Draft Report

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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

Kolar Taluk, Kolar District, Karnataka

दक्षिण पश्चिमी क्षेत्र, बैंगलोर

South Western Region,Bengaluru

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GOVERNMENT OF INDIA
MINISTRY OF WATER RESOURCES,
RIVER DEVLOPMENT AND GANGA REJUVANATION
CENTRAL GROUND WATER BOARD

KOLAR TALUK AQUIFER MAPS AND MANAGEMENT PLANS, KOLAR DISTRICT, KARNATAKA

KOLAR

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CENTRAL GROUND WATER BOARD
SOUTH WESTERN REGION
BANGALORE
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KOLAR TALUK AQUIFER MAPS AND MANAGEMENT PLANS,

KOLAR DISTRICT, KARNATAKA STATE

CONTENTS

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

1. SALIENT INFORMATION

Name of the taluk : **KOLAR**

District : Kolar

State : Karnataka

Area : 795 sq.km.

Population : 3,85,410

Annual Normal Rainfall: 735 mm

1.1 Aquifer management study area

Aquifer mapping studies was carried out in **Kolar taluk**, Kolar district of Karnataka, covering an area of 795 sq. kms under **National Aquifer Mapping Project**. Kolar taluk of Kolar district is located between north latitude 13^0 02' 03" and 13^0 19'11"& east longitude 77^0 56' 02" and 78^0 13' 02", and is covered in parts of Survey of India Toposheet Nos. 57 K/3, 57K/4, 57K/7, 57 K/8,57 G/15 and 57G/16. Kolar taluk is bounded by Srinivasapur, Sidlaghatta and Chintamani taluks on North, Hoskote Taluk in Bangalore Rural District on west, Malur and Bangarapet taluks on South and Mulbagal taluk on Eastern side. Location map of Kolar taluk of Kolar District is presented in Fig. 1.

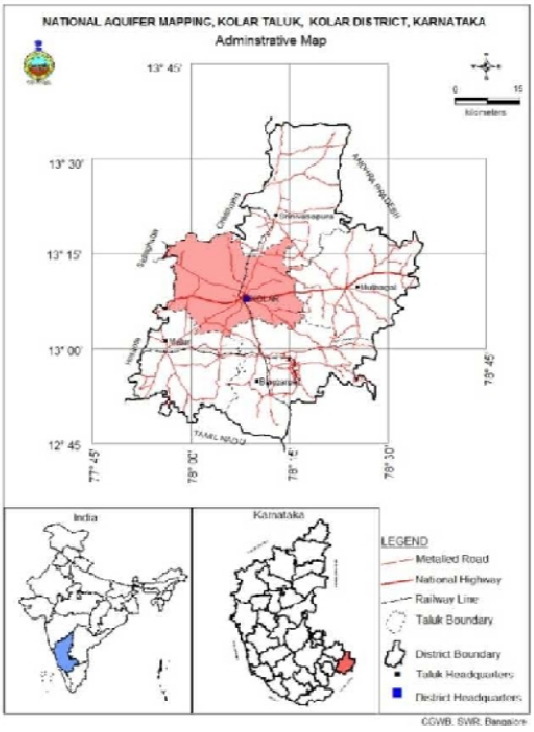

Fig 1: Location map of Kolar taluk, Kolar district

Taluk administration of, Kolar is divided into 7. There are 328 inhabited and 34 uninhabited villages in Kolar taluk. Taluk is well connected by good network of roads. It has an average elevation of 822 metres (2,697 ft). It is located at a distance of about 72 kilometres (45 mi) from Bengaluru and 32 kilometres (20 mi) from Kolar Gold Fields. The city is located on the southern maidan (plains) region of Karnataka. Ammerallikere, a tank, forms its eastern boundary. To the north is the Kodikannur tank, the main source of water supply to the city. The nearest railway junction is Bangarpet at a distance of about 15 km. It is situated on the Bengaluru to Chennai National Highway 4. There are no railway tracks in the area, however, National Highway connecting Bangalore to Chennai passes through the taluk.

1.2 Population

According to 2011 census, the population in Kolar taluk is 385410, comprising of 195129 males and 190281 females. Out of the total population of 385410, nearly 246948 constitute the rural population and 138462 is the urban population, which works out to 64 % (rural) and 36 % (urban) of the total population of taluk. The study area has an overall population density of 486 persons per sq.km. The decadal variation in population from 1991-2001 is 12.50 % in Kolar taluk.

1.3 Hydrometeorology

Kolar taluk has semi-arid 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 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 Kolar taluk (Table 1). The data in respect of this station from the year 1981 to 2010 is analysed and presented in the Table 2. The data pertaining to this gauge is of long term nature. It is presumed that they are representative of the taluk and the same is used for analysis. Normal annual rainfall in Kolar taluk for the period 1981 to 2010 is 804 mm.

Table 1: Raingauge and its location in Kolar taluk

Sl.No	Station	Latitude	Longitude	Altitude
1	Kolar	13°08’	78°08’	844

Statistical analysis

Computations were carried out for the 30 year block of 1981- 2010 on Mean, Standard deviation and coefficient of variation of pre-monsoon, monsoon, post-monsoon and annual are shown in Table 2.

The mean monthly rainfall at Kolar station is ranging between 2mm during January to 168 mm during September. The CV percent for winter, premonsoon, monsoon and post-monsoon season is 52, 32 & 55 percent respectively. Annual CV at this station works out to be 29 percent.

Table 2: Statistical Analysis of Rainfall Data of Eastern dry Agroclimatic Zone, Karnataka for the Period 1981 to 2010

Station		JAN	FEB	MAR	APRI	MAY	**PRE**	JUN	JUL	AUG	SEP	**SW**	OCT	NOV	DEC	**NE**	**ANNUAL**
Kolar	NRF(mm)	2	6	13	32	83	**136**	80	80	103	168	**431**	158	61	19	**238**	**804**
	CV(%)	437	264	145	108	64	**52**	88	82	85	51	**32**	68	91	122	**55**	**29**
	% of ARF	0	1	2	4	10	**17**	10	10	13	21	**54**	20	8	2	**30**	**100**

Assessment of Drought

Rainfall data of Kolar taluk has been analysed for 114 years using IMD method to assess the drought conditions. The results of the classification are listed in Table 3. It is observed that the taluk has experienced alternating from no drought to severe drought conditions over the years.

Table 3: Classification of drought and its recurrence (IMD, 1971)

% Deviation (Di)	0 to 25	0 to -25	-25 to -50	< -50	Probability of drought occurrences
Category	No drought	Mild (Normal)	Moderate	Severe	
	Years				
Taluk Kolar	50	43	20	1	Once in 5 years

The details of the drought assessment are discussed as herein under. Out of 114 years of analysis in Kolar taluk “No Drought” condition in the taluk is 50 years, “Mild Drought” condition 43

years, “Moderate Drought” condition experienced is 20 years. Further, it is observed that “Severe Drought” condition is experienced in 1 year i.e., in the year 1950. Based on occurrence and frequency of past drought events, the probability of occurrence of various intensities of drought at each station has been studied. It has been observed that the frequency of occurrence of drought is once in 5 years at Kolar taluk.

1.4 Agriculture & Irrigation

Agriculture is the main occupation in Kolar talukThe amount of rainfall and its distribution throughout the season contributes to the cropping pattern in the area (Table 4a). There are two agricultural seasons namely Kharif (June – October) and Rabi season (Mid October – Mid February). Major Kharif crops are paddy, maize, ragi, tur dal, and vegetables. Main crops of Rabi season are Ragi, Maize, horse gram, groundnut, and sunflower. Sugarcane is the annual crop and fruits is perennial crops grown in the area. It is observed that during the year 2013-14 percentage of gross cropped area of total geographical area was 51.0 % in Kolar taluk (Table 4b).

Table 4a: Details of Cropping pattern in Kolar taluk 2013-14 (ha)

Year	Paddy	Maize	Ragi	Total Cereals & Miner Millets	Pulses	Oil Seeds	Total Fruits	Total Vegetables
2013-14	158	165	13722	14057	4304	129	4995	3464

Table 4b: Details of land use in Kolar taluk 2013-14 (ha)

Taluk	Year	Total Geograp-hical Area	Area under Forest	Area not available for cultivation	Fallow land	Net sown area	Area sown more than once	Total sown area	Cultivable land excluding fallow land
Kolar	2013-14	69210	1560	14704	12662	32864	2383	35247	4347

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

Table 5: Irrigation details in study area (ha)

Net Area Irrigated From	Kolar Taluk
Canals	Nil
Tanks	Nil
Wells	Nil
Bore wells	5481
Lift Irrigation	Nil
Other Sources	Nil
Total	**5481**

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

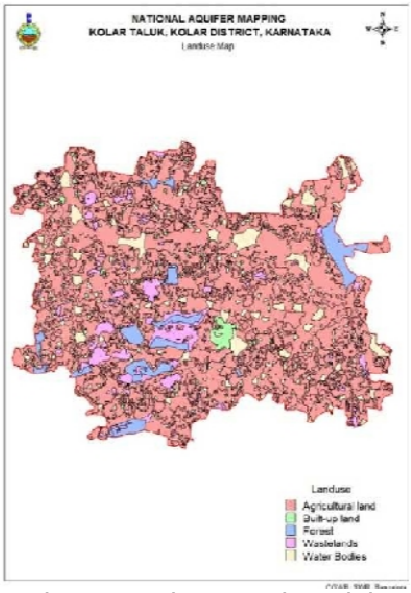

Fig. 2: Land use, Kolar taluk

1.5 Geomorphology, Physiography & Drainage

Geomorphologically, the taluk area is covered with uplands on Gneisses and Granites, 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 1116 m amsl with good degree of slope. Kolar taluk falls in the valley of Palar, which are undulating and well cultivated. Prominent hill ranges in the taluk are Kolar betta 1116 m amsl, Devarayanasamudra 1098 m amsl, Kurudumale betta 1008 m amsl and Avani 982 mamsl etc. Overall the topographic features in the area are formed by topographic divides between Palar, north and south Pennar catchments.

In Kolar taluk there are no perennial rivers flowing. There are few streams that rise in the hills and feed number of tanks. Theses tributaries are ephemeral and flow only during monsoon season and dry up during summer. Drainage pattern of the area can be described as semi dendritic to dendritic. Palar river enters southern parts of Kolar taluk and drains a part of Kolar taluk.

Nangli Hole: It is a tributary of Palar river. It rises on the Kurudamale hills in Kolar taluk and take easterly direction after feeding number of tanks in Kolar taluk.

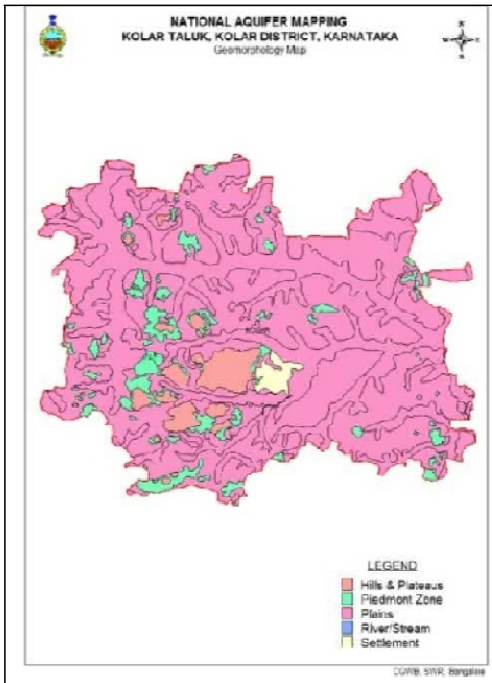

Fig. 3: Geomorphology, Kolar taluk

Fig. 4: Drainage, Kolar taluk

1.6 Soil

Five classes of soils are clayey, mixed clayey, clayey skeletal, Loamy skeletal and Rocky land. Clayey soil in western side of study area, loamy skeletal soil in the eastern part, clayey mixed along the major drainage flowing in the taluk.

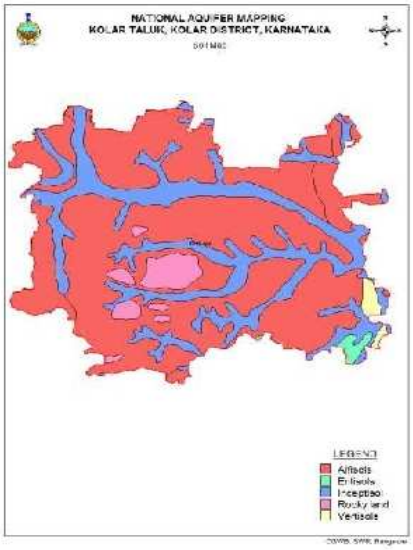

Fig. 5: Soil map, Kolar taluk

1.7 Ground water resource availability and extraction

(Aquifer wise up to 200 m depth)

Total GE Resources (2009), (Ha m)

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
Kolar	12406	38837	5269	44106

1.8 Existing and future water demands

No scope for further Irrigation from ground water.

1.9 Water level behaviour

(a) Depth to water level

Aquifer-I

Pre-monsoon: 3.8 – 14.2mbgl
Post-monsoon: 1.85– 13.52 mbgl

Aquifer-II

Pre-monsoon: 5.62 – 131.6mbgl
Post-monsoon: 1.05 – 97.0mbgl

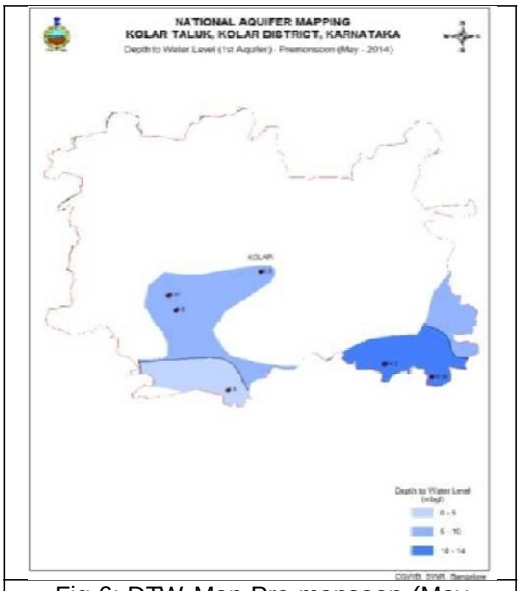

Fig 6: DTW Map Pre-monsoon (May 2014), Aq- I

(b) Water level fluctuation

Aquifer-I: Seasonal Fluctuation: Rise ranges between 0.50 to 4.95 m

Fall ranges between Nil

Aquifer-II: Seasonal Fluctuation: Rise ranges between 0.15 to 23.35 m

Fall ranges between 1.15 to 3.05 m

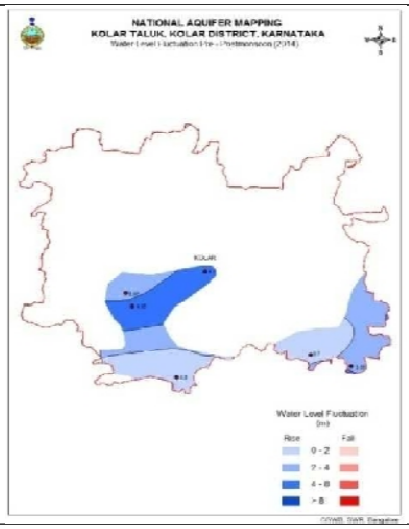

Fig. 10: Water level fluctuation (Aq – I)

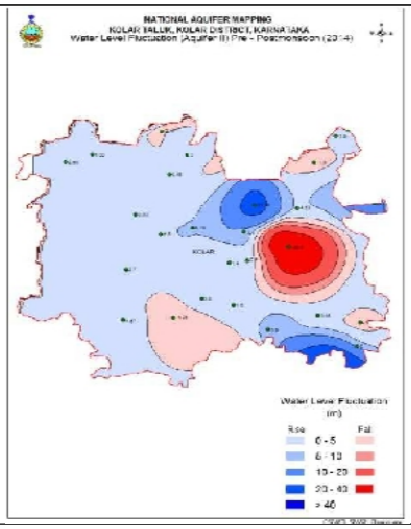

Fig. 11: Water level fluctuation (Aq – II)

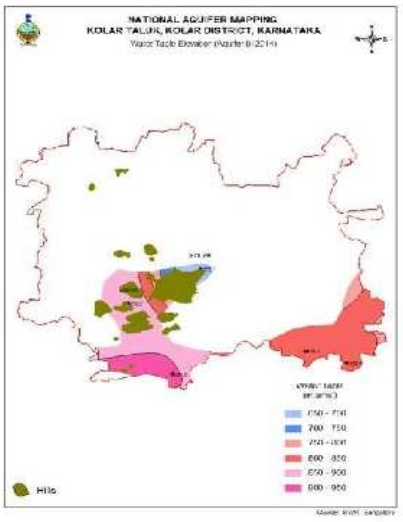

Fig 12: Water table elevation (Aq- I)

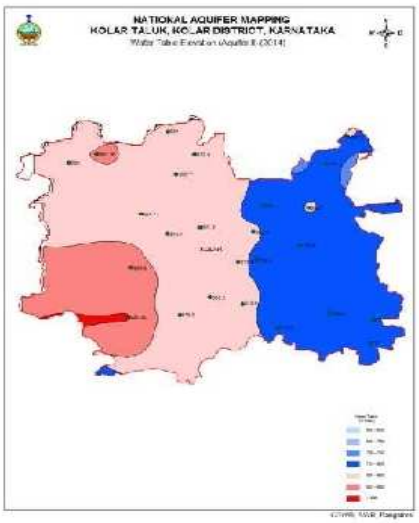

Fig 13: Water table elevation (Aq- II)

2.0 AQUIFER DISPOSITION

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

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

ii. **Aquifer-II, (Fractured multi-aquifer system) comprising** Fractured Gneiss / Granite / Schist

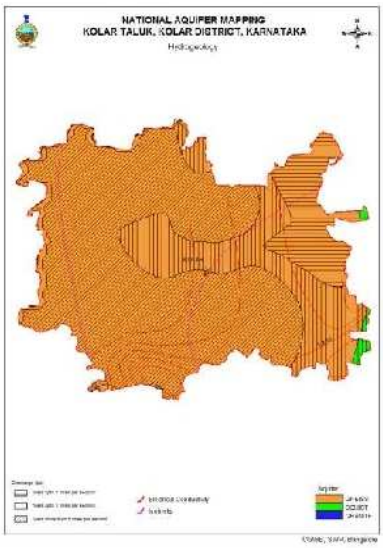

Fig 14: Hydrogeology, Kolar taluk

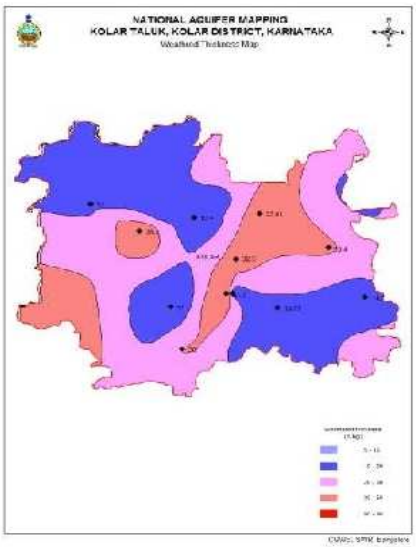

Fig 15: Weathered thickness (Aq -I disposition)

2.2 3 D aquifer disposition and basic characteristics of each aquifer

(A) Aquifer disposition – Rockworks output

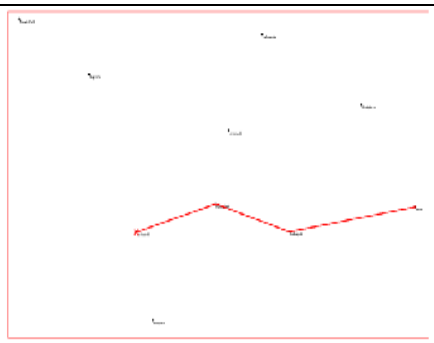

Fig 16: Cross - Section EW along A - A^{I}

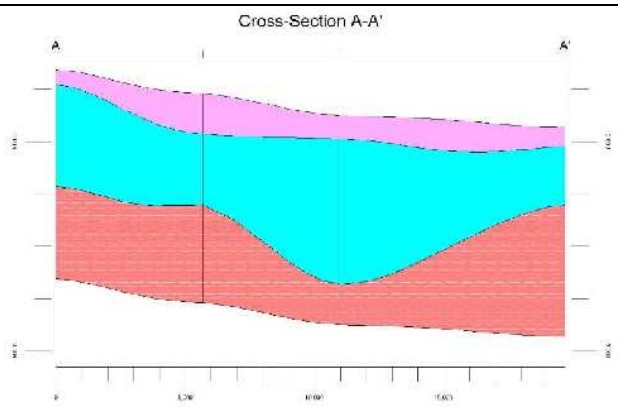

Fig 17: Aquifer disposition, Cross – section along EW,

Rockworks output

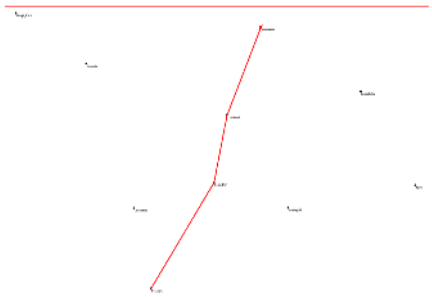

Fig 18: Cross - Section NE–SW, along A- A'

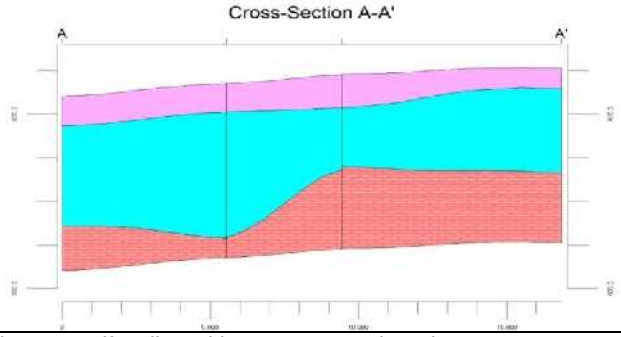

Fig 19: Aquifer disposition, Cross–section along NE–SW, Rockworks output

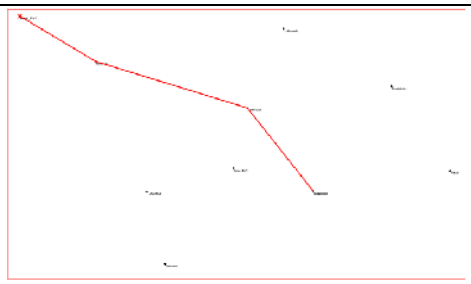

Fig 20: Cross - Section NW – SE, along A - A'

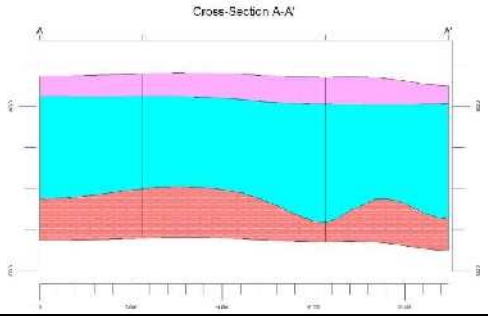

Fig 21: Aquifer disposition, Cross–section NW–SE, Rockworks output

B) Aquifer & Fracture occurrence - Rockworks output

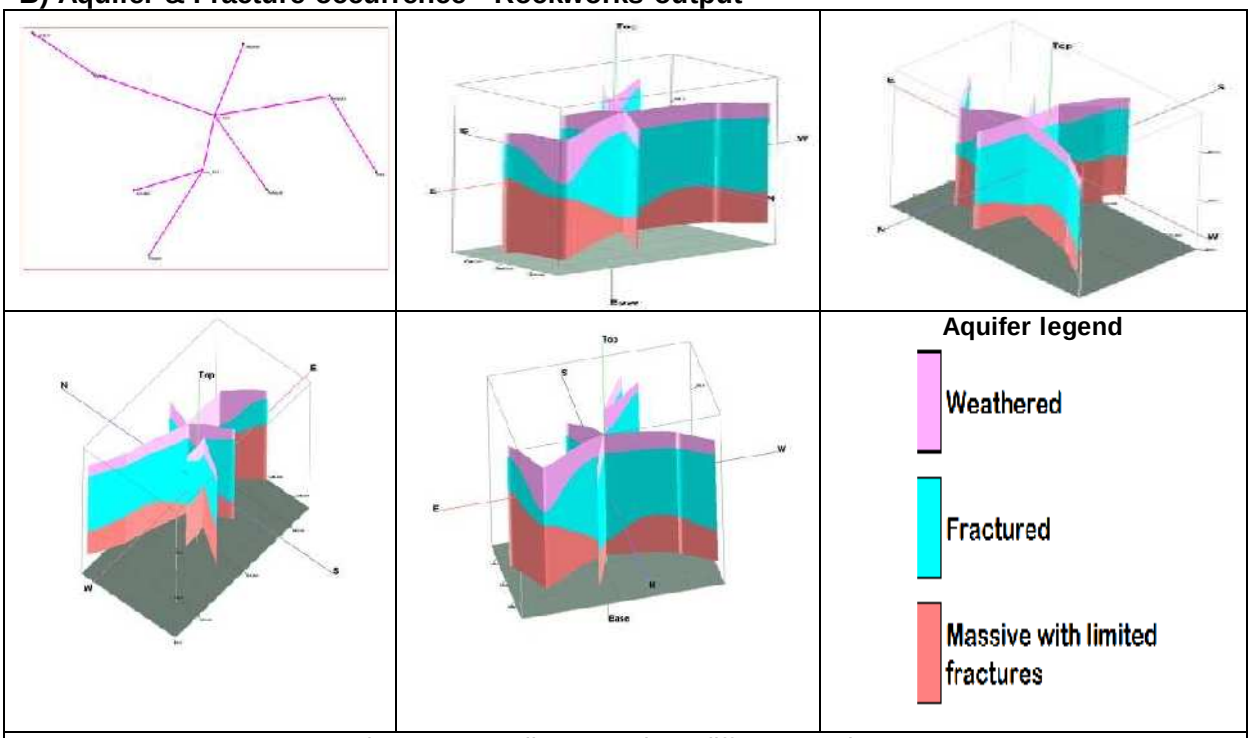

Fig 22: Fence diagrams along different sections

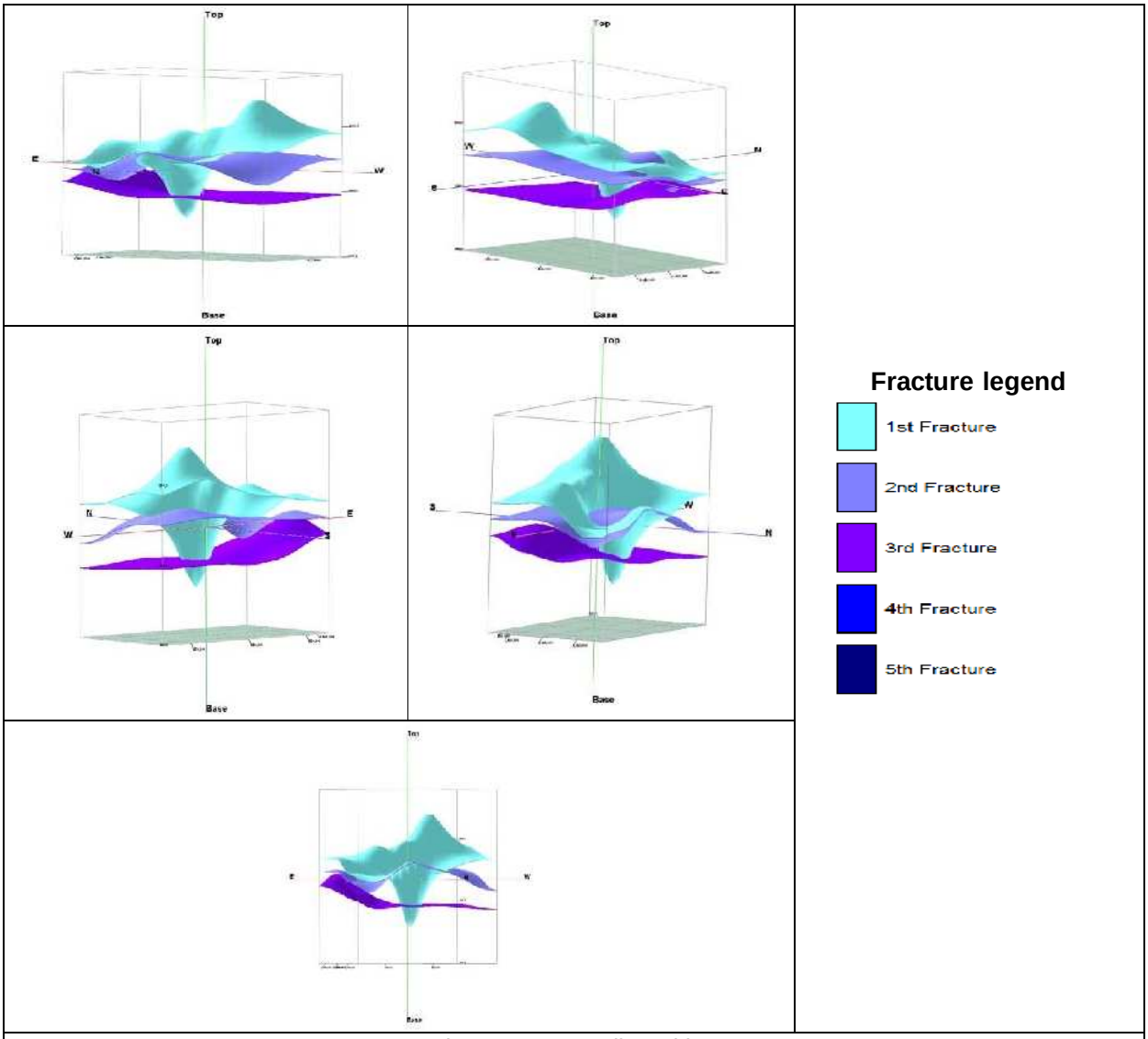

Fig 23: Fracture disposition

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

3.1 Aquifer wise resource availability and extraction

(a) Present Dynamic Ground Water Resource (2011)

Taluk	Net annual GW availability,(ham)	Total draft forall uses (ham)	Stage of GW development, %	Category
Kolar	12405.53	22322.04	180	Over Exploited

(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
Kolar	12406	38837	5269	44106

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

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 (%)
Kolar	12406	22322	-9976	180	1280	13686	163	**17**

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

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			
Kolar	4569	6726	- 2157	**147**	11053	18210	- 7157	**165**	12406	22322	-9916	**180**

3.2 Chemical quality of ground water and contamination

During Aquifer Mapping Studies in Kolar taluk, 27 samples were collected, out of which 11 were dug wells, and 16 were bore wells representing Aquifer - I & II respectively. 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 result are mentioned as under:

Electrical Conductivity:(a) Aquifer -I: Out of 11 samples collected from dug wells representing Aq -I, 2 samples indicate EC greater than the permissible limit of 2000 m/mhos/cm, which constitutes 18% of the samples collected. Fig. 24 illustrates electrical conductivity of water samples representing Aq- I, which indicates ground water in larger extent has EC value within the permissible limit. Only small areas towards South, South East of the taluk have EC greater than 2000 m/mhos/cm. EC values of Aq- I ranges between 100 to 3280 m/mhos/cm at 25^{o}C.

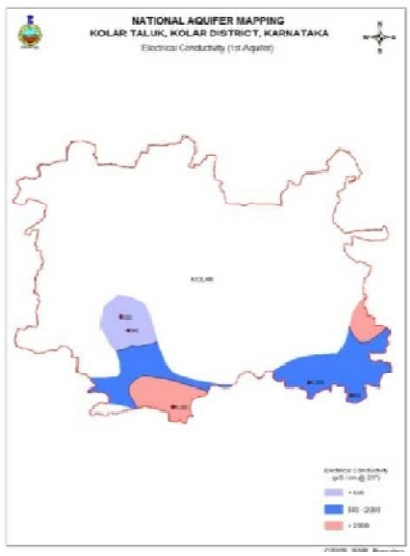

Fig 24: Electrical Conductivity (Aq-I)

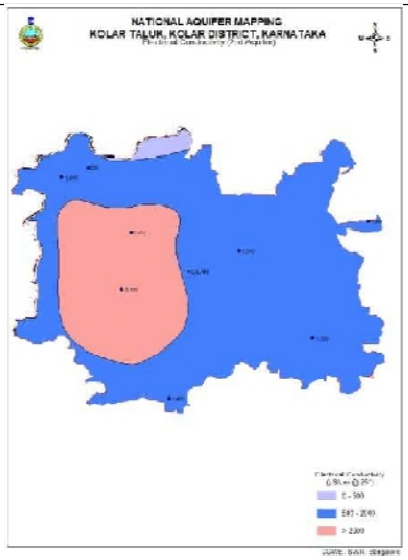

Fig 25: Electrical Conductivity (Aq- II)

(b) Aquifer- II: Out of 16 samples collected from bore wells representing Aq- II, only 2 sample indicate EC greater than the permissible limit of 2000 m/mhos/cm, which constitutes 13% of the samples collected. Fig. 25 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 500 to 3620 m/mhos/cm at 25^{o}C.

It can be inferred that more samples from Aq-II have EC values greater than the permissible limit, than in Aq – I.

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

(a) Aquifer - I: Out of 11 samples collected from dug wells representing Aq – I, 2 samples indicate fluoride greater than the permissible limit of 1.5 mg/l, which constitutes 18% of the samples collected. Fig. 26 illustrates fluoride concentration and its spatial occurrence in water samples representing Aq- I. Ground water in north and south east of taluk has areas where fluoride is greater than the permissible limit. F ranges between 0.3 to 1.55 mg/l.

(b) Aquifer – II: Out of 16 samples collected from bore wells representing Aq – II, 2 samples indicate fluoride greater than the permissible limit of 1.5 mg/l, which constitutes 13% of the samples collected. Fig. 27 illustrates fluoride concentration and its spatial occurrence in water samples representing Aq- II. Ground water in north of taluk have fluoride greater than the permissible limit. Fluoride ranges between 0.29 to 2.1 mg/l (Vadagere village).

It can be inferred that fluoride contamination is more prevalent in Aq – II.

Nitrate: (a) Aquifer – I: Out of 11 samples collected from dug wells representing Aq -I, 4 samples indicate nitrate greater than the permissible limit of 45 mg/l, which constitutes 36% of the samples collected. Fig. 28 illustrates nitrate concentration and its spatial occurrence in water samples representing Aq- I. Ground water in northwest, north, south east of taluk have areas where nitrate is greater than the permissible limit. Nitrate ranges between 4 to 200 mg/l.

(b) Aquifer – II: Out of 16 samples collected from bore wells representing Aq – II, 8 samples indicate nitrate greater than the permissible limit of 45 mg/l, which constitutes 50% of the samples collected. Fig. 29 illustrates nitrate concentration and its spatial occurrence in water samples representing Aq- II. Ground water in north,west, southwest, centre and patches on East of taluk have nitrate greater than the permissible limit. Nitrate ranges between 6 to 185mg/l (Suluru village). Nitrate contamination is due to extensive use of fertilizers, hence is anthropogenic in origin.

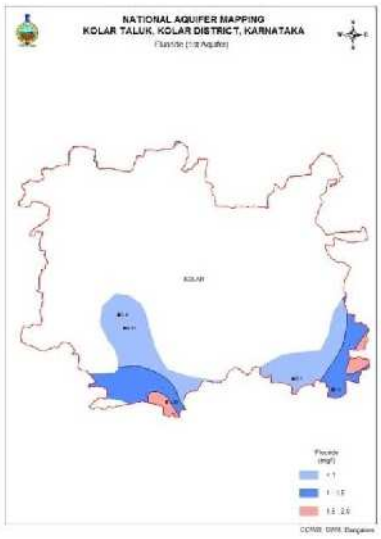

Fig 26: Fluoride (Aq - I)

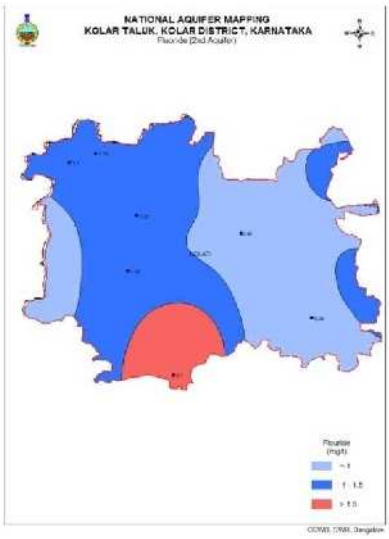

Fig 27: Fluoride (Aq - II)

It can be inferred that nitrate contamination is more prevalent in Aq – II.

Magnesium: Magnesium concentration in 14 water samples is found to be greater than the permissible limit of 30 mg/l, which constitutes 33% of samples. In general, ground water quality in Kolar taluk is good for drinking purpose except in some areas as depicted in above illustrated maps, where nitrate, fluoride and EC 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.

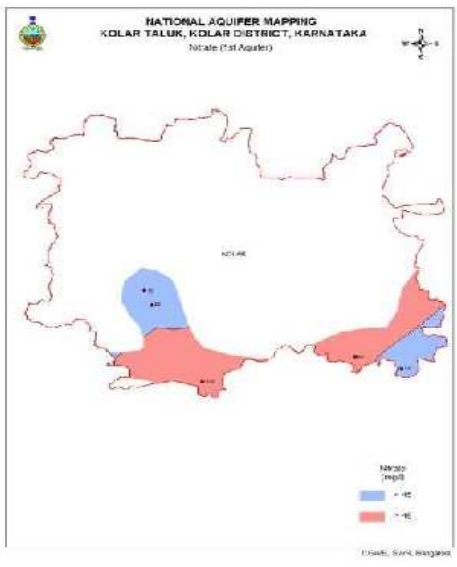

Fig 28: Nitrate (Aq – I)

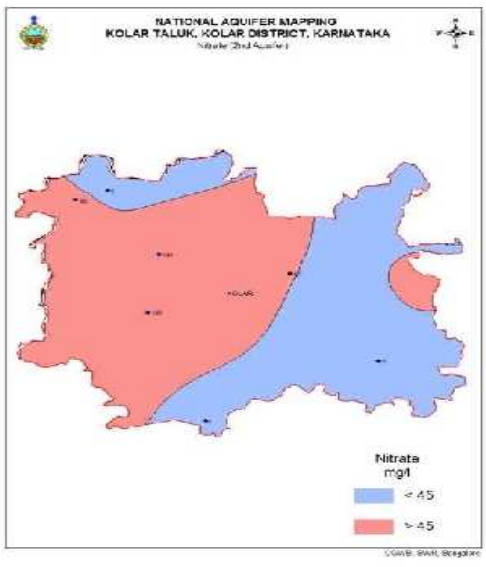

Fig 29: Nitrate (Aq – II)

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:

Artificial Recharge Structures Proposed	Kolar Taluk
Number of Check Dams	79
Number of Percolation Tanks	6
Number of Point Recharge structures	9
Tentative total cost of the project (Rs. in lakhs)	315
Excepted recharge (MCM)	7.65
Expected rise in water level (m)	0.5
Cost Benefit Ratio (Rupees/ cu.m. of waterharvested)	3.9

4.2 Improvement in GW availability due to Recharge, Kolar taluk.

Taluk	GW availability	Stage of GW development %	Expected Additional Recharge from non-committed monsoon runoff	Expected Increase in GW Availability	Expected Stage of GW Development after recharge (%)
Kolar	12406	180	1280	13686	163

Fig. 30: Area feasible for Artificial recharge

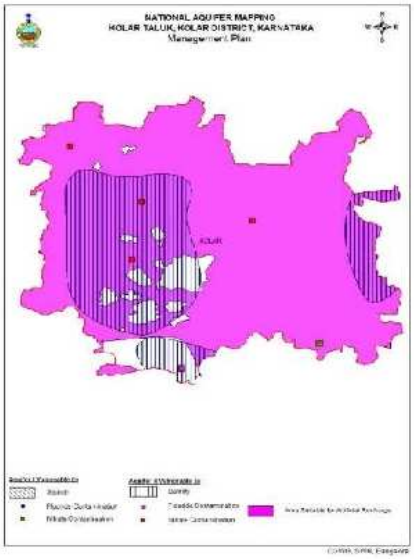

Fig. 31: Management Plan

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 below mentioned techniques, it 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.

Irrigation draft is 6736 ham

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.

5.3 Alternate water sources

Inter-basin transfer from west-flowing river Yettinahole project is considered for Kolar taluk also. Under Yettinahole Project it is proposed to fill 35 Minor Irrigation tanks with 0.210 TMC of water.

Transporting tertiary treated water from Bangalore city and filling MI tanks, is also considered as an alternate water source.

5.4 Regulation and Control

Kolar taluk has been categorized as **OVER EXPLOITED**, since the Stage of ground water development has reached 180**%** (GE March 2011). Hence, the taluk has already been notified for regulated groundwater development by Karnataka Ground Water Authority.

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.

5.5 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 Fig. 30

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

Excess nitrate & fluoride concentration is found in ground water samples from Aq-I & Aq-II, as shown in Fig. 26, 27, 28 & 29, requires remedial measures viz.

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

The following villages where **Aq -I** is affected by excess nitrate concentration, needs to adopt the above mentioned remedial measures, Vadagere, Kurugal,& Harati.

Villages where **Aq-II** is affected are , Settihalli, Virapura, Kyalanur, Suluru, & Madanahalli, .

Vadagere village is affected by excess fluoride concentration, needs to adopt the above mentioned remedial measures, in both the Aquifer I and II.

Heavy sand mining in Nangli watershed needs to be stopped to restore natural recharge to ground water.