteriorating further.

## 5.5 Other interventions proposed:

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

## 5.6 Summary

The summary of Management plan of Gadag taluk is given in Table-8.

Table-8: Summary of Management plan of Gadag taluk

| | |
|---|---|
| Gadag taluk is 'Over-Exploited' and present stage of GW Development (2013) | 111% |
| Net Annual Ground Water Availability (MCM) | 52.72 |
| Existing Gross Ground Water Draft for all uses (MCM) | 58.56 |
| Groundwater development feasibility | 6.61 |
| Total GW Resources (Dynamic & Static up to the depth of 200 m bgl) (MCM) | 190.38 |
| Expected additional recharge from monsoon surplus runoff (MCM) | 8.404 |
| Change in Stage of GW development (%) | 111 to 96 |
| Expected Saving due to adopting WUE measures (MCM) | 18.42 |
| Change in Stage of GW development, % | 96 to 74 |