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

Jagalur Taluk, Davanangere District, Karnataka

दक्षिण पश्चिमी क्षेत्र, बैंगलोर

South Western Region,Bengaluru

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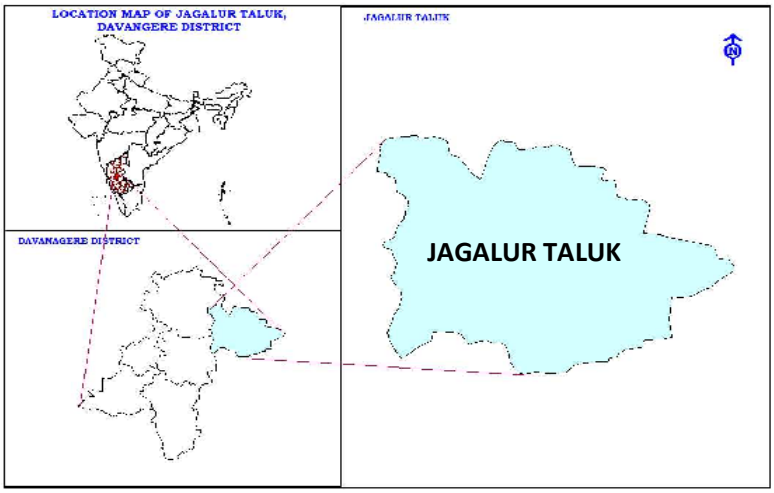
Government of India
Ministry of Water Resources, River Development & Ganga Rejuvenation
Central Ground Water Board

JAGALUR TALUK AQUIFER MAPS AND MANAGEMENT PLAN DAVANAGERE DISTRICT, KARNATAKA STATE



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March 2017

JAGALUR TALUK AQUIFER MAPS AND MANAGEMENT PLANS,
DAVANAGERE DISTRICT, KARNATAKA STATE

CONTENTS

JAGALUR TALUK AQUIFER MAPS AND MANAGEMENT PLAN, DAVANAGERE DISTRICT, KARNATAKA STATE

1. SALIENT INFORMATION

Name of the taluk: **JAGALUR**

District: Davanagere

State: Karnataka

Area: 978 sq.km.

Population: 1, 71,822

Annual Normal Rainfall: 546 mm

1.1 Aquifer management study area

Aquifer mapping studies was carried out in Jagalur taluk, Davanagere district of Karnataka, covering an area of 978 sq.kms under National Aquifer Mapping Project. Jagalur taluk of Davanagere district is located between north latitude $14^0$24'18.5" and $14^0$42'16.0" & east longitude $76^0$06'34.7" and $76^0$32'02.2", and is covered in parts of Survey of India Toposheet Nos. 57B/2, 57B/3, 57B/6, 57B/7 and 57B/10. Jagalur taluk is bounded by Kudligi taluk on north, Chitradurga taluk on south, Challakere taluk on east and Harpanahalli taluk on western side. Location map of Jagalur taluk of Davanagere district is presented in Figure-1.

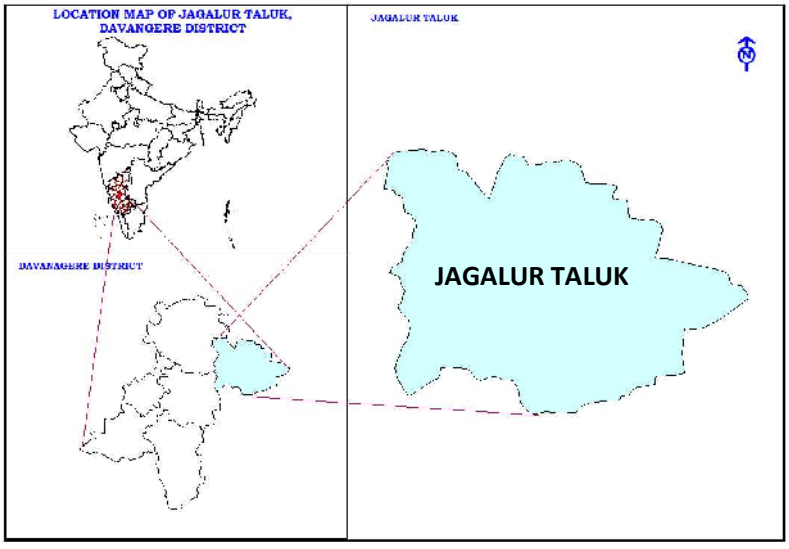

Fig 1: Location Map of Jagalur taluk, Davanagere district

Taluk administration of Jagalur taluk is divided into 3 Hoblies and Jagalur is only one town, which is also the taluk head quarter. There are 135 inhabited and 36 uninhabited villages in Jagalur taluk.

1.2 Population

According to 2011 census, the population in Jagalur taluk is 171822, in which 154565 constitute the rural population and 17257 is the urban population, which works out to 90% (rural) and 10% (urban) of the total population of taluk. The study area has an overall population density of 176 persons per sq.km. The decadal variation in population from 2001-2011 is 8.14 % in Jagalur taluk.

1.3 Rainfall

Jagalur 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 normal annual rainfall in Jagalur taluk for the period 1981 to 2010 is 546 mm. Seasonal rainfall pattern indicates that, major amount of (298 mm) rainfall was recorded during South-West Monsoon seasons, which contributes about 54% of the annual normal rainfall, followed by North-East Monsoon season (147 mm) constituting 27% and remaining (102 mm) 19% in Pre-Monsoon season (Table-1).

On Computations were carried out for the 30 year blocks of 1981- 2010, the mean monthly rainfall at Jagalur taluk is ranging between 1mm during January to 106 mm during October. The coefficient of variation percent for pre-monsoon, monsoon and post monsoon season is 66, 32 & 56 percent respectively. Annual CV at this station works out to be 29 percent (Table-1).

Table 1: Statistical Analysis of Rainfall Data of Jagalur Station, (1981 to 2010)

STATION		JAN	FEB	MAR	APR	MAY	PRE	JUN	JUL	AUG	SEP	SW	OCT	NOV	DEC	NE	Annual
JAGALUR	NRM	1	5	6	25	66	102	65	61	76	96	298	106	34	7	147	546
	STDEV	3	13	14	26	59	67	44	41	38	56	94	69	47	14	83	156
	CV%	369	290	251	105	90	66	67	67	50	58	32	65	137	204	56	29

1.4 Agriculture & Irrigation

Agriculture is the main occupation in Jagalur taluk. Major Kharif crops are maize, ragi, tur and vegetables. Main crops of Rabi season are ragi, maize, horse gram, groundnut, and sunflower (Table-2). Water intensive crops like sugarcane and paddy are not grown. Maize is grown in 43% and oil seeds in 19.5% of total crop area of taluk. Cotton accounts 15% of total crop area.

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

Year	Paddy	Maize	Ragi	Jowar	Pulses	Fruits	Vegetables	Oil seeds	Sugarcane	Cotton
	Area under cultivation (Ha)									
2014-2015	1	25306	3483	1219	2391	875	4393	11363	23	8904

It is observed that net sown area accounts 58% and area sown more than once is 5% of total geographical area in Jagalur taluk (Table-3). 100% of net area irrigated is only from bore wells (Table-4).

Table 3: Details of land use in Jagalur 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
Jagalur	95527	12688	5677	9673	55580	4976

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

Table 4: Irrigation details in Jagalur taluk (Ha)

Source of Irrigation	Net area irrigated (Ha.)	% of area
Canals	0	0
Tanks	0	0
Wells	0	0
Bore wells	13264	100%
Lift Irrigation	0	0
Other Sources	0	0
Total	**13264**	

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

1.5 Geomorphology, Physiography & Drainage

The geomorphology of the district is characterized by vast stretches of undulated plains interspersed with sporadic ranges or isolated clusters of low ranges of rocky hills (Fig.-2). Jagalur taluk falls in the eastern hilly region. The Jagalur taluk, Davangere district falls under Krishna River basin. The important rivers of the district are Tungabhadra and its tributary, Chikka Hagari. The drainage network is influenced by South West monsoon (Fig.-3).

1.6 Soil

Major part of the taluk is covered by red sandy soil and followed by black soil. The Red Sandy soil comprises of red loams, red sandy, sandy loams and medium black soils.

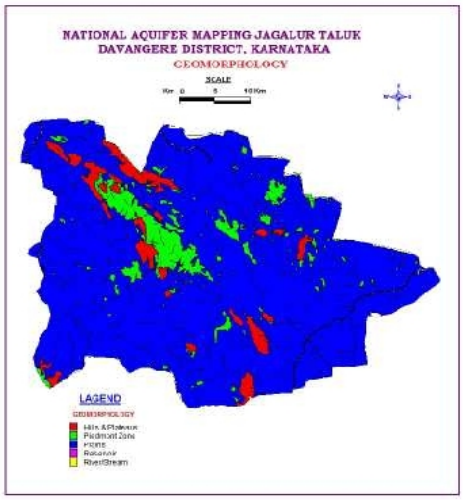

Fig 2: Geomorphology Map

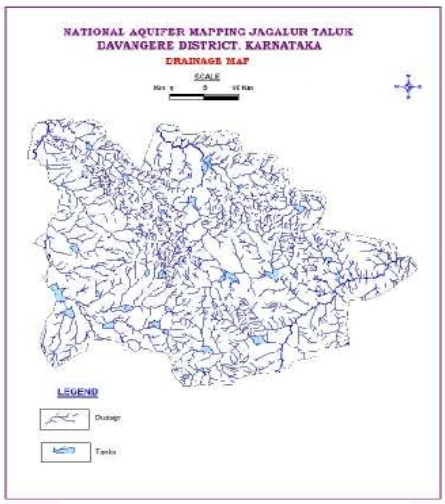

Fig 3: Drainage Map

1.7 Ground water resource availability and extraction

Aquifer wise total ground water resources up to 200 m depth are 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 200m)	Dynamic +phreatic in-storage + fractured
Jagalur	8701	22388	2512	33602

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

- Net ground water availability for future irrigation development : 4.24 MCM
- Domestic (Industrial sector) demand for next 25 years : 7.91 MCM

1.9 Water level behavior

(a) Depth to water level

Aquifer - I

- Pre-monsoon: 2.0 – 10.0 mbgl (Fig.-4)
- Post-monsoon: 2.0 – 10.0 mbgl (Fig.-5)

Aquifer - II

- Pre-monsoon: 5.0 – 40.0 mbgl (Fig.-6)
- Post-monsoon: 10.0 – 40.0 mbgl (Fig.-7)

(b) Water level fluctuation

Aquifer-I (Fig.-8)

- Seasonal Fluctuation: Rise ranges upto 2.0 m;
  Fall ranges upto 2.0 m

Aquifer-II (Fig.-9)

- Seasonal Fluctuation: Rise shows upto 4.0 m;

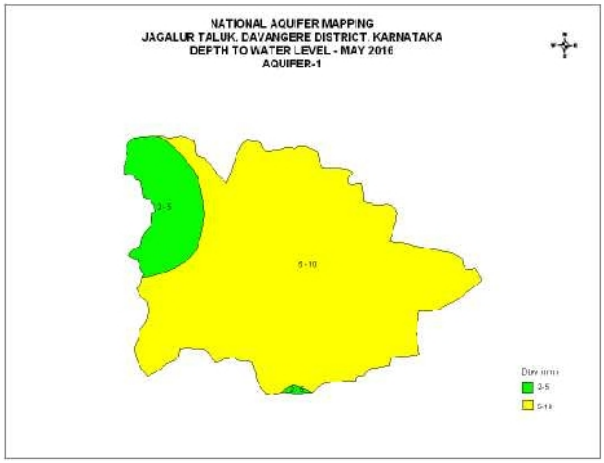

Fig 4: Pre-monsoon Depth to Water Level (Aq-I)

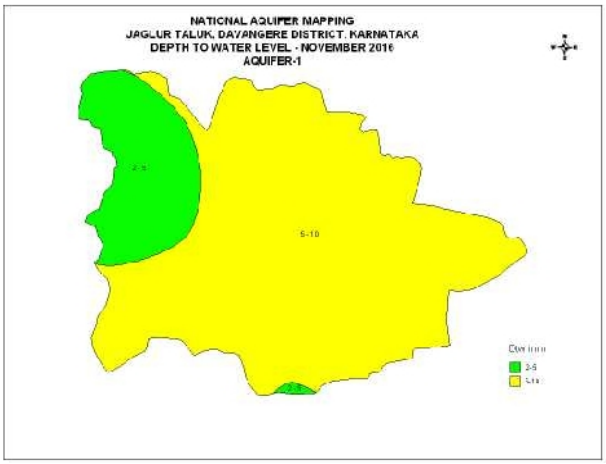

Fig 5: Post-monsoon Depth to Water Level (Aq-I)

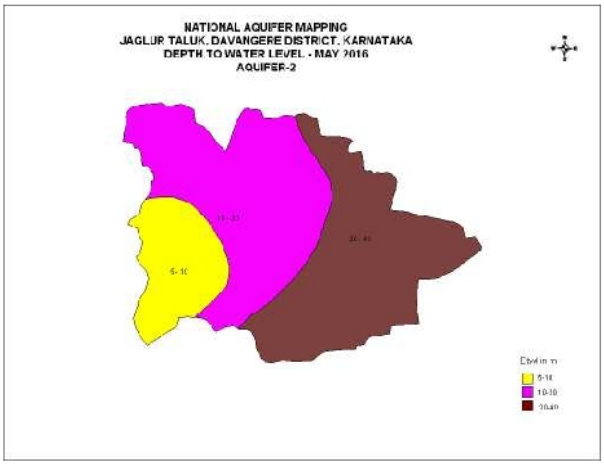

Fig 6: Pre-monsoon Depth to Water Level (Aq-II)

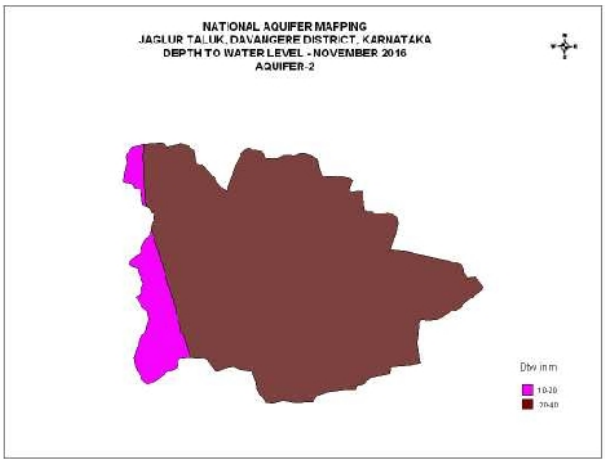

Fig 7: Post-monsoon Depth to Water Level (Aq-**II)**

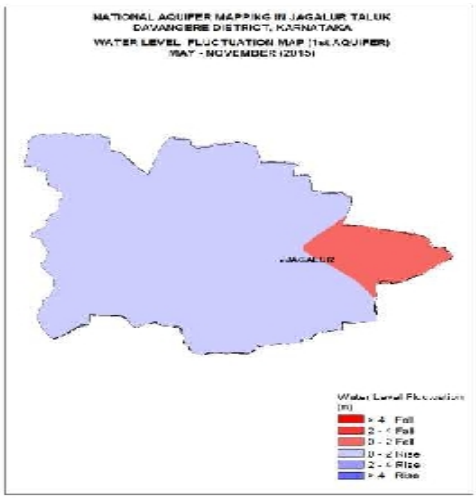

Fig 8: Water Level Fluctuation (Aq-I)

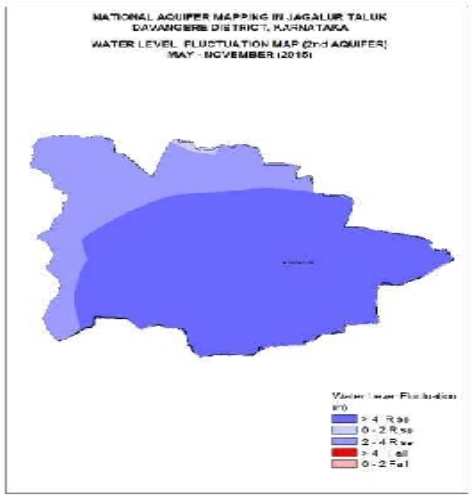

Fig 9: Water Level Fluctuation (Aq-II)

2. AQUIFER DISPOSITION

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

i. **Aquifer-I (Phreatic aquifer)** comprising Weathered Granite Gneiss / Schist
ii. **Aquifer-II (Fractured aquifer)** comprising Fractured Granite Gneiss / Schist

In Jagalur taluk, granitic-gneisses and schists are the main water bearing formations (Figure-10). Ground water occurs within the weathered and fractured granitic-gneisses and schist under water table condition and semi-confined condition. In Jagalur taluk bore wells were drilled from a minimum depth of 132 mbgl to a maximum of 200 mbgl (Table-6). Depth of weathered zone (Aquifer-I) ranges from 5.7 mbgl to 36.74 mbgl (Figure-11). Ground water exploration reveals that aquifer-II fractured formation was encountered between the depth of 30 to 200 mbgl. Yield ranges from 0.21 to 18.56 lps. The basic characteristics of each aquifer are summarized in Table-7.

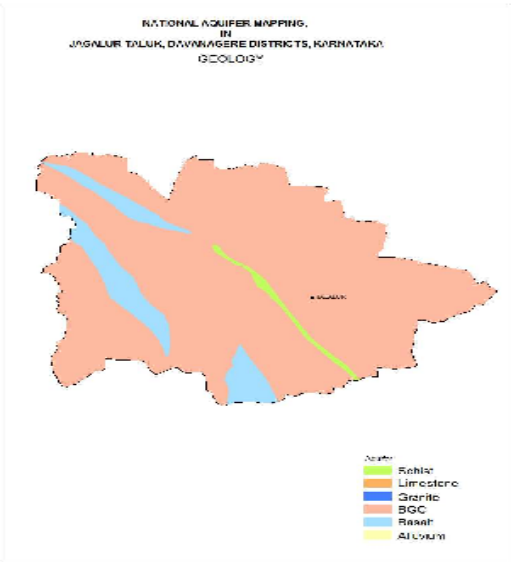

Fig 10: Geology Map

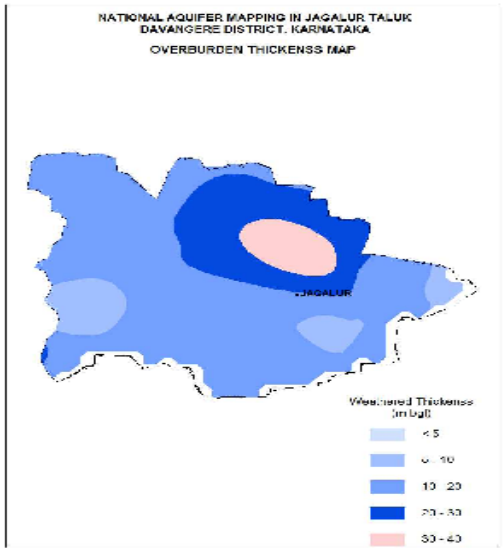

Fig 11: Weathered thickness map (Aq-I disposition)

Table 6: Details of Ground water Exploration

S.No	Location	Latitude	Longitude	Depth Drilled (mbgl)	Casing Depth (m)	Fracture Zones (mbgl)	SWL (mbgl)	Q (lps)	DD (m)	T (m2/ day)
1	Suraddihalli	14°30'40"	76°13'40"	200	11.95					
2	Shettygondanahalli	14°30'20"	76°14'40"	200	11.85	121.30,175,190	40.87	0.21	55.13	
3	Malammanahalli	14°30'30"	76°14'0"	200	24.3	146	21.95	0.21	72.77	
4	Uddaboranahalli	14°41'30"	76°7'30"	200	11.7	110		0.21		
5	Chadargola	14°28'40"	76°11'30"	200	11.72	99.00, 136.00,192.00	42.44	0.96	56.8	
6	Hosakere	14°36'44"	76°17'49"	200	29.25		17.92	1.2	6.5	-
7	Bangaralanagudda	14°31'46"	76°25'16"	200	19		9.82	1.69	12.74	-
8	Chikkaujani	14°42'5"	76°19'45"	200	18		3.3	1.83	19.04	26.3
9	Magadi	14°40'20"	76°10'20"	200	11.7	30.00, 190.00	23	2.44	5.27	
10	Belichodu	14°29'50"	76°9'50"	183.2	5.74	108.00,182.00	41.48	2.84		
11	Bennehalli	14°28'40"	76°24'20"	200	5.7	72.00, 137.00.	22.65	3.28	51	
12	Kunchur	14°41'60"	75°40'30"	200.05	24		22.92	3.34	-	-
13	Gurusiddapura	14°39'40"	76°11'40"	200	11.85	39.26, 106.40, 190.00	19.3	4.27	21.72	
14	Anabur	14°35'60"	76°24'30"	200	22.1	30.00, 140.00, 200.00	5.57	4.27	9.23	
15	Hiremallanahole	14°31'20"	76°27'10"	200	11.62	22.43, 126.25, 198.00	17.93	4.27	38	
16	Kalledevarapura	14°26'30"	76°24'20"	200	14.13	50.38, 160.00	41.54	4.27	41.72	
17	Kunchur	14°41'60"	75°40'30"	200.1	24.5		23.7	4.39	-	7.73
18	Pallaghatta-Tarehalli	14°35'10"	76°13'40"	187.78	14.77	58.54, 68.70, 73.28, 187.78.	39.45	5.42	2.65	
19	Betegaranahalli	14°35'20"	76°23'10"	132.82	36.74	28.00, 102.00.	8.81	11.76	17.59	
20	Kanchikere	14°36'50"	75°40'0"	192.36	5.55	41, 59, 141	23.47	11.76	15.04	
21	Minagaranahalli	14°31'30"	76°13'30"	178.62	11.9	36.00, 85.00, 121.00, 177.00	34.72	18.56	14.23	

Table 7: Basic characteristics of each aquifer

Aquifers	Weathered Zone (Aq.-I)	Fractured Zone (Aq.-II)
Prominent Lithology	Weathered Gneiss / Schist	Fractured / Jointed Gneiss / Schist
Thickness range (mbgl)	20	Fractures upto 200 mbgl
Depth range of occurrence of fractures (mbgl)	-	22 - 200 80% between 50 - 200
Range of yield potential (lps)	Poor yield	1 - 5
Specific Yield	2%	0.2%
T (m^2/day)	-	7.7 – 26.3
Quality Suitability for Irrigation	Suitable	Suitable
Suitability for Domestic purposes	Suitable	Suitable
Remarks	Over exploited	Ground water potential fractures, 1 to 3 sets likely up to the depth of 200 m bgl.

2.2 3 D aquifer disposition and Cross-Sections

(A) Aquifer disposition – Rockworks output (Fig.-12 & Fig.-13)

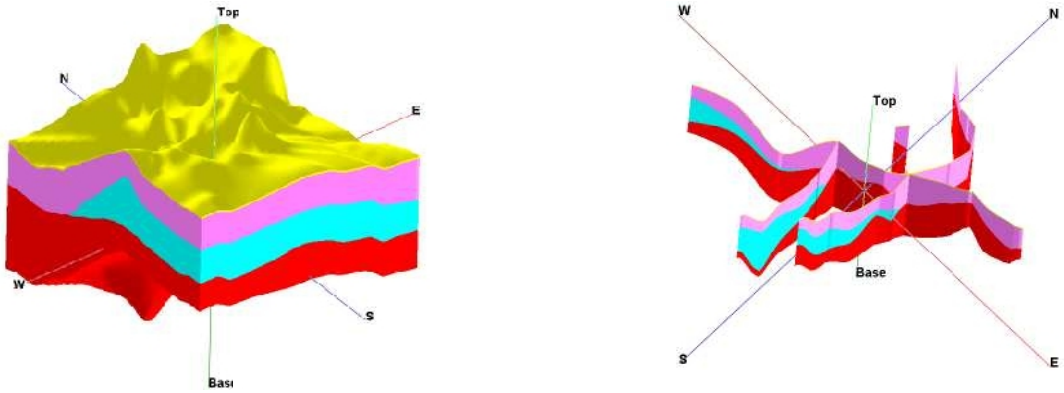

Fig 12: 3D aquifer Disposition and Fence Diagram

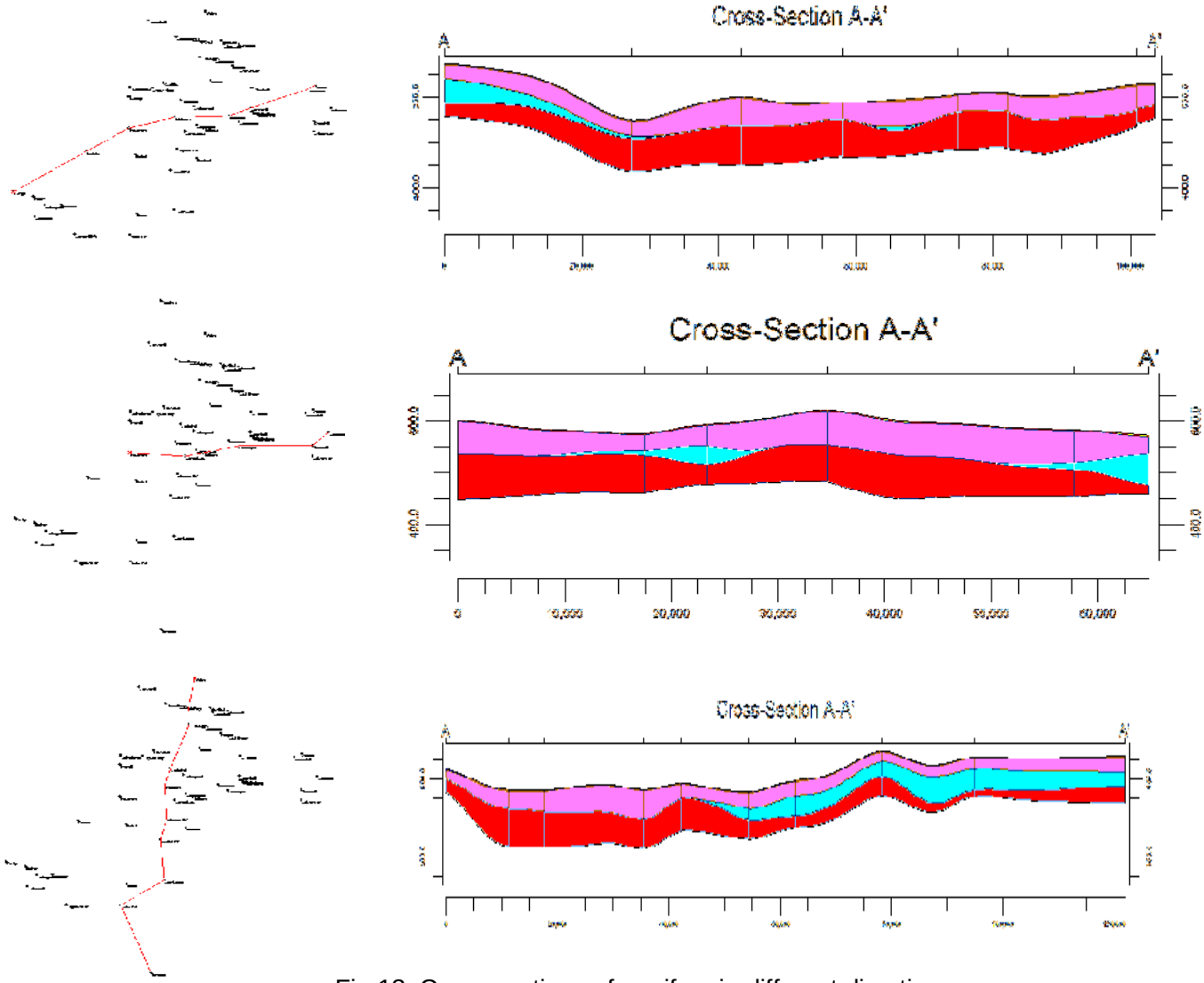

Fig 13: Cross sections of aquifers in different directions

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	EXISTING GROSS GROUND WATER DRAFT FOR IRRIGATION	EXISTING GROSS GROUND WATER DRAFT FOR DOMESTIC AND INDUSTRIAL WATER SUPPLY	EXISTING GROSS GROUND WATER DRAFT FOR ALL USES	ALLOCATION FOR DOMESTIC AND INDUSTRIAL USE FOR NEXT 25 YEARS	NET GROUND WATER AVAILABILITY FOR FUTURE IRRIGATION DEVELOPMENT	EXISTING STAGE OF GROUND WATER DEVELOPMENT	Category
Jagalur	8701	8855	663	9517	791	424	109	OE

(b) 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
Jagalur	8701	22388	2512	33602

(c) Comparison of ground water availability and draft scenario in Jagalur 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
	2009			**2011**			**2013**		
Jagalur	8221	8741	106	8287	9175	111	8701	9517	109

B. Chemical quality of ground water and contamination

Interpretation from Chemical Analysis results in Jagalur taluk is mentioned as under:

Electrical Conductivity: In general, EC values are within the permissible limit in both the aquifers (Figure-14).

Fluoride: Fluoride concentration in ground water is of geogenic origin in areas underlain by younger granites/ gneisses containing minerals like Flurospar & fluroapatite F values are also within the permissible limit of 1.5 mg/l.

Nitrate: In general, Nitrate value is within the permissible limit of 45 mg/l. Nitrate contamination is due to extensive use of fertilizers, hence is anthropogenic in origin.

In general ground water quality in Jagalur taluk is good for drinking purpose except in some areas as depicted in above illustrated maps, where nitrate & fluoride is 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

a. Aquifer wise space available for recharge and proposed interventions

Dry **phreatic aquifer (Aq-I)** in the taluk, can be recharged 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. Tentative location of proposed artificial recharge structures is shown in Figure-15.

Table 8: Quantity of non-committed surface runoff & expected recharge through AR structures

Artificial Recharge Structures Proposed	Jagalur taluk
Non committed monsoon runoff available (Ham)	570
Number of Check Dams	35
Number of Percolation Tanks	2
Number of Point Recharge structures	4
Tentative total cost of the project (Rs. in lakhs)	138.14
Excepted recharge (MCM)	3.25
Expected rise in water level (m)	0.17
Cost Benefit Ratio (Rupees/ cu.m. of water harvested)	4.26

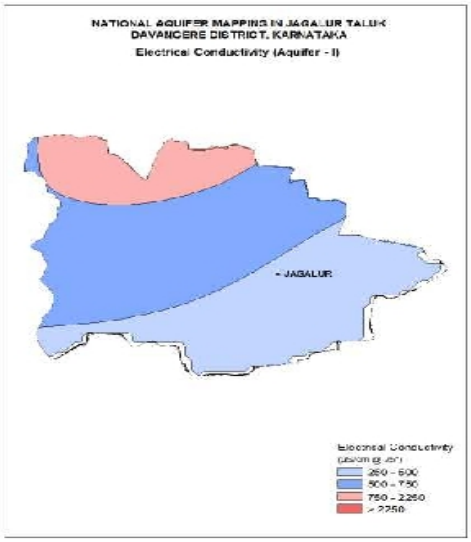

Fig 14: Electrical Conductivity Map

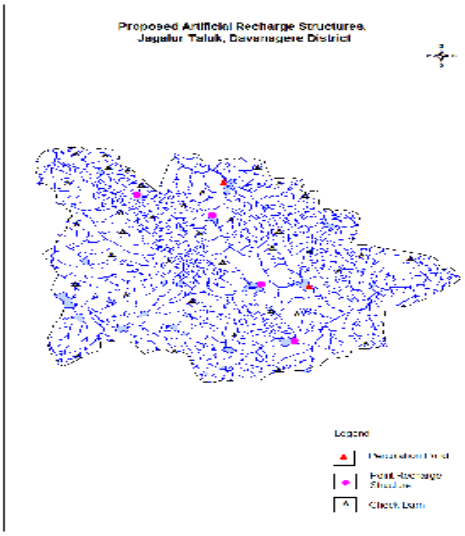

Fig 15: Tentative Location of Proposed AR Structures Map

b. Improvement in GW availability due to Recharge, Jagalur 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 interbasin 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		%
Jagalur	8701	9517	109	325	5886	14912	64	45

c. Alternate water sources

- **Proposed GW Recharge and Assured Supply of Drinking Water Schemes (Inter basin Transfer):** Inter-basin transfer from Tunga Basin under Project-2 service canal is proposed in the "Integrated Irrigation Development Schemes" by Shri.G.S.Paramashivaiah, Retd. CE, Irrigation Department and submitted to the Govt. of Karnataka.

- Under this project, it is proposed to fill Minor Irrigation tanks with 79 TMC of water to 19 taluks of Bellary, Davanagere, Tumkur and Kolar districts. 50% recharge is considered from the surface water proposed to fill the tanks for irrigation, which includes recharge from tanks, canal seepage and return flow from irrigation.
- For Jagalur taluk, it is calculated that about 5886 Ham can be considered as recharge from above project, if commenced.
- After implementation of Artificial Recharge structures and proposal of GW recharge scheme (inter-basin transfer), the annual ground water availability will increase from 8701 to 14912 ham and the expected improvement in stage of development is 45% from 106% to 64%

5. DEMAND SIDE INTERVENTIONS

a. Advanced irrigation practices

It is observed that bore wells are only the 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 17534 ha of gross irrigated area by bore wells.
- Irrigation draft is 9517 ham.
- Efficient irrigation techniques will contribute in saving ground water by 2657 ham and thus will improve stage of development by 10% from 64% to 54% (Table-9).

b. Change in cropping pattern

Water intensive crops like paddy & sugarcane are not grown in the Jagalur taluk. Hence, change in cropping pattern has not been suggested.

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		%
Jagalur	14912	9517	64	2657	17569	54	10

c. Water Logging and additional area of irrigation

Area prone for water logging falls between 2-5 m premonsoon water level contour is estimated (Table-.10). In these areas, quantum of withdrawal of ground water is calculated considering specific yield of 2% and water column to be reduced to 5 mbgl. The volume of ground water withdrawn in Jagalur taluk is 179 ham (0.0.063 TMC). Additional area of crop can be irrigated using 75% of irrigation efficiency is calculated on the basis of recommendation of Agriculture University, Bangalore. Accordingly, since maize is grown in 43% of total crop area of taluk, it is suggested that additional area of 268 ha can be irrigated for Maize or 447 ha for Jowar crops (Table-.10).

Table 10: Withdrawal of Ground Water and Increase in area of Irrigation in Jagalur Taluk

Water Level Range (mbgl)	Water Level to be reduced to (mbgl)	Water Column (m)	Area (Ha)	Specific Yield	Volume of Ground Water to be withdrawn		Area of crop can be irrigated using 75% of Irrigation Efficiency (Ha)	
					(Ham)	(TMC)	Maize	Jowar
0 - 2	5	4	0	0.02	0	0	0	0
2 - 5	5	3	2977	0.02	179	0.063	268	447
Total					**179**	**0.063**	**268**	**447**

d. Regulation and Control

- Jagalur taluk has been categorized as **Overexploited**, since the Stage of ground water development has reached **109%** (GE March 2013). Hence, stringent action

has to be taken up through Karnataka Ground Water Authority to control further ground water exploitation in the taluk**.**

- Ground water recharge component needs to be made mandatory in the non-command area of the taluk for further development of ground water.

e. 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.
    - Micro irrigation.