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

Gudibanda Taluk, Chikballapur District, Karnataka

दक्षिण पश्चिमी क्षेत्र, बैंगलोर

South Western Region, Bengaluru

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Government of India
Ministry of Water Resources, River Development
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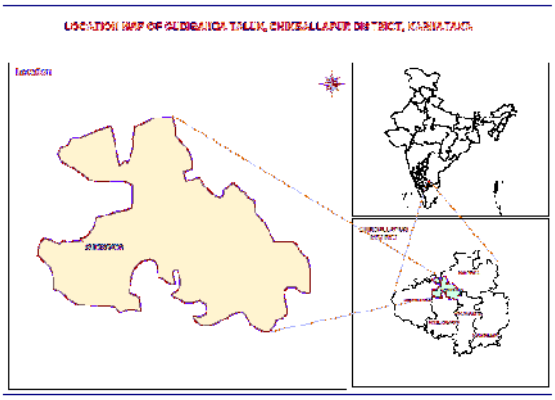
Central Ground Water Board

GUDIBANDA TALUK AQUIFER MAPS AND MANAGEMENT PLAN, CHIKBALLAPUR DISTRICT, KARNATAKA



BY
T.RAJENDRAN
Scientist-D

Central Ground Water Board
South Western Region
Bangalore
January 2017

GUDIBANDA TALUK AQUIFER MAPS AND MANAGEMENT PLAN,
CHIKBALLAPUR DISTRICT,
KARNATAKA

CONTENTS

GUDIBANDA TALUK AQUIFER MAPS AND MANAGEMENT PLAN,
CHIKBALLAPUR DISTRICT,
KARNATAKA

1. SALIENT INFORMATION

Name of the taluk : **GUDIBANDA**
District : Chikballapur
State : Karnataka
Area : 226 sq.km.
Population : 55,832 (2011)
Annual Normal Rainfall: 717 mm

1.1 Aquifer management study area

Aquifer mapping studies was carried out in **Gudibanda taluk**, Chikballapur district of Karnataka, covering an area of **226 sq.kms** under **National Aquifer Mapping Project**. Gudibanda taluk of Chikballapur district is located between north latitude 13^0 36' 32" and 13^0 46' 33" & east longitude 77^0 38' 40" and 77^0 51' 50", and is covered in parts of Survey of India Toposheet Nos. 57 G/9, 57 G/110 and 57 G/14. Gudibanda taluk is bounded by the State of Andhra Pradesh in the north, Chikballapur taluk in the south, Sidlaghatta and Bagepalli taluks in the east and Gauribidnur taluk in the west. The location map of Gudibanda taluk of Chikballapur District is presented in Fig. 1.1

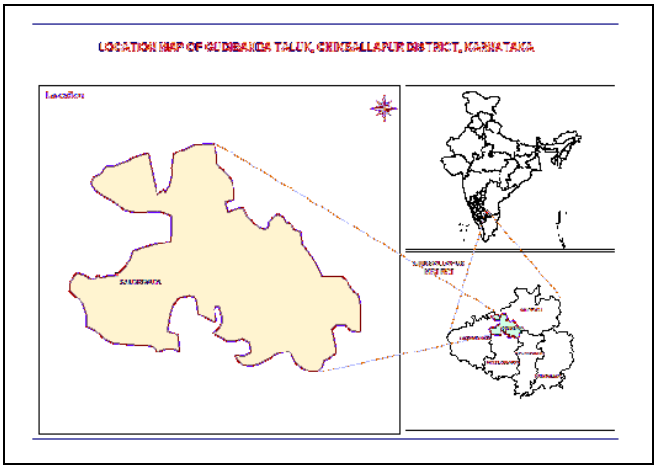


Fig. 1.1: Location Map of Gudibanda taluk, Chikballapur district

1.2 Taluk administration

Gudibanda taluk is divided into 2 Hoblies and Gudibanda is the only one town, which is also the taluk head quarter. There are 86 inhabited and 19 uninhabited villages in Gudibanda taluk. The taluk is well connected by good network of roads.

1.3 Population

According to 2011 census, the population in Gudibanda taluk is 55,832, comprising 28,078 males and 27,754 females. Out of the total population of 55,832, nearly 46,391 constitute the rural population and 9,441 is the urban population, which works out to 83 % (rural) and 17 % (urban) of the total population of taluk. The study area has an overall population density of 246 persons per sq.km. The decadal variation in population from 2001-2011 is 7.2 % in Gudibanda taluk.

1.4 Hydrometeorology

Gudibanda taluk enjoys semiarid to arid climate. Dryness and hot weather prevails in major part of the year. The area falls under Eastern 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 Gudibanda taluk (Table 1.1). The data in respect of this station from the year 1981 to 2010 is analysed and presented in the table 1.2. The data pertaining to this gauge is of long term nature and are well maintained. It is presumed that they are representative of the taluk and the same is used for analysis. Normal annual rainfall in Gudibanda taluk for the period 1981 to 2010 is 717 mm.

Table1.1: Rain gauge and its location in Gudibanda taluk

Sl.No.	Station	Latitude	Longitude	Altitude (m amsl)
1	Gudibanda	13°38’	77°42’	844

Statistical analysis

Computations were carried out for the 30 year blocks of 1981- 2010 on Mean, Standard deviation and coefficient of variation of premonsoon, monsoon, post monsoon and annual and are shown in Table 1.2.

The mean monthly rainfall at Gudibanda station is ranging between 1mm during January to 140mm during September. The CV percent for winter, premonsoon, monsoon and post

monsoon season is 72, 35 & 56 percent respectively. Annual CV at this station works out to be 29 percent.

Table 1.2: Statistical Analysis of Rainfall Data of Gudibanda, (1981 to 2010)

Param-eters	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec	**Annual**
NRF (mm)	1	7	4	22	53	67	93	100	140	129	52	12	680
CV (%)	316	376	186	121	76	68	70	61	48	72	104	147	29
% of ARF	0	1	1	3	8	10	14	15	21	19	8	2	100

Assessment of Drought

Rainfall data of Gudibanda taluk has been analysed for 115 years using IMD method to assess the drought conditions. The results of the classification are listed in the Table 1.3. It is observed that the Gudibanda taluk has experienced alternating from no drought to severe drought conditions over the years.

Table 1.3: Classification of drought and its recurrence in Gudibanda RG station (IMD, 1971)

% Deviation (Di)	>0	0 to -25	-25 to -50	< -50	Probability of drought occurrences
Category	No drought	Mild (Normal)	Moderate	Severe	
	Years				
	52	40	18	3	Once in 6 years

The details of the drought assessment are discussed as herein under. Out of 115 years of analysis in Gudibanda taluk “No Drought” condition in the taluk is 52 years, “Mild Drought” condition 40 years, “Moderate Drought” condition experienced is 18 years. Further it is observed that “Severe Drought” condition is experienced in 3 years i.e., during the years 1923, 1984 and 1985. Based on occurrence and frequency of past drought events, the probability of occurrence of various intensities of drought at the station has been studied. It has been observed that the frequency of occurrence of drought is **once in 6 years** in Gudibanda taluk.

1.5 Agriculture & Irrigation

Agriculture is the main occupation in Gudibanda taluk. The amount of rainfall and its distribution throughout the season contributes to the cropping pattern in the area. There are two agricultural seasons namely Khariff (June - October) and Rabi season (Mid October - Mid February). Major Khariff crops are paddy, maize, ragi, tur dal and vegetables

(Table 1.4). Main crops of Rabi season are Ragi, Maize, avare, groundnut, and sunflower. Mango plantations are the major perennial crop grown in the area (table 1.4). It is observed from table 1.5 that during the year 2013-14 percentage of gross cropped area of total geographical area was 60.34 % in Gudibanda taluk. The land use map of Gudibanda taluk is given fig 1.2. Ground water is the only source of irrigation (Table 1.6).

Table 1.4: Details of cropping pattern in Gudibanda taluk 2013-2014 (ha)

Year	Paddy	Maize	Ragi	Tur dal	Avare	Other pulses	Fruit trees	Vegetables	Groundnut	other oil seeds	Sugarcane
	Area under cultivation (in ha)										
2013-2014	120	6443	3530	805	470	106	337	378	1215	69	19

Table 1.5: Details of land use in Gudibanda taluk 2013-2014 (ha)

Taluk	Year	Geographical Area	Area under Forest	Area not available for cultivation	Fallow land	Net sown area	Area sown more than once
Gudibanda	2013-14	21645	2534	3540	1836	13061	1085

Source: District at a glance 2013-14, Govt. of Karnataka.

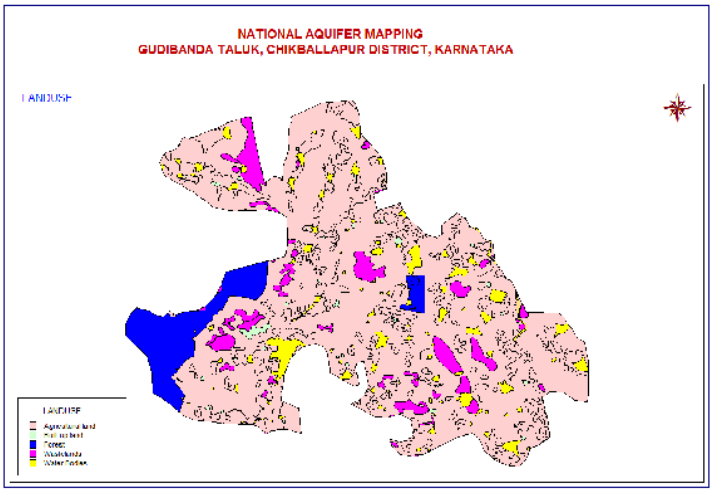


Fig 1.2: Land use map, Gudibanda taluk

Table 1.6: Net area under irrigation in study area (ha)

Source	Area under irrigation
Canals	0
Tanks	0
Wells	0
Bore wells	2531
Lift Irrigation	0
Other Sources	0

Total	**2531**

Source: District at a glance Govt. of Karnataka 2013-14

1.6 Geomorphology, Physiography & Drainage

Geomorphologically, the taluk area is covered with uplands on Gneisses, which are ideal for agriculture. Physiography of the entire area is in southern maidan region, characterized by undulating landscape with broad valleys, where the elevation ranges from 700m to 1189 m amsl with good degree of slope. Prominent hill ranges in the taluk are Narasimhadevara betta

1189 m amsl, Yerra Konda 1055 m amsl etc. Overall the topographic features in the area are formed by topographic divides between north Pennar and south Pennar catchments.

In Gudibanda taluk, there are no perennial rivers. Theses tributaries are ephemeral. Gudibanda taluk is drained by tributaries of North Pennar river, the most important tributary being Chitravathi. The drainage pattern of the area can be described as semi-dendritic to dendritic type. The drainage patterns are described as sub-rectangular due to marked influence of geologic structures.. The geomorphology and drainage maps of Gudibanda taluk are given in fig 1.3 and 1.4 respectively.

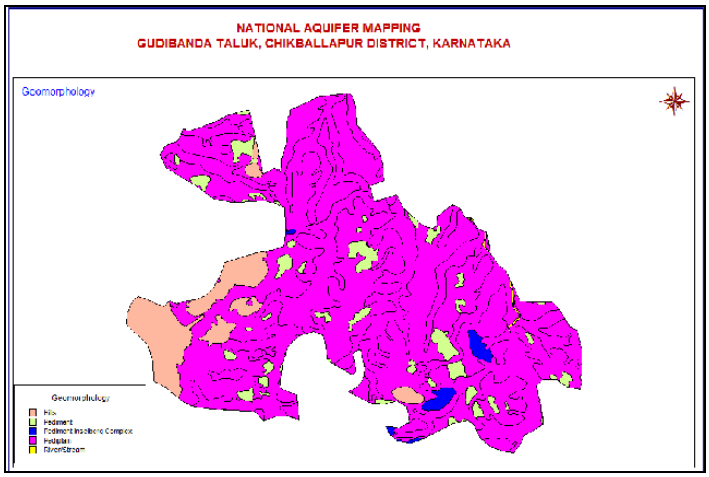


Fig. 1.3: Geomorphology, Gudibanda taluk

Fig. 1.4 Drainage map, Gudibanda taluk

1.6 Soil

Four classes of soils are found in Gudibanda taluk. They are clayey, clayey mixed, Loamy skeletal and Rocky land. Soil map of Gudibanda taluk is given in fig 1.5.

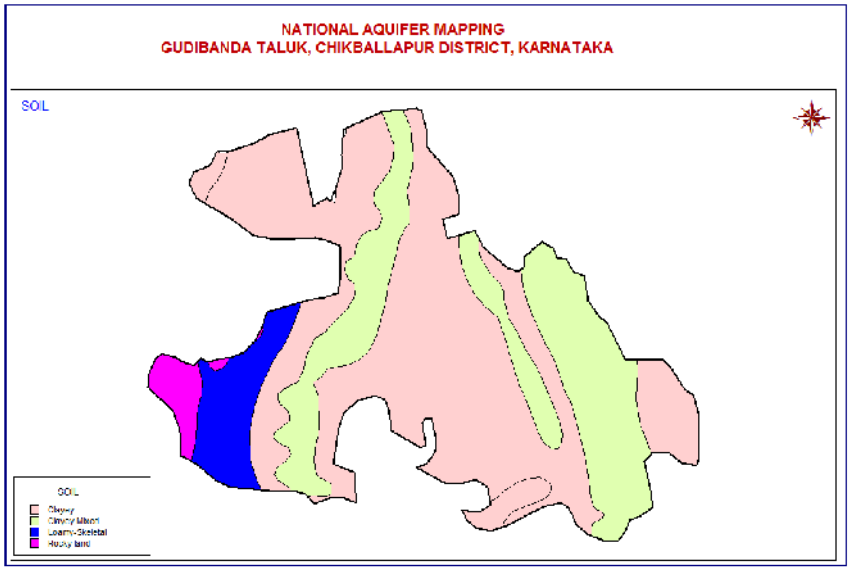


Fig 1.5: Soil map, Gudibanda taluk

1.7 Ground water resource availability and extraction:(Aquifer wise up to 200 m depth)

Table 1.7: Total GW Resources (2011), (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
Gudibanda	2394	0	1338	3732

1.8 Existing and future water demands

No scope for further Irrigation from ground water.

Domestic (Industrial sector) demand: 136.0 Ha m (GWRE-2013)

1.9 Water level behaviour

(a) Depth to water level

Aquifer - II

Pre-monsoon: 7.99 – 125.58 mbgl

Post-monsoon: 7.41- 146.67 mbgl

Depth to water level maps of pre- and post- monsoon period of 2014 are given in fig nos 1.6 and 1.7 respectively.

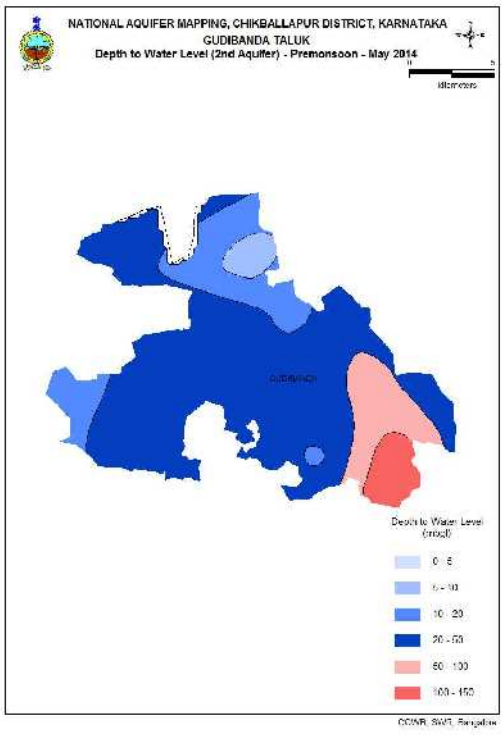


Fig 1.6: Depth to water level Pre-monsoon May2014 (Aq –I I)

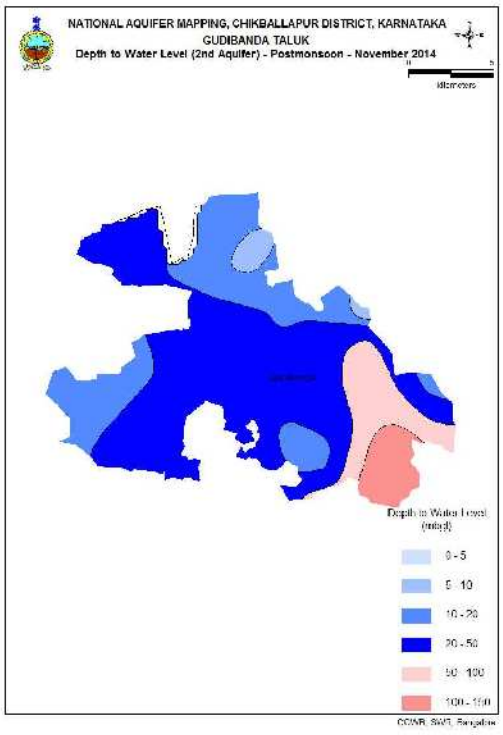


Fig 1.7: Depth to water level Post-monsoon Nov 2014 (Aq –I I)

(b) Water level fluctuation

Aquifer-II

Seasonal Fluctuation: Rise ranges between 0.36 to 17.11m

Fall ranges between 0.33 to 19.4m

Water level fluctuation and Water table elevation maps are given in fig nos 1.8 and 1.9 respectively.

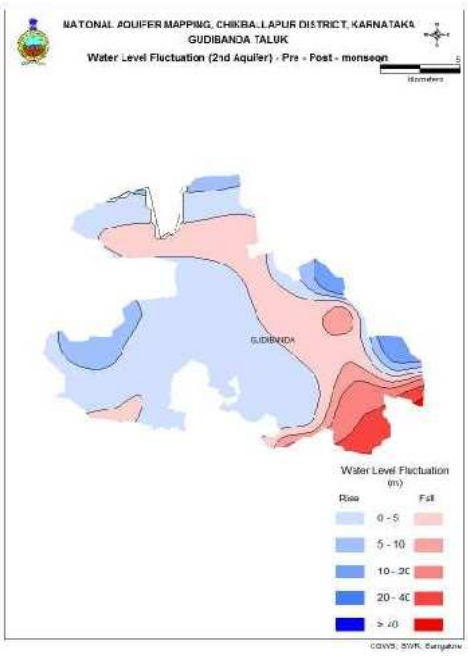


Fig 1.8: Water level fluctuation map (Aq – II)

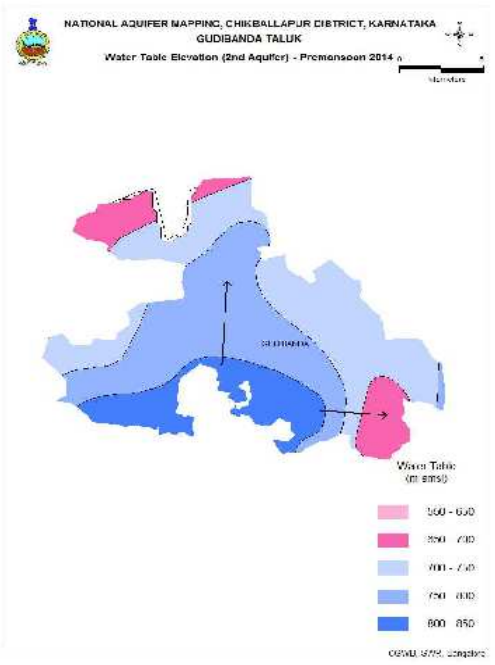


Fig1.9: Water table elevation map (Aq – II)

2. AQUIFER DISPOSITION

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

i. **Aquifer-I (Phreatic aquifer) comprising** Weathered Gneiss

ii. Aquifer-II, (Fractured multi-aquifer system) comprising ffractured Gneiss

The map showing weathered thickness in the taluk is given in fig 2.1.

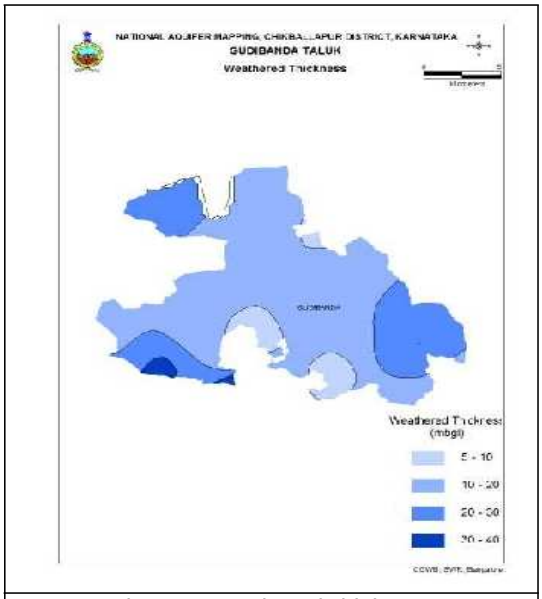


Fig 2.1: Weathered thickness
(Aq–I disposition)

2 3 D aquifer disposition and basic characteristics of each aquifer

(A) Aquifer disposition – Rockworks output

Based on the aquifer input data, various aquifer models viz., 3D aquifer models, 3D aquifer fence diagram, 3D fracture models, integrated 3D fracture models, aquifer sections have been prepared and presented in Figure 2.2 to 2.5

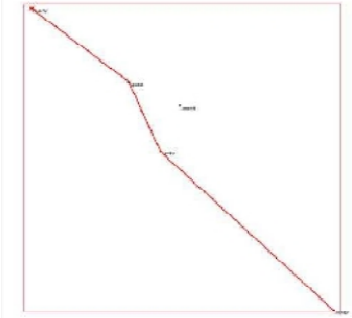


Fig.2.2.: Cross - Section NW-SE

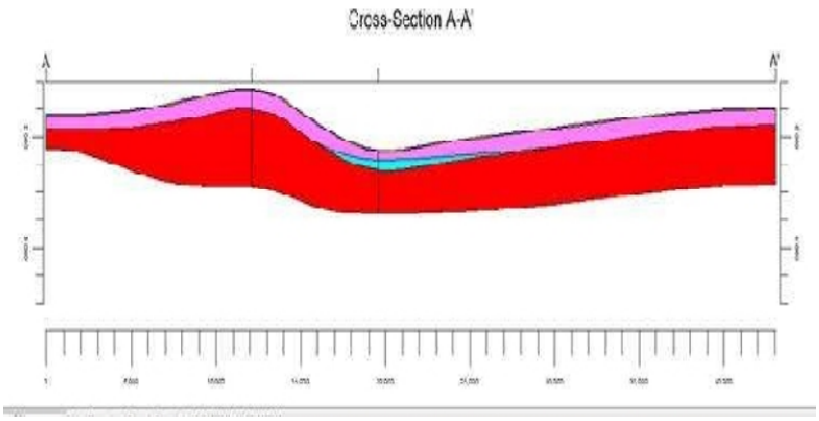


Fig 2.3: Aquifer disposition, Cross – section along NW-SE

nce - Rockworks output;

(B) Aquifer & Fracture occurre

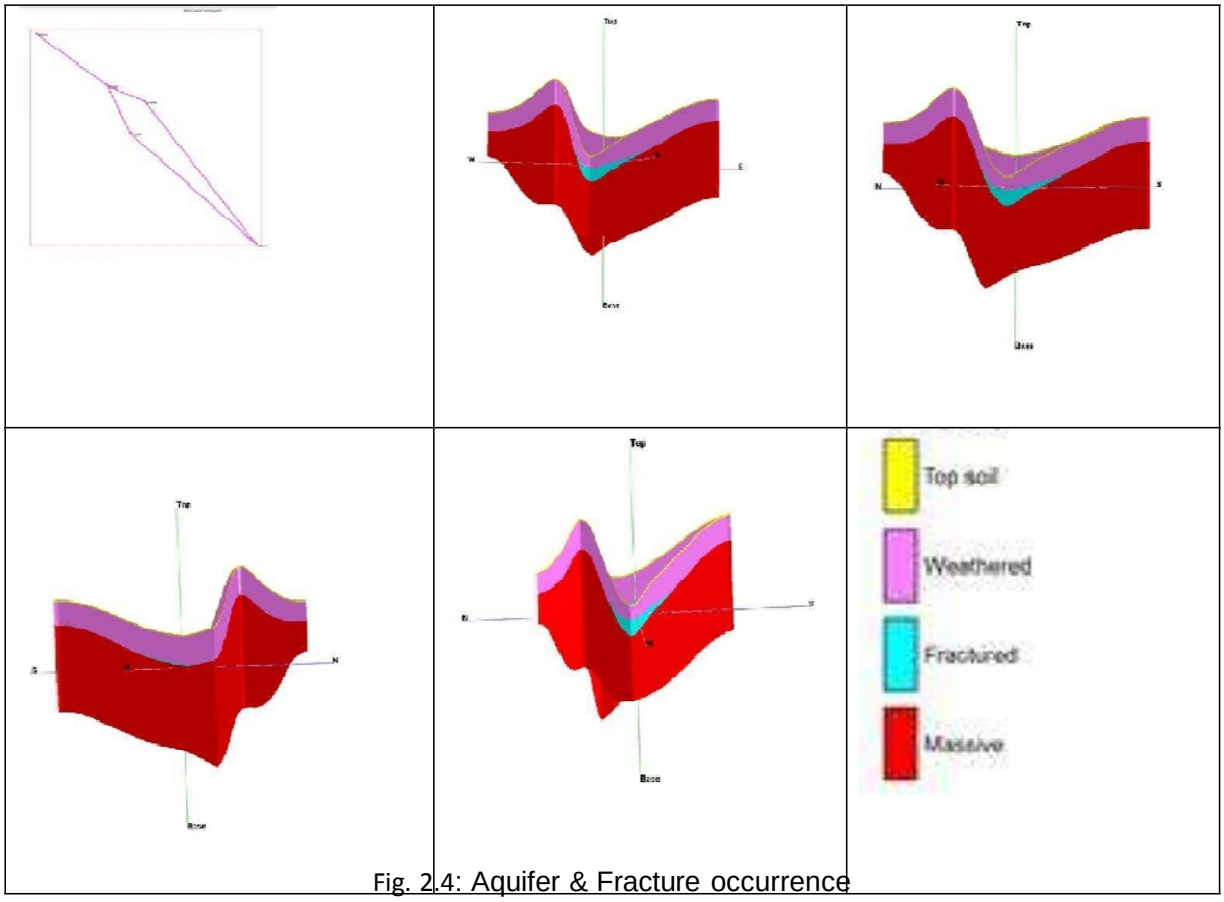


Fig. 2.4: Aquifer & Fracture occurrence

(C) Fracture disposition

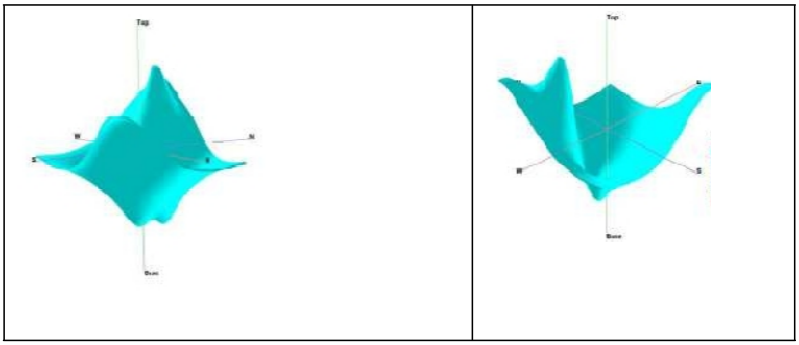


Fig 2.5: Fracture disposition

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

3.1 Aquifer wise resource availability and extraction

(a) Dynamic Ground Water Resource (2011)

Table 3.1: Dynamic Ground Water Resource (2011)

Taluk	Net annual GW availability, (ham)	Total draft for all uses, (ham)	Stage of GW development, %	Category
Gudibanda	2394	3944	165	**Over Exploited**

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

Table 3.2 Present total Ground Water Resource (in ham).

Taluk	Annual replenishable GW resources (in ham)	Fresh In-storage GW resources (in ham)		Total availability of GW resource (in ham)
		Phreatic	Fractured	Dynamic + phreatic in-storage + fractured in-storage
Gudibanda	2394	0	1338	3732

(c) Present ground water availability and draft scenario (2011) in Gudibanda taluk of Chikballapur district and expected improvement in Stage of Ground Water Development in future.

Table 3.3: Present ground water availability and draft scenario (2011)

TALUK	GW Availability (in ham)	GW DRAFT (in ham)	Net Balance	Stage of GW Development (%)	Expected Additional Recharge from non committed monsoon runoff available (in ham)	Expected Increase in GW Availability (in ham)	Expected Reduction in Stage of GW Development (%)	Expected Difference in Stage of GW Development (%)
Gudibanda	2394	3944	-1550	165	174	3022	131	**34**

(d) Comparison of ground water availability and draft scenario in Gudibanda taluk

Table 3.4: Comparison of ground water availability and draft scenario (2011)

Taluk	GW availability (in ham)	GW draft (in ham)	Net Balance	Stage of GW development	GW availability (in ham)	GW draft (in ham)	Net Balance	Stage of GW development	GW availability (in ham)	GW draft (in ham)	Net Balance	Stage of GW development
	2004				**2009**				**2011**			
Gudibanda	1228	2374	-1146	**193**	2375	3803	- 1428	**160**	2394	3944	- 1550	**165**

3.2 Chemical quality of ground water and contamination

During Aquifer Mapping Studies in Gudibanda taluk, 10 key wells were established for Aquifer II which were all bore wells. In order to study the chemical quality of ground water one acidified and one normal representative water samples were collected from each of the key wells during pre-monsoon and were analyzed at Chemical Laboratory, C.G.W.B, S.W.R, Bangalore. Interpretation of Chemical Analysis results are mentioned as under:

Electrical conductivity

Aquifer- II - Out of 10 samples collected from bore wells representing Aq – II only, no sample indicates EC greater than the permissible limit of 2000 m/mhos/cm. Fig 3.1 illustrates electrical

conductivity of water samples representing Aq- II, which indicates ground water in larger extent has EC value within the permissible limit. EC values of Aq- II ranges between 310 to 1990 m/mhos/cm at 25^{O}C.

Fluoride: Fluoride concentration in ground water is of geogenic origin in areas underlain by younger granites/ gneisses containing minerals like Fluorspar & fluroapatite

Aquifer – II - Out of 10 samples collected from bore wells representing Aq – II, 4 samples indicate fluoride greater than the permissible limit of 1.5 mg/l, which constitutes 40% of the samples collected. Fig 3.2 illustrates fluoride concentration and its spatial occurrence in water samples representing Aq- II. Ground water in western and south eastern parts of taluk has fluoride more than the permissible limit. Fluoride ranges between 0.69 to 1.8 mg/l (Somenahalli).

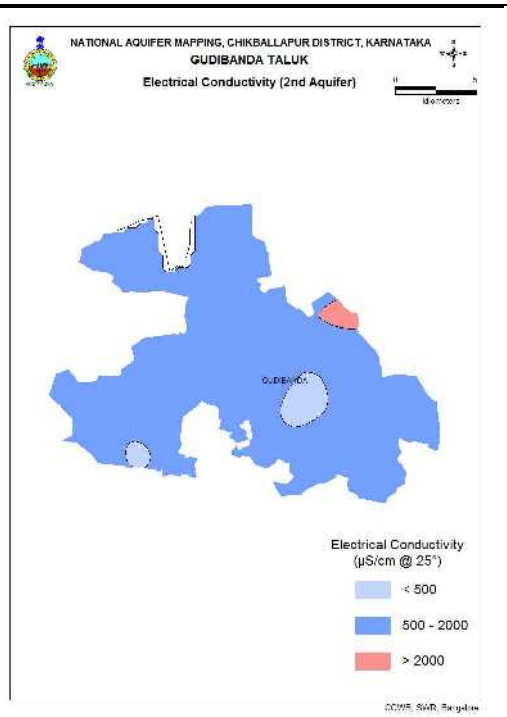


Fig 3.1: Electrical Conductivity Aq-II

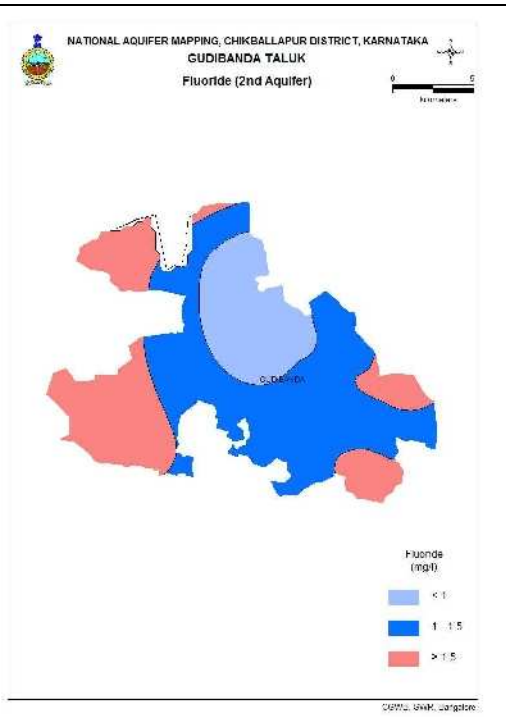


Fig 3.2: Fluoride distribution Aq-II

Nitrate: Aquifer II: Out of 10 samples collected from bore wells representing Aq – II, 4 samples indicate nitrate greater than the permissible limit of 45 mg/l, which constitutes 40% of the samples collected. Fig 3.3 illustrates nitrate concentration and its spatial occurrence in water samples representing Aq- II. Ground water in central and eastern parts of the taluk have nitrate greater than the permissible limit. Nitrate ranges between 8 to 106 mg/l

(Chanduru village). Nitrate contamination is due to extensive use of fertilizers, hence is anthropogenic in origin.

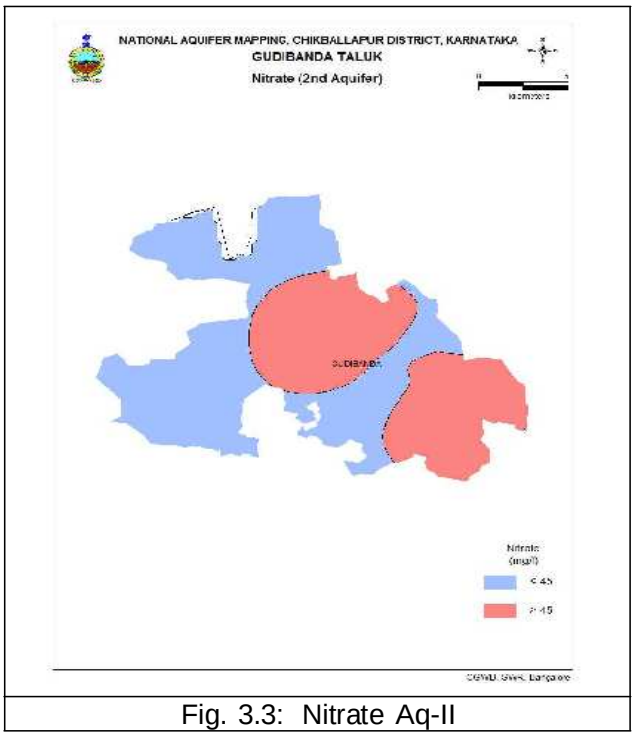


Fig. 3.3: Nitrate Aq-II

Arsenic: Arsenic concentration in water samples is much less than the permissible limit of 0.05mg/l.

Magnesium: Magnesium concentration in 6 water samples was found to be greater than the permissible limit of 30 mg/l, which constitutes 60% of samples.

In general, ground water quality in Gudibanda taluk is good for drinking purpose except in some areas as depicted in above illustrated maps, where nitrate, fluoride and magnesium are found to be greater than the permissible limit 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

4.1 Aquifer wise space available for recharge and proposed interventions

Quantity of water available through non-committed surface runoff:

Table 4.1: water available through non-committed surface runoff

Artificial Recharge Structures Proposed	Gudibanda Taluk
Non committed monsoon runoff available (Ham)	290
Number of Check Dams	18
Number of Percolation Tanks	1
Number of Point Recharge structures	2
Tentative total cost of the project (Rs. in lakhs)	69.72
Excepted recharge (MCM)	1.74
Expected rise in water level (m)	0.4
Cost Benefit Ratio (Rupees/ cu.m. of water harvested)	3.99

The area feasible for artificial recharge of ground water in Gudibanda taluk is shown in fig 4.1.

4.2 Improvement in GW availability due to Recharge, Gudibanda taluk (Ham).

Table 4.2: Improvement in GW availability due to Recharge

Taluk	GW availability	Stage of GW dev %	Expected Additional Recharge from non committed monsoon runoff	Expected Increase in GW Availability	Expected Stage of GW Development after recharge (%)
Gudibanda	2394	165	174	3022	131

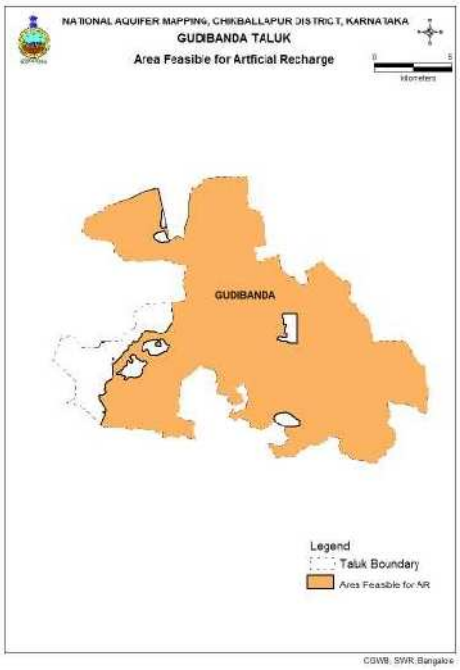


Fig 4.1: Area feasible for Artificial recharge in Gudibanda taluk

5. DEMAND SIDE INTERVENTIONS

5.1 Advanced irrigation practices

It is observed that bore well is the prevalent source for irrigation in the taluk. Thus, by adopting the below mentioned techniques will contribute in ground water resource enhancement in the long run.

Efficient irrigation practices like Drip irrigation & sprinkler needs to be adopted by the farmers in the existing 2531 ha of gross irrigated area.

Efficient irrigation techniques will contribute in saving ground water and thus will reduce the irrigation draft.

5.2 Change in cropping pattern

Not necessary as due to water scarcity, water intensive crops are not grown in the taluk. Cereals, fruits, vegetables, pulses and oil seeds constitute major crops of the taluk.

Alternate water sources

Inter-basin transfer from west-flowing river Yettinahole project is considered for Gudibanda taluk also.

5.3 Regulation and Control

Gudibanda taluk has been categorized as **OVER EXPLOITED**, since the Stage of ground water development has reached **165%** (GE March 2011).

Ground water recharge component needs to be made mandatory in State Govt. Project related to further development of ground water, viz; Irrigation Projects or Public Water Supply Projects.

5.4 Other interventions proposed

Recharge already dry **phreatic aquifer (Aq-I)** in the taluk, through construction of artificial recharge structures, viz; sub-surface dams, check dams, step bunds & percolation tanks. 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.

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

Recharge Plan.

Excess nitrate, fluoride and magnesium concentration is found in ground water samples from Aq-II, as shown in the Figures given above & requires remedial measures viz.

- Dilution of nitrate rich ground water through artificial recharge & water conservation.
- Roof top rain water harvesting.
- Micro irrigation.