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

Mulbagal Taluk, Kolar District, Karnataka

दक्षिण पश्चिमी क्षेत्र, बैंगलोर

South Western Region,Bengaluru

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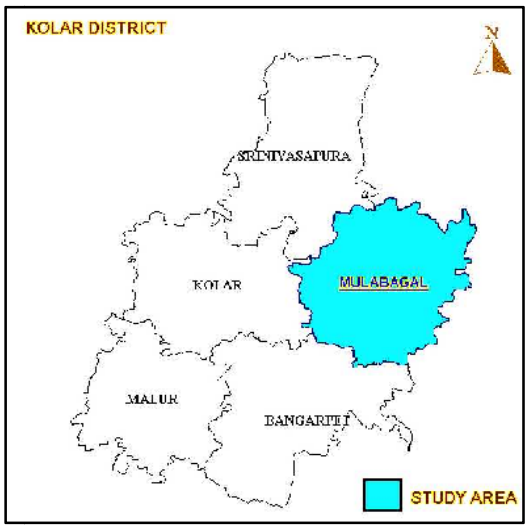
GOVERNMENT OF INDIA
MINISTRY OF WATER RESOURCES,
RIVER DEVLOPMENT AND GANGA REJUVANATION
CENTRAL GROUND WATER BOARD

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



By

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DECEMBER 2016

MULBAGAL TALUK AQUIFER MAPS AND MANAGEMENT PLANS,

KOLAR DISTRICT, KARNATAKA

CONTENTS

AQUIFER MANAGEMENT PLAN OF MULBAGAL TALUK, KOLAR DISTRICT, KARNATAKA STATE

1.0 SALIENT INFORMATION

Taluk name: **MULBAGAL**

District: Kolar; State: Karnataka

Area: 824 sq.km.

Population: 2,31,302

Annual Normal Rainfall: 760 mm

1.1 Aquifer management study area

Aquifer mapping studies was carried out in **Mulbagal taluk**, Kolar district of Karnataka, covering an area of **824 sq.kms** under **National Aquifer Mapping Project**. Mulbagal taluk of Kolar district is located between north latitude 16^0 15' and 16^0 54' & east longitude 76^0 17' and 77^0 17', and is covered in parts of Survey of India Toposheet Nos. 57 K/7, 57K/8, 57K/11 and 57K/12. Taluk is bounded by Kolar taluk on west, Shrinivasapura taluk on northwest, state of Andhra Pradesh on north and east, and Bangarpet taluk on southern side. Location map of Mulbagal taluk of Kolar District is presented in Figure-1.

Taluk administration of, Mulbagal is divided into 5 Hoblies namely Mulbagal, Tayilur, Duggasandra, Avani and Bairakur. Mulbagal is only one town, which is also the taluk headquarters.

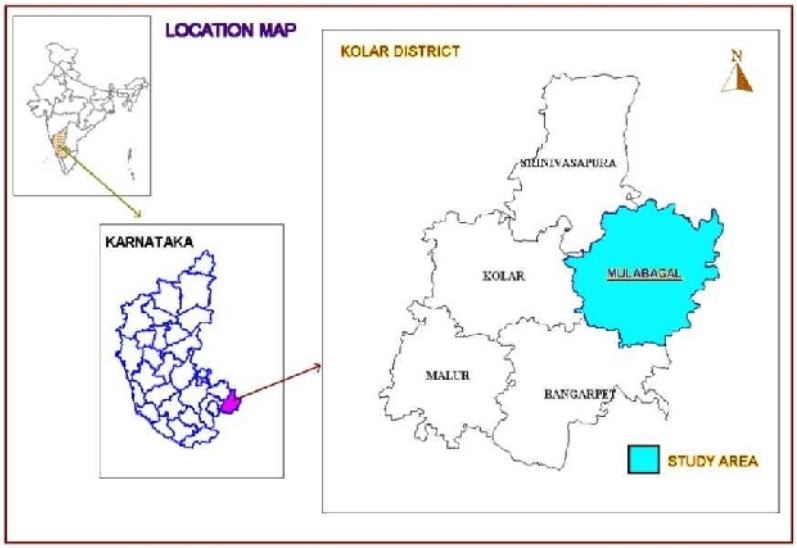

Fig 1: Location Map of Mulbagal taluk, Kolar district

There are 314 inhabited and 29 uninhabited villages in Mulbagal taluk. Taluk is well connected by good road network. 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 Mulbagal taluk is 231302, comprising of 116494 males and 114808 females. Out of the total population of 231302, nearly 187269 constitute the rural population and 44043 is the urban population, which works out to 81 % (rural) and 19 % (urban) of the total population of taluk. The study area has an overall population density of 280 persons per sq.km. Decadal variation in population from 1991-2001 is 14 % in Mulbagal taluk.

1.2 Rainfall

Mulbaglu taluk forms part of South-Interior Karnataka and experiences semi-arid type of climate characterized by hot summer and low rainfall. Agro-climatically it falls in eastern dry zone. Rainfall data for the period from 1901 to 2011 is used for analysis and results is presented in Table 1.

Table1: Rainfall analysis for Mulbagal taluk, Kolar district.

Mulbagal taluk	**Winter (Jan - Feb)**	**Hot Weather (Mar - May)**	**South-West Mon (Jun - Sep)**	**North-East Mon (Oct -Dec)**	**Annual**
Mean (mm)	14	120	378	248	760
Minimum rainfall (mm)	0	12	146	32	319
Maximum rainfall (mm)	108	358	742	643	1453
Median (mm)	3	113	366	228	753
Standard deviation (mm)	22	69	133	118	205
C.V (%)	153	57	35	48	27
% of Drought years	%	%	%	%	%
No drought (nd)	37	67	74	65	84
Moderate drought (md)	2	13	23	21	14
Severe drought	61	21	4	14	3

Taluk receives an annual normal rainfall of 760 mm in 50 normal rainy days. During the period 1901 to 2011 the highest annual rainfall of 1453 mm was recorded during 2005, and the lowest being recorded (319 mm) in 1950. The co-efficient of variation of annual rainfall is 27%. About 17% of the years were drought years, of which 3% were severe drought years and remaining 14% were moderate drought years.

Seasonal rainfall pattern indicates that, major amount of (378 mm) rainfall was recorded during South-West Monsoon seasons, which contributes about 50% of the annual normal

rainfall, followed by North-East Monsoon season (248 mm) constituting 33% and remaining (134 mm) 17% in Pre-Monsoon season.

1.4 Agriculture & Irrigation

Agriculture is the main occupation in Mulbagal taluk. The amount of rainfall and its distribution throughout the season contributes to the cropping pattern in the area (Table 2). There are two agricultural seasons namely Kharif (June – October) and Rabi season (Mid October – Mid February). Major Kharif crops are paddy, maize, ragi, tur, and vegetables. Main crops of Rabi season are ragi, raize, horse gram, groundnut, and sunflower. Sugarcane, fruits are perennial crops grown in the area. During the year 2010-11 percentage of gross cropped area of total geographical area was 61.51 % in Mulabagal taluk. Land use pattern is shown in table 3.

Table 2: Details of land use in Mulbagal taluk 2010-2011 (ha)

Year	Paddy	Maize	Ragi	Tur dal	Horse Gram	Other pulses	Fruit trees	Vegetables	Groundnut	other oil seeds	Sugarcane
	Area under cultivation (in ha)										
2010-2011	4413	197	11721	779	2535	1418	12227	5043	6888	51	140

Table 3: Details of land use in Mulbagal taluk 2010-2011 (ha)

Item Taluk	Year	Total Geographical Area	Area under Forest	Area not available for cultivation	Fallow land	Net sown area	Area sown more than once
Mulbagal	2010-11	82470	2122	14683	4755	45280	5455

Source: District at a glance 2010-11, Govt. of Karnataka.

Table 4: Irrigation details in study area (ha)

Net Area Irrigated From	Mulbagal Taluk
Canals	Nil
Tanks	497.67*
Wells	Nil
Bore wells	7758
Lift Irrigation	Nil
Other Sources	Nil
Total	**7758**

Source: District at a glance Govt. of Karnataka 2010-11. * from RRR scheme data

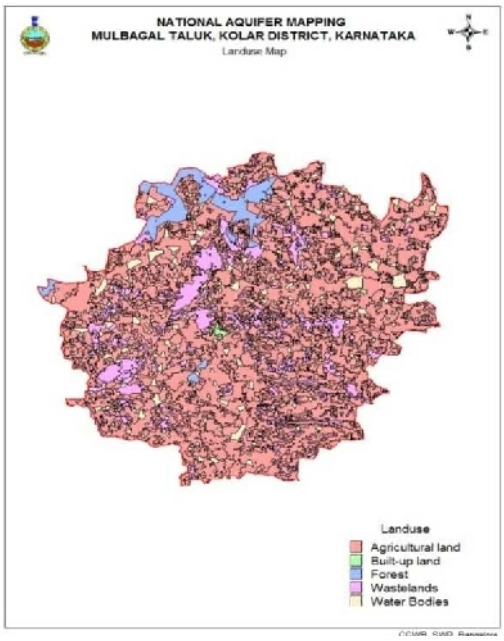

Fig 2: Land use map, Mulbagal taluk

1.5 Geomorphology, Physiography & Drainage

Geomorphologically taluk area is covered with uplands on Gneisses and Granites, which are ideal for agriculture.

Physiography of the entire area is 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. Mulbagal taluk falls in the valley of Palar, which are undulating and well cultivated. Prominent hill ranges in the taluk are Mulbagal betta 1116 mamsl, Devarayana samudra 1098 mamsl, Kurudumale betta 1008 mamsl and Avani 982 mamsl etc. Overall topographic features in the area are formed by topographic divides between Palar, north and south Pennar catchments.

There are no perennial rivers flowing. A few streams that rise in the hills feed number of tanks. These 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 Mulbagal taluk and drains the part of Mulbagal taluk.

Nangli Hole: It is a tributary of Palar river. It rises on the Kurudamale hills in Mulbagal taluk and take easterly direction after feeding number of tanks in Mulbagal taluk,like Nangli tank. Over all the Palar River and its tributaries drain an area of 1156 sq.kms, of which 823 sq.kms of Mulbagal taluk.

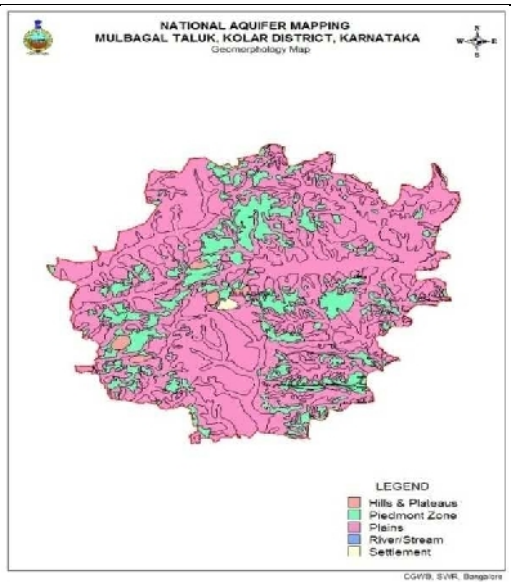

Fig 3: Geomorphological map

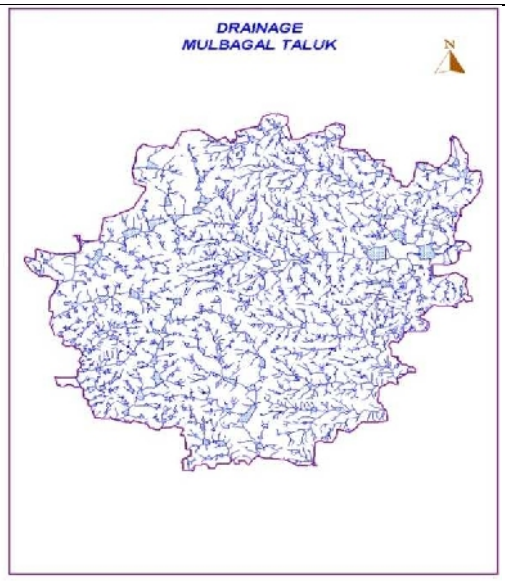

Fig 4: Drainage map

1.6 Soil

Five classes of soil are clayey, clayey mixed, 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 major drainage flowing in the taluk.

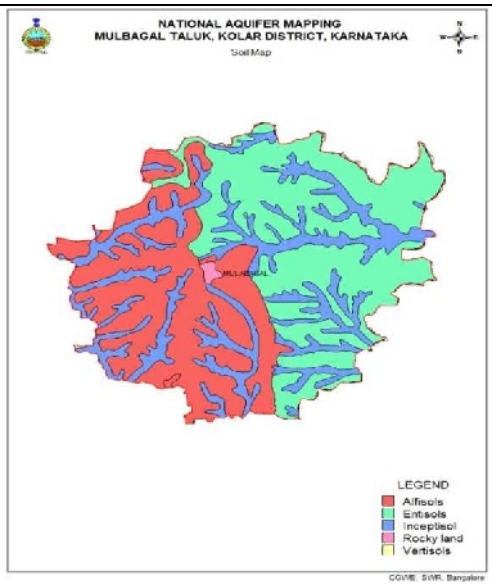

Fig 5: Soil map

1.7 Ground water resource availability and extraction

(Aquifer wise up to 200 m depth)

Table 5: Total GE Resources (2009), (Ha m)

Taluk	Annual replenishable GE resources	Fresh In-storage GW resources		Total availability of fresh GW resources
		Phreatic	Fractured (Down to 200m)	Dynamic + phreatic in-storage + fractured
Mulbagal	4740	7496	2077	14,313

1.8 Existing and future water demands

- No scope for further Irrigation from ground water.
- Domestic (Industrial sector) demand: 292.05 MCM (From GWRE- 2011)

1.9 Water level behavior

(a) Depth to water level

Aquifer - I

- Pre-monsoon: 1.2 – 12.52 mbgl
- Post-monsoon: 1.2 – 12.52 mbgl

Aquifer - II

- Pre-monsoon: 10.93 – 117.06 mbgl
- Post-monsoon: 3.3 – 96.52 mbgl

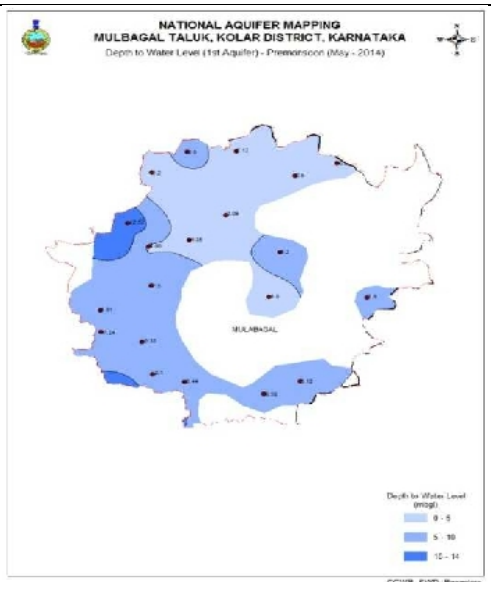

Fig 6: DTW Pre-monsoon(May2014), Aq-I

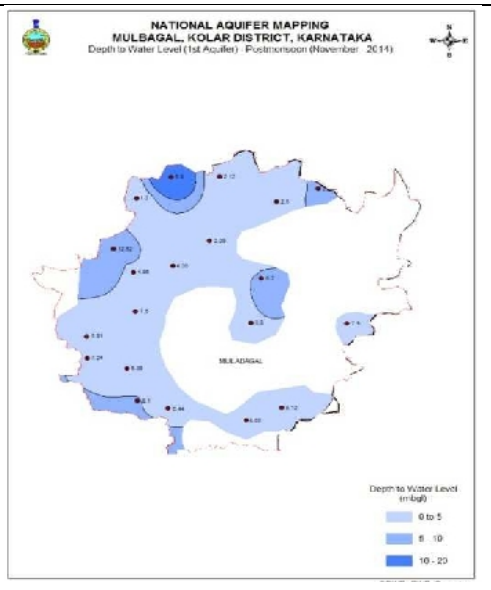

Fig 7: DTW Post-monsoon(Nov2014), Aq-II

(b) Water level fluctuation

Aquifer-I

- Seasonal Fluctuation: Rise ranges between 1.1 & 7.1 m;
  Fall ranges between 0 & 12.11m

Aquifer-II

- Seasonal Fluctuation: Rise ranges between 0.94 & 32.79m;
  Fall ranges between 2.37 & 4.45m

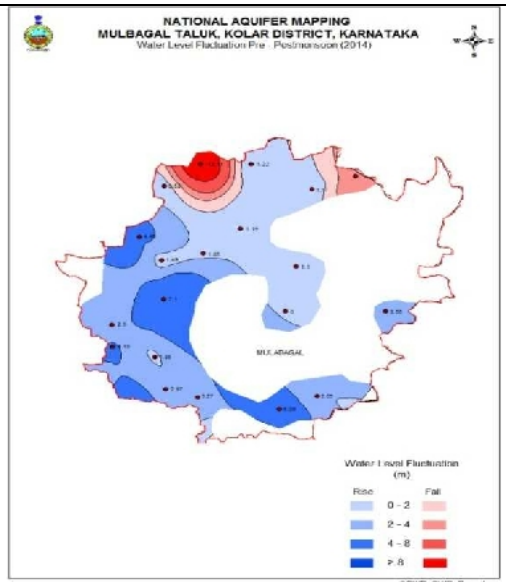

Fig 8: Water level fluctuation (Aq – I)

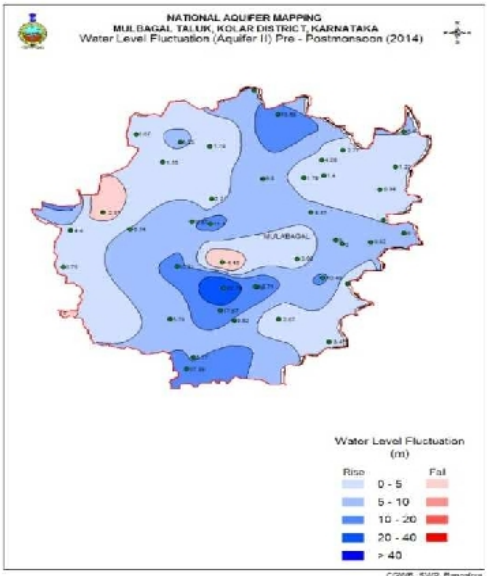

Fig 9: Water level fluctuation (Aq – II)

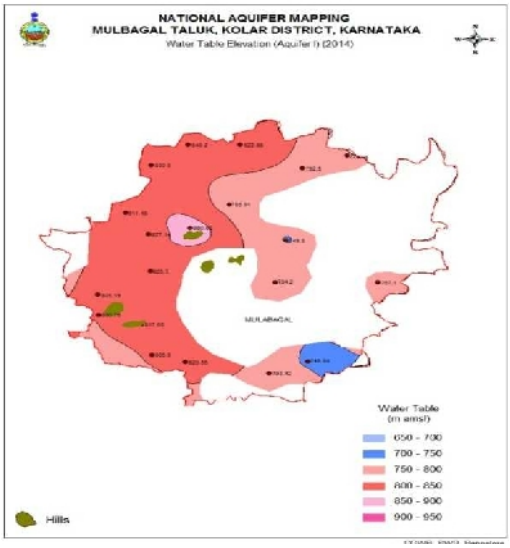

Fig 10: Water table elevation map (Aq – I)

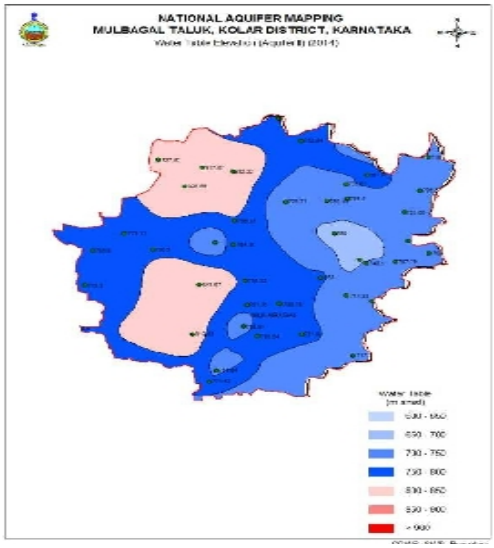

Fig 11: Water table elevation map (Aq - II)

2.0 AQUIFER DISPOSITION

2.1 Number of aquifers: In Mulbagal 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

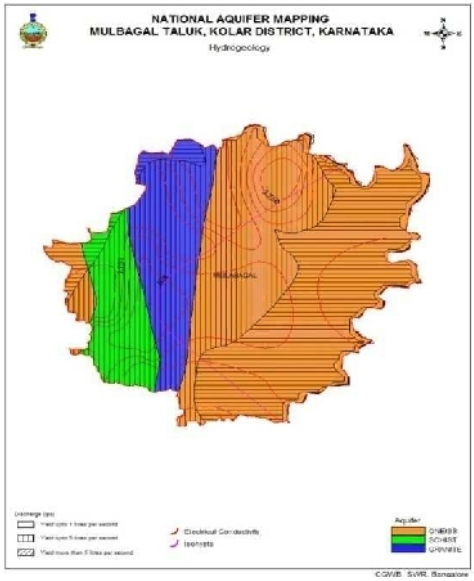

Fig 12: Hydrogeology of Mulbagal taluk

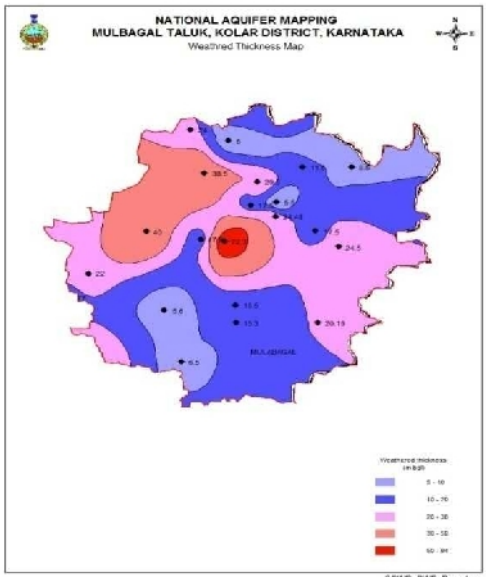

Fig 13: Weathered thickness (Aq – I)

2.2 3-D aquifer disposition and basic characteristics of each aquifer

(A) Aquifer disposition – Rockworks output

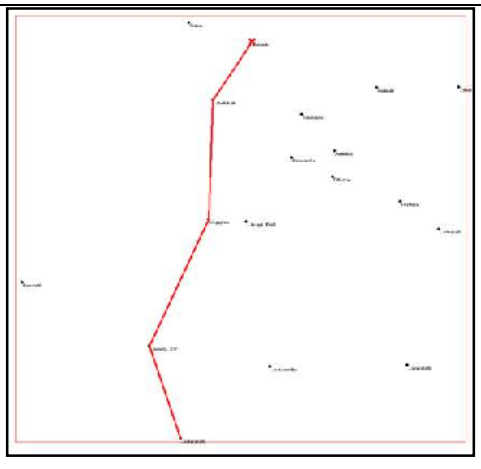

Fig 14: Cross - Section NS along A - A^{I}

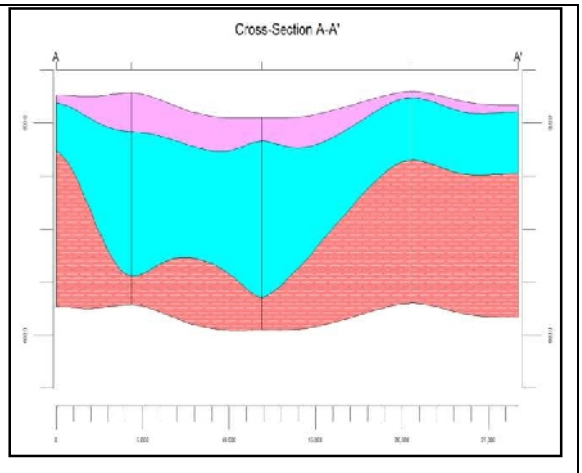

Fig 15: Aquifer disposition, Cross – section along NS

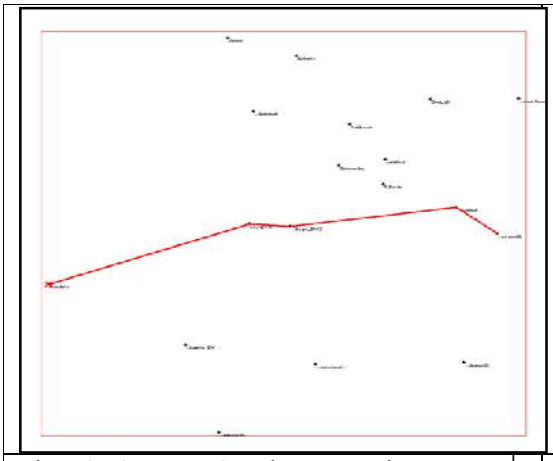

Fig 16: Cross - Section EW along A - A^{I}

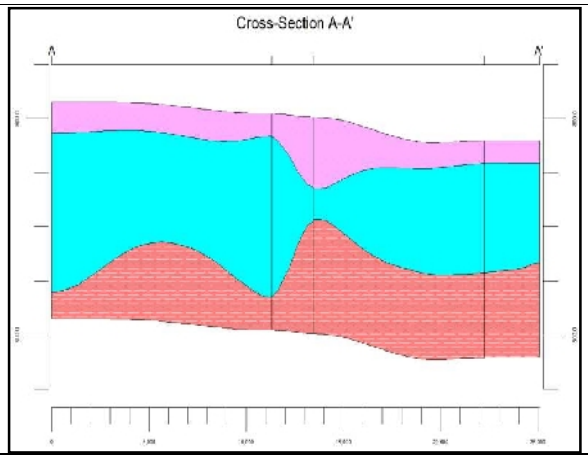

Fig 17: Aquifer disposition, Cross – section along EW

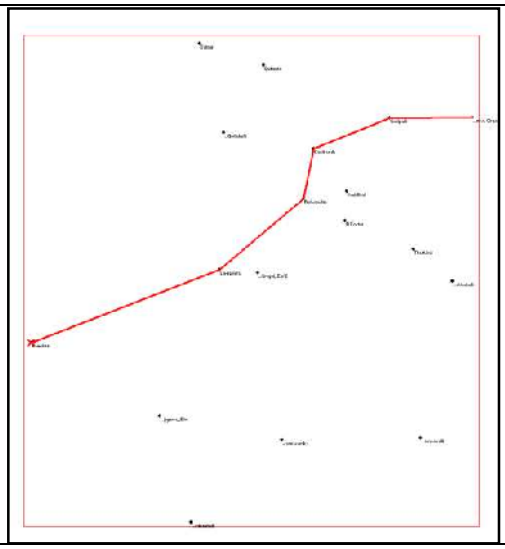

Fig18: Cross - Section NE–SW, along A - A^{I}

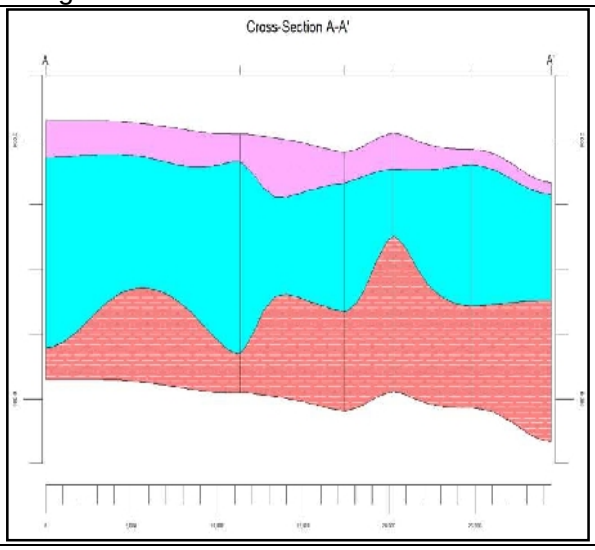

Fig 19: Aquifer disposition, Cross–section along NE–SW, Rockworks output

Fig 20:Cross - Section NW – SE, along A-A^{I}

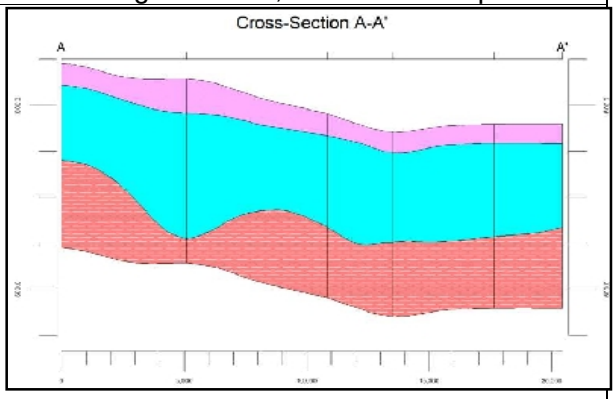

Fig 21: Aquifer disposition,Cross–section along NW–SE

(B) Aquifer & Fracture occurrence - Rockworks output:

i. Fence diagrams

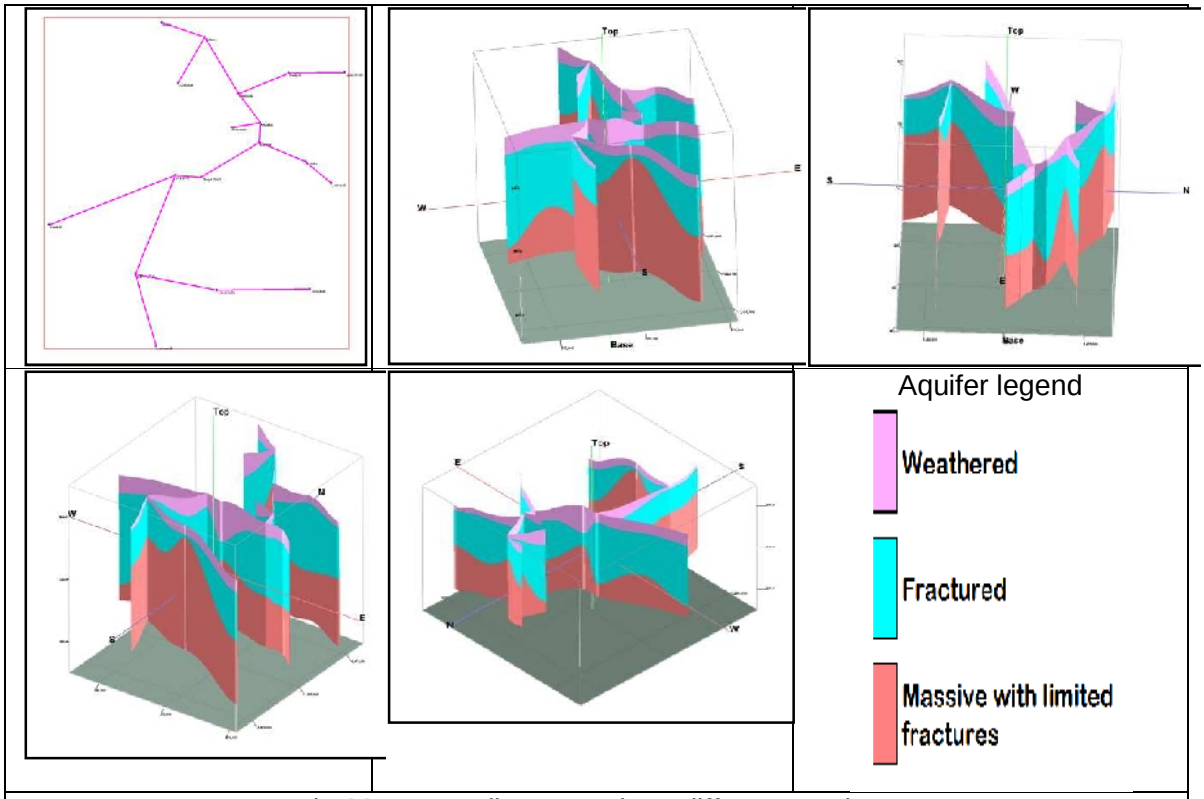

Fig 22: Fence diagrams along different sections

ii. Fracture occurrence

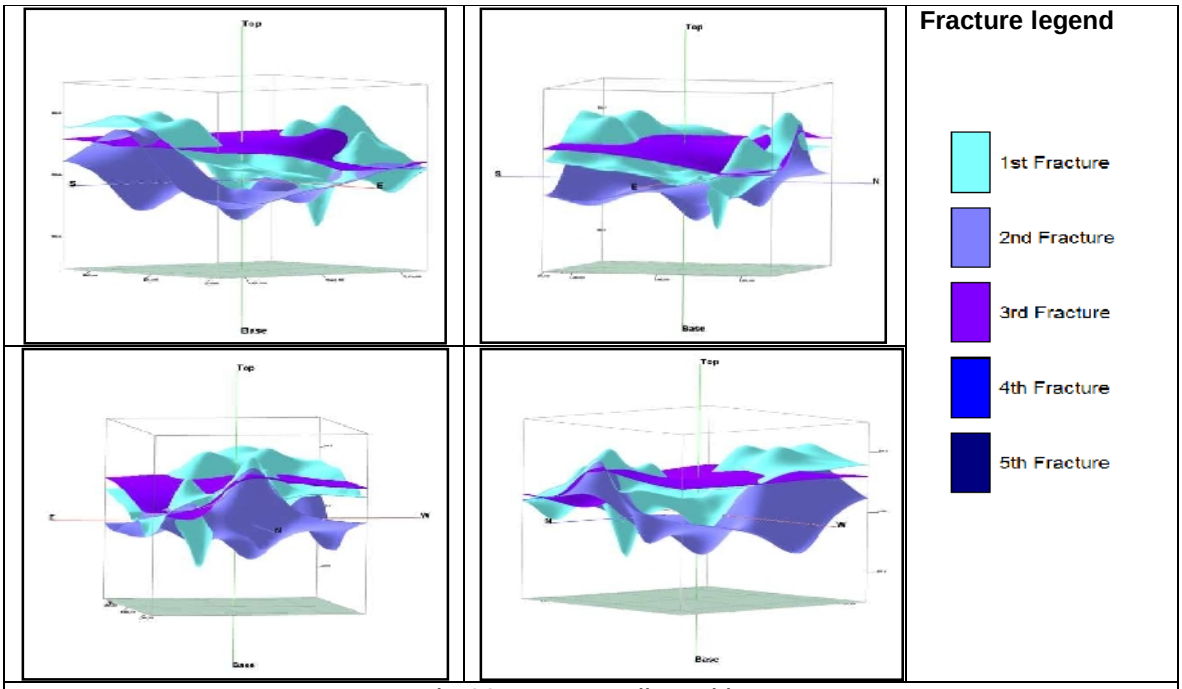

Fig 23: Fracture disposition

3.0 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 for all uses (ham)	Stage of GW development, %	Category
Mulbagal	4740	10101	213	Over Exploited

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

Taluk	Annual replenishable GW resources (in ham)	Fresh In-storage GW resources (ham)		Total availability of GW resource (ham)
		Phreatic	Fractured	Dynamic + phreatic in-storage + fractured in-storage
Mulbagal	4740	7496	2077	14,313

(c) Present ground water availability and draft scenario (2011) in Mulbagal 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 (%)
Mulbagal	4740	10101	-5361	213	1510	6250	162	**51**

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

Taluk	GW availability (in ham)	GW draft (in ham)	Net Balance	Stage of GW development	GW availability (ham)	GW draft (ham)	Net Balance	Stage of GW development	GW availability (ham)	GW draft (in ham)	Net Balance	Stage of GW development
	2004				2009				2011			
Mulbagal	6991	13986	- 6995	**200**	4420	8895	- 4475	**201**	4740	10101	- 5361	**213**

3.2 Chemical quality of ground water and contamination

During Aquifer Mapping Studies in Mulbagal taluk, 60 key wells were established, out of which 19 were dug wells, and 41 were bore wells representing Aquifer – I & II respectively.

Representative water samples were collected from each of the key wells during pre-monsoon and analyzed at Chemical Laboratory, C.G.W.B, S.W.R, Bangalore. Interpretation from Chemical Analysis result is mentioned as under:

Electrical Conductivity: (a) Aquifer–I : Out of 19 samples collected from dug wells representing Aq – I, 5 samples indicate EC greater than the permissible limit of 2000 m/mhos/cm, which constitutes 26% 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 area towards north, northwest, west and south of the taluk have EC greater than 2000 m/mhos/cm. EC values of Aq- I ranges between 430 to 3430 m/mhos/cm at 25^{o}C.

(b) Aquifer- II - Out of 41 samples collected from bore wells representing Aq – II, only 1 sample indicate EC greater than the permissible limit of 2000 m/mhos/cm, which constitutes 2% 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 430 to 2040 m/mhos/cm at 25^{o}C.

Inference: Aq-I has EC values greater than the permissible limit, than in Aq – II.

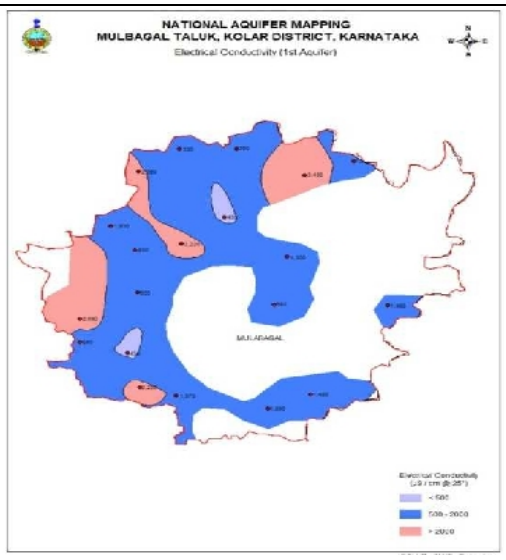

Fig 24 : Distribution of EC, Aq-I

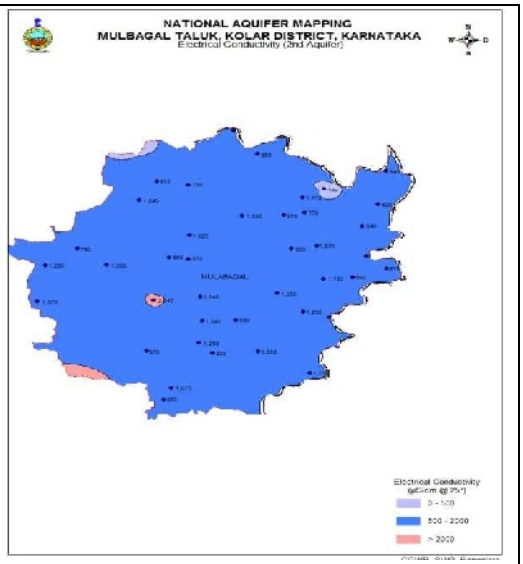

Fig 25: Distribution of EC, Aq-II

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 19 samples collected from dug wells representing Aq – I, 7 samples indicate fluoride greater than permissible limit of 1.5 mg/l, which constitutes 37% of the samples collected. Fig.26 illustrates fluoride concentration and its spatial occurrence in water samples of Aq- I. Ground

water in northwest, central, south west and south of taluk have areas where fluoride is greater than permissible limit. F ranges between 1 to 2 mg/l.

(b) Aquifer – II: Out of 41 samples collected from bore wells representing Aq – II, 3 samples indicate fluoride greater than permissible limit of 1.5 mg/l, which constitutes 7% of the samples collected. Fig. 27 illustrates fluoride concentration and its spatial occurrence in water samples of Aq- II. Ground water in northeast and west of taluk have fluoride greater than the permissible limit. Fluoride ranges between 0.32 to 2.1 mg/l (Vanaganahalli).

Inference: Fluoride contamination is more prevalent in Aq – I.

Nitrate: (a) Aquifer – I: Out of 19 samples collected from dug wells representing Aq – I, 7 samples indicate nitrate greater than the permissible limit of 45 mg/l, which constitutes 37% of the samples collected. Fig. 28 illustrates nitrate concentration and its spatial occurrence in water samples of Aq- I. Ground water in northwest, central, south west and south of taluk have areas where nitrate is greater than permissible limit. Nitrate ranges between 8 to 140 mg/l.

(b) Aquifer – II: Out of 41 samples collected from bore wells representing Aq – II, 17 samples indicate nitrate greater than permissible limit of 1.5 mg/l, which constitutes 41% of the samples collected. Fig.29 illustrates nitrate concentration and its spatial occurrence in water samples of Aq- II. Ground water in west, southwest and southeast of taluk have nitrate greater than permissible limit. Nitrate ranges between 4 to 170 mg/l (Byapalli village). Nitrate contamination is due to extensive use of fertilizers, hence is anthropogenic in origin.

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

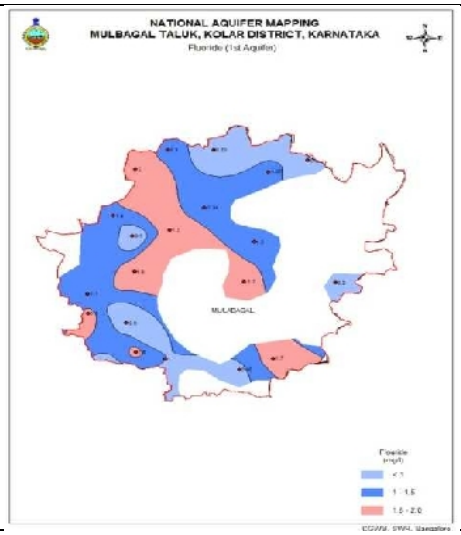

Fig 26: Distribution of Fluoride, Aq-I

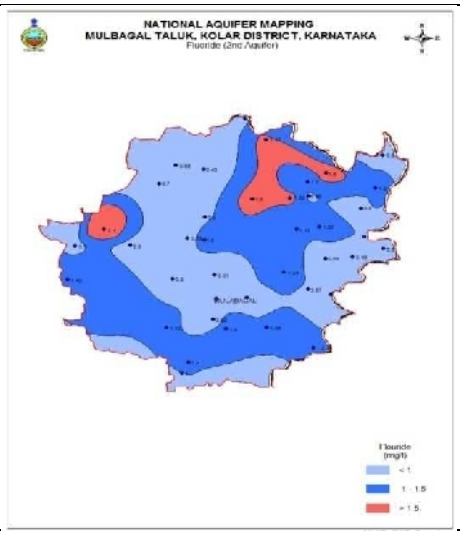

Fig 27: Distribution of Fluoride, Aq-II

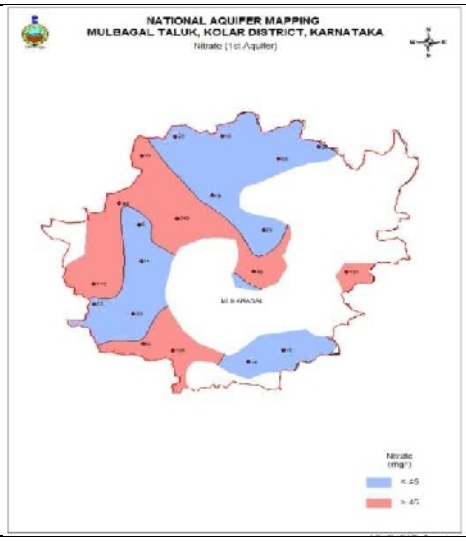

Fig 28 : Distribution of Nitrate, Aq-I

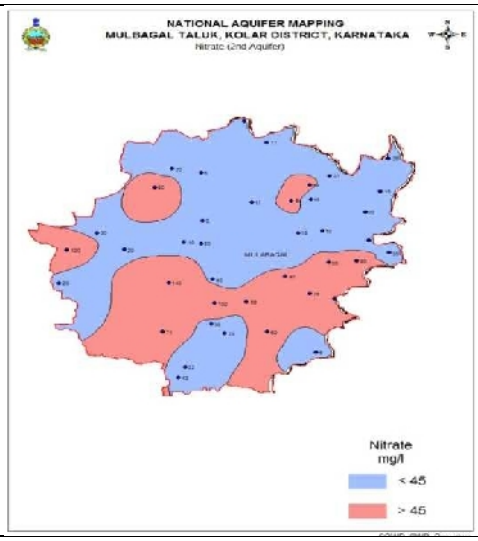

Fig. 29: Distribution of Nitrate, Aq-II

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

Magnesium: Magnesium concentration in 51 water samples were found to be greater than the permissible limit of 30 mg/l, which constitutes 85% of samples.

In general, ground water quality in Mulbagal 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 permissible limit. Ground water samples have been found suitable for agriculture & irrigation purposes*.*

3.3 Other issues

Radon concentration in water samples from bore wells indicate greater concentration than the permissible limit of 11.1 Bq/l. it may be due to presence of radioactive minerals in host rock.

4.0 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	**Mulbagal Taluk**
Non committed monsoon runoff available (Ham)	1510
Number of Check Dams	93
Number of Percolation Tanks	6
Number of Point Recharge structures	10
Tentative total cost of the project (Rs. in lakhs)	361.20
Excepted recharge (MCM)	8.53
Expected rise in water level (m)	0.6
Cost Benefit Ratio (Rupees/ cu.m. of water harvested)	4.23

4.2 Improvement in GW availability due to Recharge, Mulbagal 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 (%)
Mulbagal	4740	213	1510	6250	162

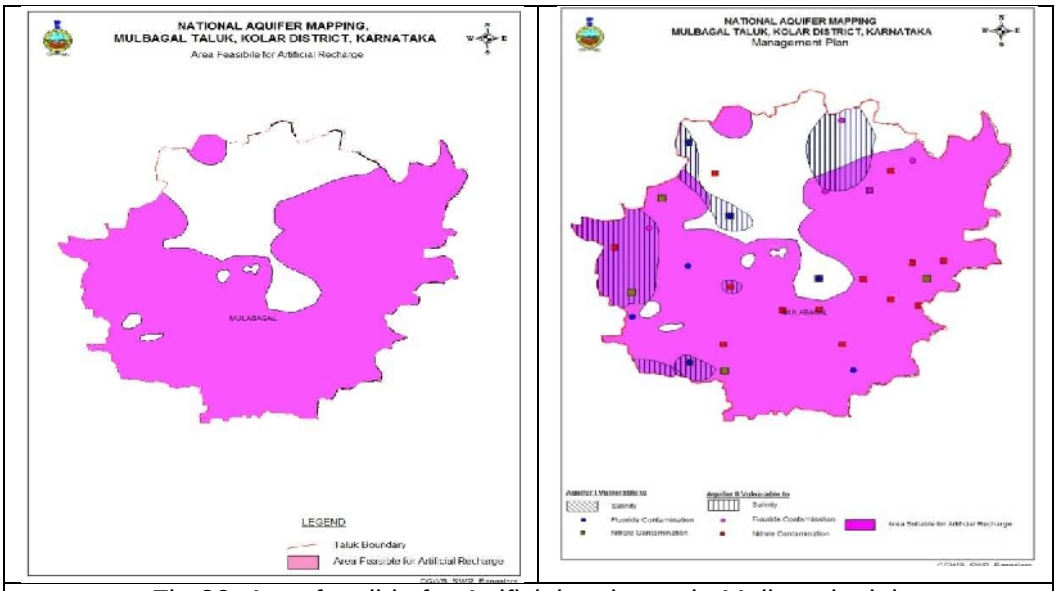

Fig 30: Area feasible for Artificial recharge in Mulbagal taluk

5.0 DEMAND SIDE INTERVENTIONS

5.1 Advanced irrigation practices

Bore well is the prevalent source for irrigation in taluk. Thus, by adopting 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 13213 ha of gross irrigated area.
- Irrigation draft is 9810 ham
- Efficient irrigation techniques will contribute in saving ground water and thus will reduce the irrigation draft.

Water efficient use irrigation techniques

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 Mulbagal 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

- Mulbagal taluk is categorized as **OVER EXPLOITED**, since the stage of ground water development has reached **213%** (GE March 2011). Hence, 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 concerned with 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 Mulbagal 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 31
- Periodical maintenance of artificial recharge structures should be incorporated in the Recharge Plan.
- Excess nitrate & fluoride concentration is found in ground water samples from Aq-I & Aq-II, and requires remedial measures viz.
  - Dilution of nitrate rich ground water through artificial recharge & water conservation.
  - Roof top rain water harvesting.
  - Micro irrigation.
- Villages where **Aq – I** is affected by excess nitrate, needs to adopt remedial measures, - Angondanahalli, Urkunte Nittur, Mallapanahalli, Kurudumalle, Agra and Doddahattihalli.
  - Villages where **Aq – II** is affected are Bandarhalli, Mudiyanur, Koladevi,

Virupaksha, Kadakatchahalli, Chelapalli, Belaganhalli and Byapalli, Sonawadi, Honnekere, Lingapura, Gollahalli, Dasarahalli, Bairakur, Hebbani, Thatikalu, Yaduvanahalli, Hirumuthanahalli, Vanaganahalli and Padakashi.

- Villages where **Aq –I** is affected by excess fluoride concentration, needs to adopt remedial measures - Vegamadagu, Kamadatti, Keloli, Ananatapur, Chammareddihalli, Sriranagpura, Vammasandra, Gollahalli cross, Angondanahalli, Urkunte-Nittur, Mallapanahalli, Kurudumalle, Agra and Doddahattihalli.

- Villages where, **Aq – II** is affected are Mudiyanur, Kadakatchahalli, Chelapalli, Belaganhalli, Chammanyakanapalli, Konasandra cross, Sonawadi, Gandhipura, Manchiganahalli, Pullivebradihalli, Surkunte, and Tippadoddi

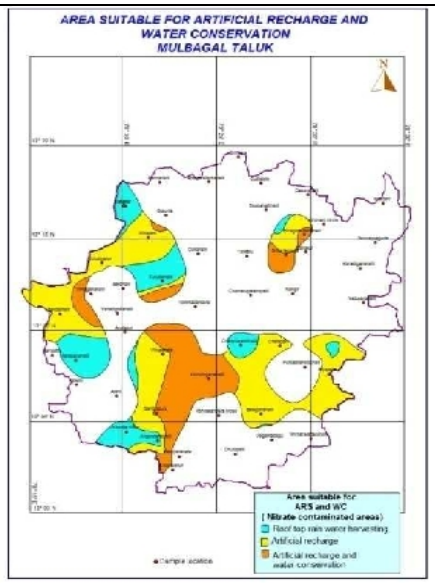

Fig 31: Feasibility for RWH & AR, Nitrate affected area

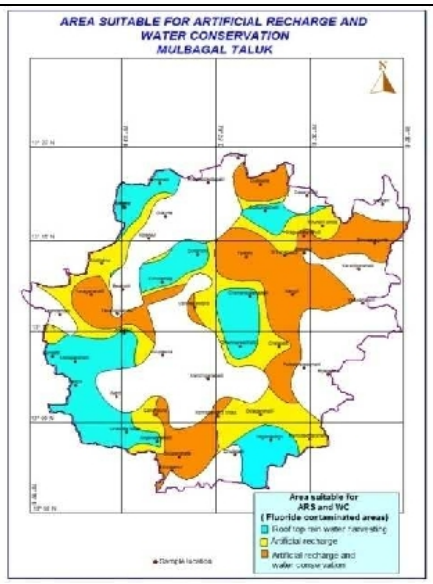

Fig 32: Feasibility for RWH & AR, Fluoride affected area

- Heavy sand mining in Nangli watershed is proposed to be stopped to restore natural recharge to ground water.