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

Davanagere Taluk, Davanagere District, Karnataka

दक्षिण पश्चिमी क्षेत्र, बैंगलोर

South Western Region,Bengaluru

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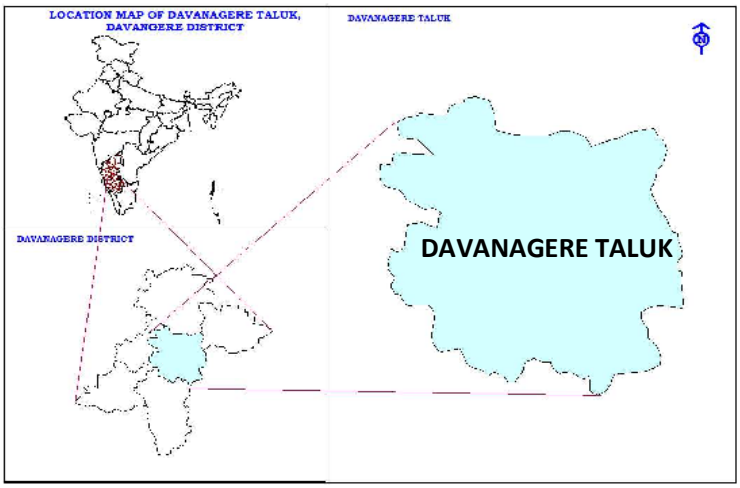
Government of India
Ministry of Water Resources, River Development & Ganga Rejuvenation
Central Ground Water Board

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



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

CONTENTS

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

1. SALIENT INFORMATION

Name of the taluk : **DAVANAGERE**

District : Davanagere

State : Karnataka

Area : 971 sq.km.

Population : 6,81,979

Annual Normal Rainfall: 626 mm

1.1 Aquifer management study area

Aquifer mapping studies was carried out in **Davanagere taluk**, Davanagere district of Karnataka, covering an area of **971 sq.kms** under **National Aquifer Mapping Project**. Davanagere taluk of Davanagere district is located between north latitude $14^0$13'11.0" and $14^0$33'52.3" & east longitude $75^0$48'53.9" and $76^0$09'28.3", and is covered in parts of Survey of India Toposheet Nos. 48N/14, 48N/15, 48N/16, 57B/2, 57B/3 and 57B/4. Davanagere taluk is bounded by Harapanahalli taluk on north, Channagiri taluk on south, Chitradurga taluk on east and Harihar taluk on western side. Location map of Davanagere taluk of Davanagere district is presented in Figure-1**.**

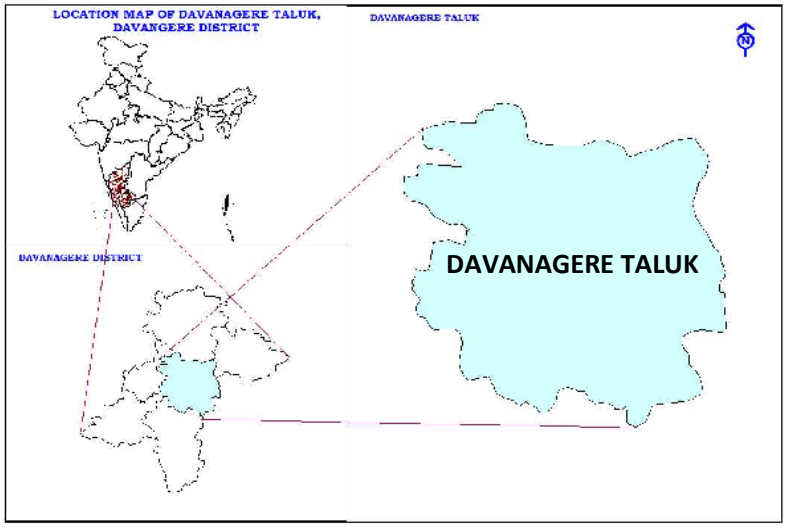

Fig 1: Location Map of Davanagere taluk, Davanagere district

Taluk administration of Davanagere taluk is divided into 3 Hoblies and Davanagere is only one town, which is also the taluk head quarter. There are 154 inhabited and 12 uninhabited villages in Davanagere taluk.

1.2 Population

According to 2011 census, the population in Davanagere taluk is 681979, in which 247008 constitute the rural population and 434971 is the urban population, which works out to 36% (rural) and 64% (urban) of the total population of taluk. The study area has an overall population density of 702 persons per sq.km. The decadal variation in population from 2001-2011 is 13 % in Davanagere taluk.

1.3 Rainfall

Davanagere 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 Davanagere taluk for the period 1981 to 2010 is 626 mm. Seasonal rainfall pattern indicates that, major amount of (387 mm) rainfall was recorded during South-West Monsoon seasons, which contributes about 62% of the annual normal rainfall, followed by North-East Monsoon season (154 mm) constituting 25% and remaining (85 mm) 13% 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 2mm during January to 112 mm during September. The coefficient of variation percent for premonsoon, monsoon and post monsoon season is 76, 34 & 57 percent respectively. Annual CV at this station works out to be 28 percent (Table-1).

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

	JAN	FEB	MAR	APR	MAY	PRE	JUN	JUL	AUG	SEP	SW	OCT	NOV	DEC	NE	Annual
NRM	2	2	8	20	52	85	73	95	107	112	387	102	44	8	154	626
STDEV	8	11	29	19	45	64	43	54	55	67	131	73	62	16	88	175
CV%	409	440	350	93	87	76	58	57	51	59	34	71	142	210	57	28

1.4 Agriculture & Irrigation

Agriculture is the main occupation in Davanagere taluk. Major Kharif crops are paddy, maize, tur and vegetables. Main crops of Rabi season are ragi, maize, horse gram, groundnut, and sunflower (Table-2). Sugarcane is perennial crops grown and paddy accounts 43% of total crop area. Maize grown in 40% of total crop area of taluk.

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

Year	Paddy	Maize	Ragi	Jowar	Pulses	Fruits	Vegetables	Oil seeds	Sugarcane	Cotton
	Area under cultivation (in ha)									
2014-2015	38282	35210	486	328	1218	855	895	191	9346	1246

It is observed that net sown area accounts 76% and area sown more than once is 22% of total geographical area in Davanagere taluk (Table-3). 71% of net area irrigated is from canals and 29% from bore wells (Table-4).

Table 3: Details of land use in Davanagere 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
Davanagere	99410	2362	8576	3027	76016	22095

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

Table 4: Irrigation details in Davanagere taluk (Ha)

Source of Irrigation	Net area irrigated (Ha.)	% of area
Canals	26931	71
Tanks	0	0
Wells	0	0
Bore wells	11241	29%
Lift Irrigation	0	0
Other Sources	0	0
Total	**38172**	

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. Davanagere taluk falls in the plain region. The Davanagere 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.

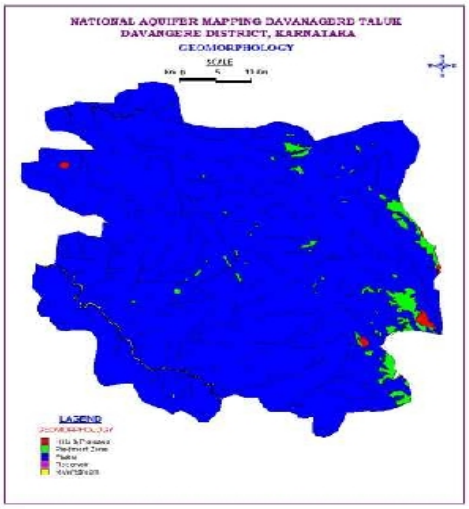

Fig 2: Geomorphology Map

Fig 3: Drainage Map

1.7 Ground water resource availability and extraction

Aquifer wise total ground water resources up to 200 m depth 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 200m)	Dynamic + phreatic in-storage + fractured
Davanagere	8293	17233	1803	27329

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

- Net ground water availability for future irrigation development : 19.24 MCM
- Domestic (Industrial sector) demand for next 25 years : 8.36 MCM

1.9 Water level behavior

(a) Depth to water level

Aquifer - I

A. Pre-monsoon: 0.45 - 7.65 mbgl (Fig.-4)
B. Post-monsoon: 0.3 - 7.18 mbgl (Fig.-5)

Aquifer - II

C. Pre-monsoon: 4.80 mbgl (Fig.-6)
D. Post-monsoon: 2.72 mbgl (Fig.-7)

(b) Water level fluctuation

Aquifer-I (Fig.-8)

E. Seasonal Fluctuation: Rise ranges between 0.10 to 3.20 m;
Fall ranges between 0.05 to 1.58 m

Aquifer-II (Fig.-9)

F. Seasonal Fluctuation: Rise shows 2.08 m;

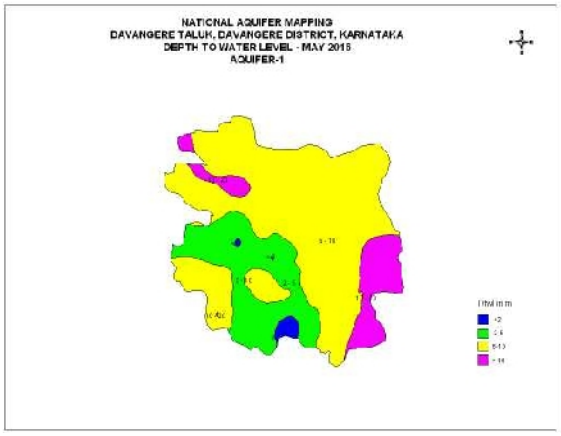

Fig 4: Pre-monsoon Depth to Water Level (Aq-I)

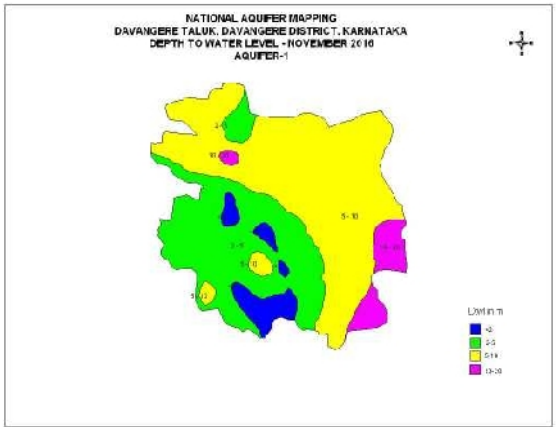

Fig 5: Post-monsoon Depth to Water Level (Aq-I)

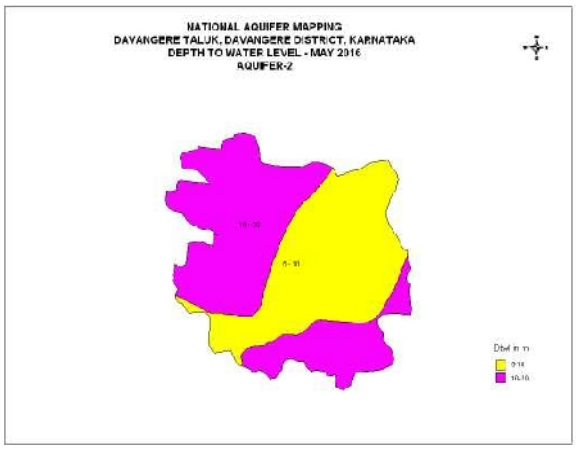

Fig 6: Pre-monsoon Depth to Water Level (Aq-II)

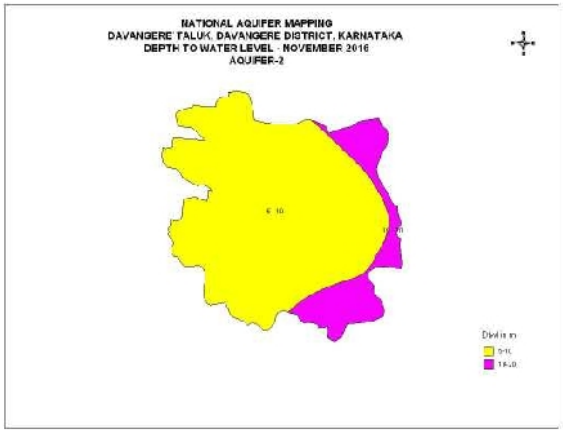

Fig 7: Post-monsoon Depth to Water Level (Aq-II)

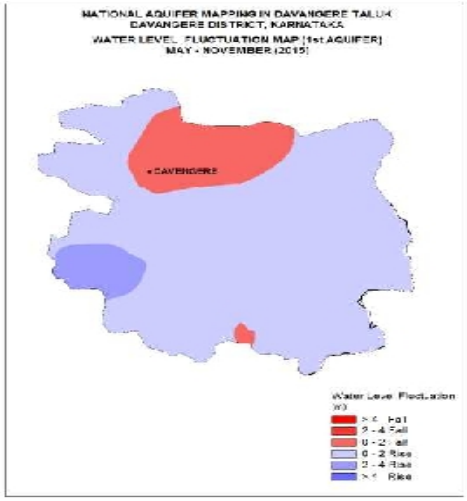

Fig 8: Water Level Fluctuation (Aq-I)

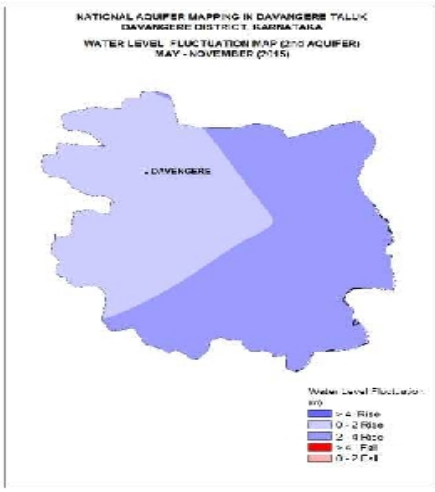

Fig 9: Water Level Fluctuation (Aq-II)

2. AQUIFER DISPOSITION

2.1 Number of aquifers: In Davanagere 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 Davangere taluk, fractured granitic-gneisses, gneisses and hornblende-schist 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 Davangere 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 13.3 mbgl to 30.0 mbgl (Figure-11). Ground water exploration reveals that aquifer-II fractured formation was encountered between the depth of 30 to 200 mbgl. Yeild ranges from 1.5 to 4.0 lps. Transmissivity ranges from 5.27 to 42.16 m^2/day. Specific capacity ranges from 4.54 to 29.6 lpm/m draw down.

The basic characteristics of each aquifer are summarized in Table-7.

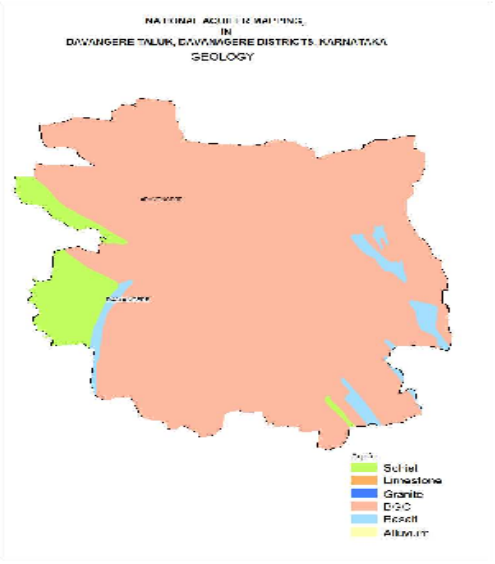

Fig 10: Geology Map

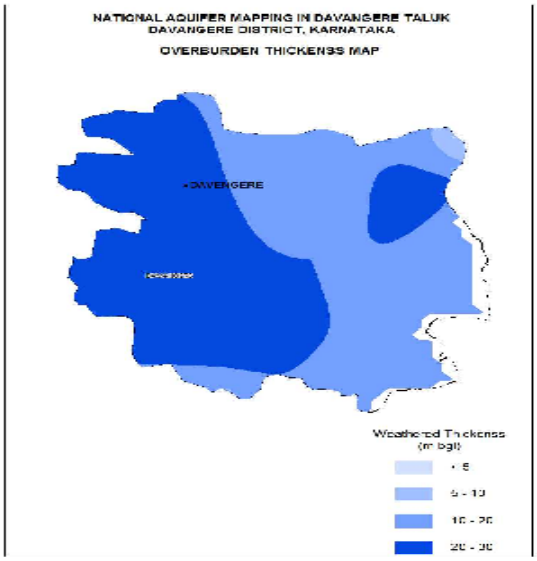

Fig 11: Weathered thickness map (Aq-I disposition)

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	Oll Bullapura	14°22'60''	76°0'50''	200	19.8		38.2	1.5	4.3	5.27
2	Agasanghatta	14°26'34''	76°2'11''	200	13.3	121.30,175, 190	3.3	1.5	16.27	7.18
3	Ramagondanahalli	14°18'35''	75°59'42''	200	17	146	3.85	1.6	21.1	21.08
4	Kundavada	14°27'24''	72°52'30''	188.9	13.5	110	11	2.5	9.67	5.93
5	Ramagondanahalli	14°18'35''	75°59'42''	35.4	30	99.00, 136.00,192.00	7.6	3.01	5	31.62
6	Hidusghatti	14°14'28''	76°4'6''	181	5.55		9.1	3.1	18.8	23.38
7	Hidusghatti	14°14'28''	76°4'6''	174	16.5		10.5	3.3	11.35	16.3
8	Hadadi	14°21'50''	75°53'40''	181.5	26		6.9	3.5	10.1	110.67
9	Oll Bullapura -	14°22'60''	76°0'50''	126	20.4	30.00, 190.00	28	4	8.1	42.16
10	Hullikatte	14°27'21''	76°5'20''	200	26.5				-	-
11	Neertadi	14°20'60''	76°4'4''	200	16.5				-	-

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)	30	Fractures upto 200 mbgl
Depth range of occurrence of fractures (mbgl)	-	30 - 200 80% between 50 - 200
Range of yield potential (lps)	Poor yield	1 - 5
Specific Yield	2%	0.2%
T (m^2/day)	-	5.27 – 42.16
Quality Suitability for Irrigation	Suitable	Suitable
Suitability for Domestic purposes	Suitable	Suitable
Remarks	Critical	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)

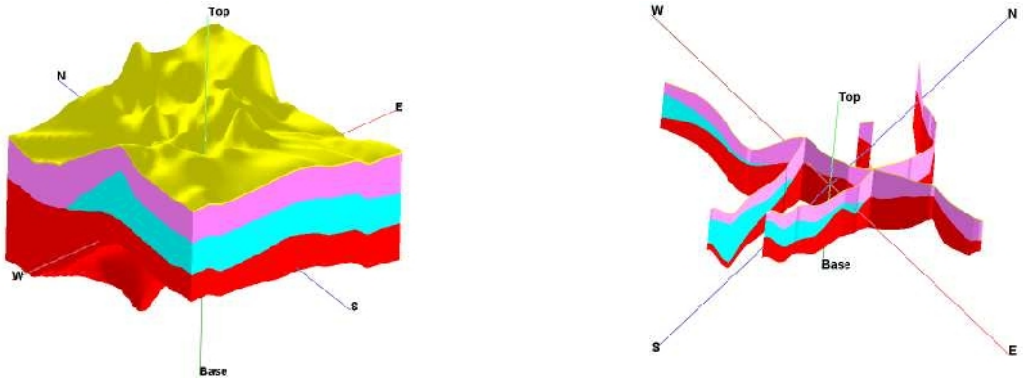

Fig 12: 3D aquifer Disposition and Fence Diagram

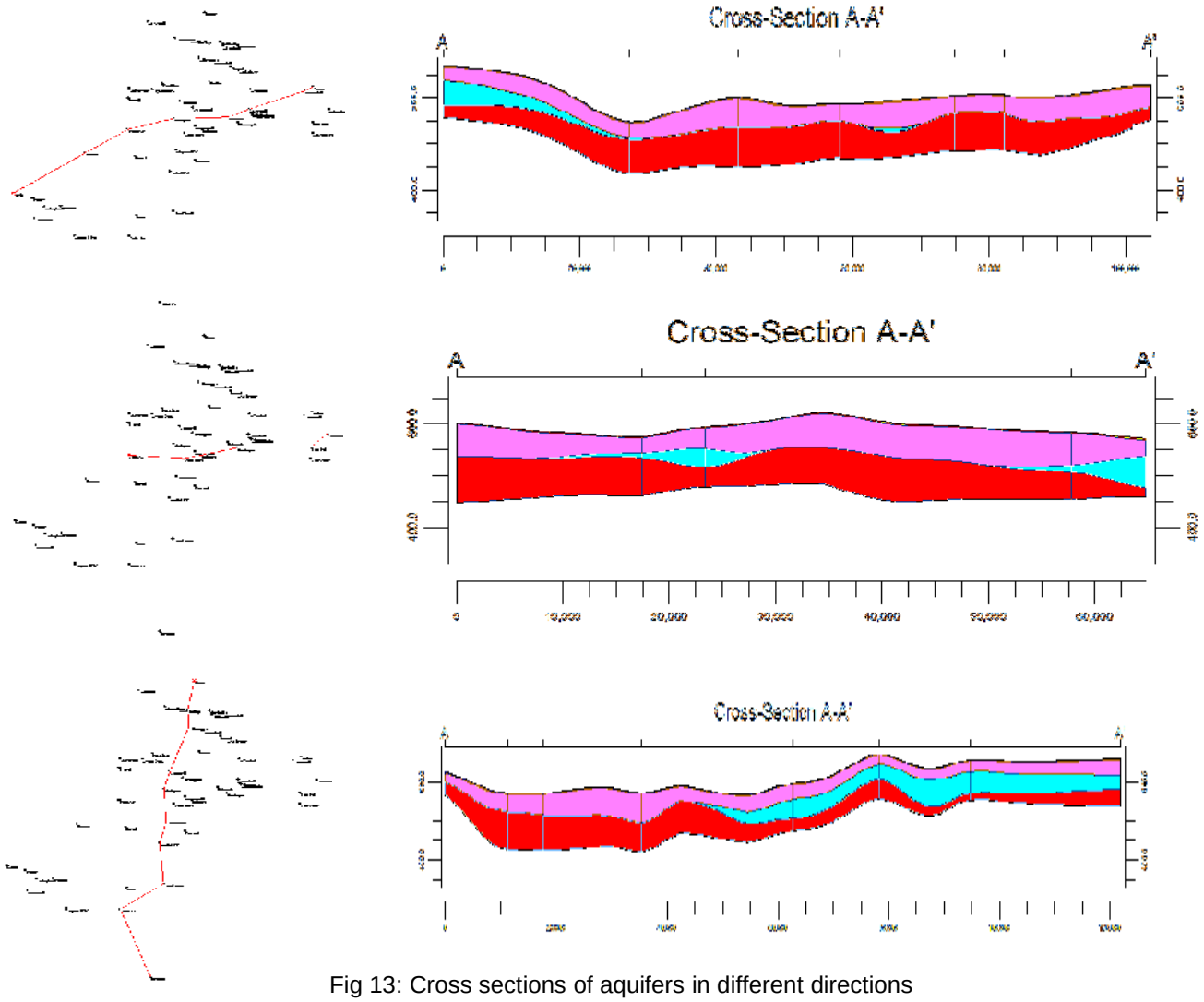

Fig 13: Cross sections of aquifers in different directions

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
Davangere	8293	7157	686	7843	836	1924	95	CRITICAL

(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
Davanagere	8293	17233	1803	27329

(c) Comparison of ground water availability and draft scenario in Davanagere 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**		
Davanagere	7818	7657	98	7828	7497	96	8293	7843	95

b. Chemical quality of ground water and contamination

Interpretation from Chemical Analysis results of 15 samples in Davanagere taluk is mentioned as under:

Electrical Conductivity: Out of 15 samples, EC values ranges from 330 to 1942 µ/mhos/cm at 25^{o}C which indicates ground water has EC value within the permissible limit in both the aquifers (Fgure-14).

Fluoride: Fluoride concentration in ground water is of geogenic origin in areas underlain by younger granites/ gneisses containing minerals like Flurospar & fluroapatite F value ranges between 0.3 - 2.7 mg/l. Out of 15 samples, 7 samples indicate fluoride greater than the permissible limit of 1.5 mg/l, which constitutes 47% of the samples collected (Fgure-15).

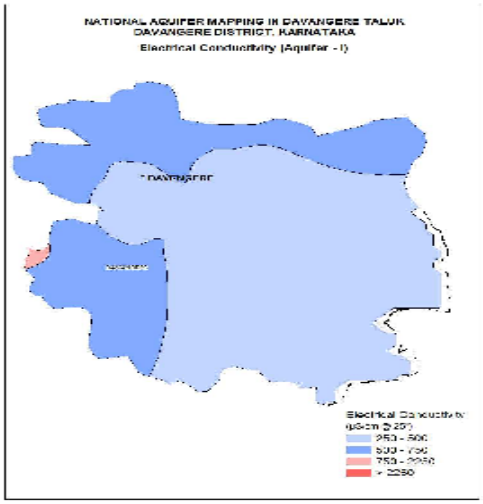

Fig 14: Electrical Conductivity Map

Fig 15: Fluoride Map

Nitrate: Nitrate value ranges between 8 to 140 mg/l. Out of 12 samples, 4 samples indicate nitrate greater than the permissible limit of 45 mg/l, which constitutes 33% of the samples analyzed. Nitrate contamination is due to extensive use of fertilizers, hence is anthropogenic in origin.

In general ground water quality in Davanagere 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

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	Davanagere taluk
Non committed monsoon runoff available (Ham)	1150
Number of Check Dams	71
Number of Percolation Tanks	5
Number of Point Recharge structures	8
Tentative total cost of the project (Rs. in lakhs)	276.53
Excepted recharge (MCM)	6.50
Expected rise in water level (m)	0.35
Cost Benefit Ratio (Rupees/ cu.m. of water harvested)	4.26

4.2 Improvement in GW availability due to Recharge, Davanagere 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		%
Davangere	8293	7843	95	650	5886	14829	53	42

4.3 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 Davanagere 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 8293 to 14829 ham and the expected improvement in stage of development is 42% from 95% to 53%

5. DEMAND SIDE INTERVENTIONS

5.1 Advanced irrigation practices

It is observed that borewells and canals are 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 15920 ha of gross irrigated area by borewells.
- Irrigation draft is 7843 ham.
- Efficient irrigation techniques will contribute in saving ground water by 1573 ham and thus will improve stage of development by 5% from 53% to 48% (Table-9).

5.2 Change in cropping pattern

Water intensive crops like paddy & sugarcane are only grown from canal irrigation in the Davanagere 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		%
Davangere	14829	7843	53	1573	16402	48	5

5.3 Water Logging and additional area of irrigation

Water logging area falls in <2 m pre-monsson water level contour and area prone for water logging falls between 2-5 m water level contour are 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 Davanagere taluk is 2703 ham (0.955 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 40% of total crop area of taluk, it is suggested that additional area of 4056 ha can be irrigated for Maize or 6759 ha for Jowar crops (Table-10).

Table-10: Withdrawal of Ground Water and Increase in area of Irrigation in Davanagere 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	4640	0.02	371	0.131	557	928
2 - 5	5	3	38871	0.02	2332	0.824	3499	5831
Total					**2703**	**0.955**	**4056**	**6759**

5.4 Regulation and Control

- Davanagere taluk has been categorized as **Critical**, since the Stage of ground water development has reached **95%** (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.

5.5 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 sample requires remedial measures viz.
    - Dilution of nitrate rich ground water through artificial recharge & water conservation.
    - Roof top rain water harvesting.
    - Micro irrigation.