जल वर्ष 2007 Water Year 2007

स्वच्छ सुरक्षित जल – सुन्दर खुशहाल कल

CONSERVE WATER - SAVE LIFE

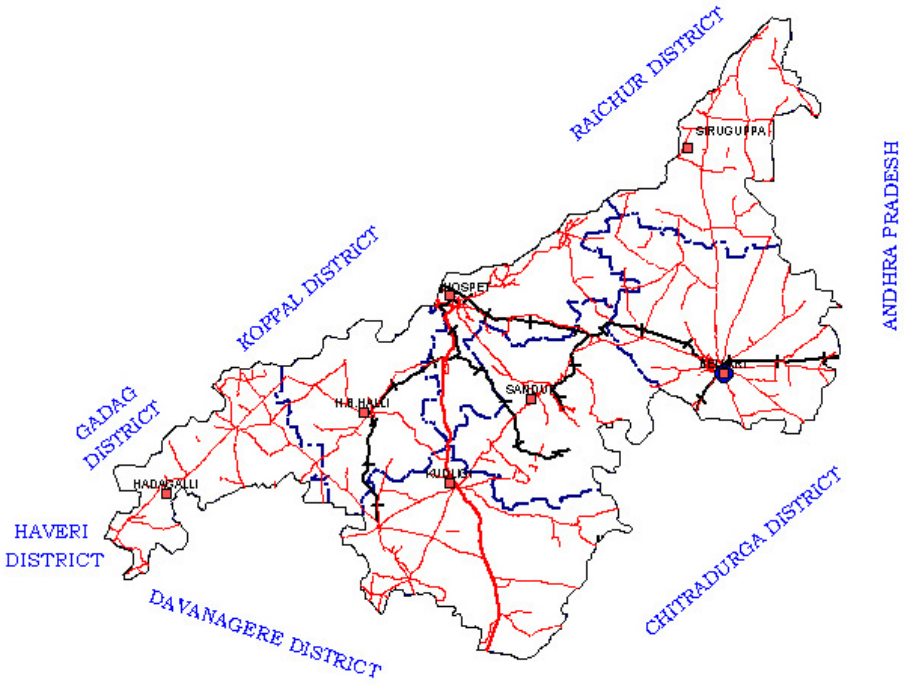
GOVERNMENT OF INDIA

MINISTRY OF WATER RESOURCES

CENTRAL GROUND WATER BOARD

GROUND WATER INFORMATION BOOKLET

BELLARY DISTRICT, KARNATAKA STATE



SOUTH WESTERN REGION

BANGALORE

MARCH 2011

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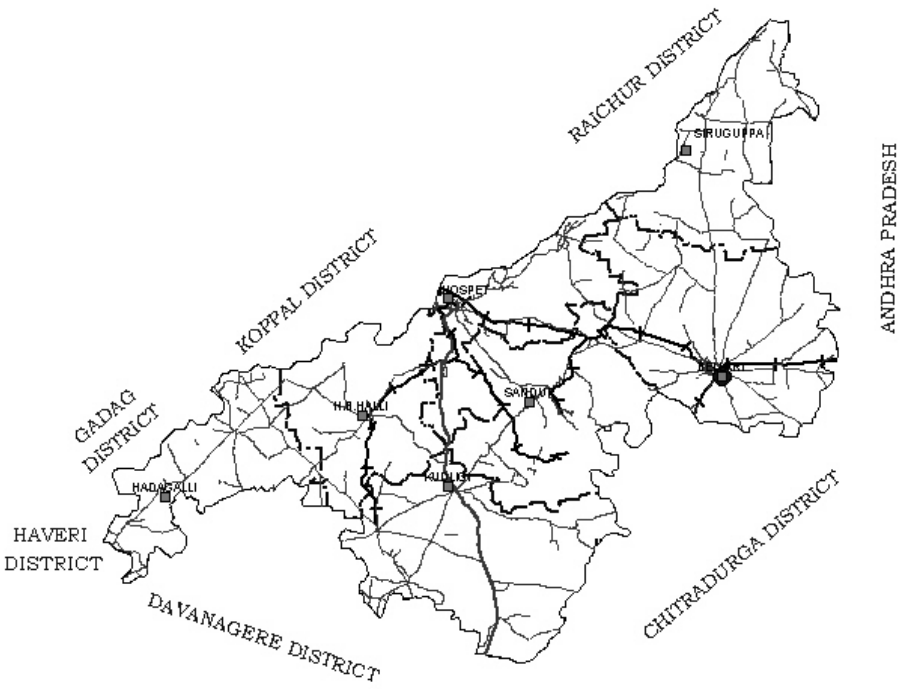

SOUTH WESTERN REGION

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FOREWORD

Ground water contributes to about eighty percent of the drinking water requirements in the rural areas, fifty percent of the urban water requirements and more than fifty percent of the irrigation requirements of the nation. Central Ground Water Board has decided to bring out district level ground water information booklets highlighting the ground water scenario, its resource potential, quality aspects, recharge – discharge relationship, etc., for all the districts of the country. As part of this, Central Ground Water Board, South Western Region, Bangalore, is preparing such booklets for all the 27 districts of Karnataka state, of which six of the districts fall under farmers' distress category.

The **Bellary** district Ground Water Information Booklet has been prepared based on the information available and data collected from various state and central government organisations by several hydro-scientists of Central Ground Water Board with utmost care and dedication. This booklet has been prepared by Shri **L.J.Balachandra**, **Scientist 'C'.** The figures were prepared by S/Sri. H.P.Jayaprakash, Scientist-C and K.Rajarajan, Assistant Hydrogeologist. The efforts of Report processing section in finalising and bringing out the report in this format are commendable.

I take this opportunity to congratulate them for the diligent and careful compilation and observation in the form of this booklet, which will certainly serve as a guiding document for further work and help the planners, administrators, hydrogeologists and engineers to plan the water resources management in a better way in the district.

(Dr.K.Md.Najeeb)
Regional Director

BELLARY DISTRICT AT A GLANCE

Sl. No.	Items	Statistics	
1	**General Information**		
	i. Geographical area (sq. km)	8420	
	ii. Administrative Divisions	1	
	iii. Number of Taluks	7 (Bellary, Hadagali, H.B.Halli, Hospet, Kudlugi, Sandur & Siruguppa.)	
	iv. No. of Panchayats /Villages :	189/554(524 Inhabited+30 uninhabited)	
	v. Population (As on 2001 Census)	20,27,140	
	vi Annual normal rain fall (1996-2005)	611 mm	
2	**Geomorphology**		
	Major Physiographic Units	Northern maidan region, monotonous, treeless and expansive plateau landscape. Sandur hills are the main physical features dividing the district into eastern and western parts. The principal hill ranges are Kumaraswamy hills, Ramanmalai, and Jambunatha hills. The highest peaks of the hills are in kumaraswamy hills with 1084m amsl. The average altitude of the district is 493.71m amsl.	
	Major Drainage	Drained by Tungahadra river, which runs along the border and forms the boundary of the district for about 300 kms. Chikkahagari & Hagari/Vedavathy are tributaries drains south to north of the district. The drainage pattern is dendritic to subdendritic.	
3	**Land use (ha)**		
	Forest area (District at a glance)	27017	
	Net area sown (District at a glance)	459250	
4	**Major soil types**	Sandy loam soil along the stream beds, Red soil in elevated places, black soil in irrigated land and in other parts.	
5	**Area under principal crops (2005-2006) in ha**	**Crop** Jower Paddy Maize Bajra Ragi Wheet **Total cereals** Gram Tur Other pulses	**Area** 88970 66807 53782 18570 5794 848 **234771** 10510 8889 14027

		Total Pulses	**33426**
		Sun flower	88158
		G. nut	72964
		Others	13811
		Total oil seeds	**174933**
		Cotton	42373
		Sugar cane	5352
		Tobacco	560
		Others	177713
		Total Cash crops	**225998**
6	**Irrigation by different sources (District at a glance 2005-2006 Minor irrigation census-2001)**	**<u>Number</u>**	**<u>Area (ha)</u>**
	Dug wells	2860	7159
	Bore wells	17768	53256
	Tanks/ Ponds	-	2054
	Canals	2+Branch canals	79706
	Lift	3322	11943
	Other Sources	**-**	7115
	Net Irrigated Area (ha)	161233	
	Gross irrigated area (ha)	204259	
7	**Number of ground water monitoring stations of CGWB (as on 31-03-2007)**		
	Number Dug wells	37	
	Number of Piezometers	23 (10 VRB project+13 Hydrology Project)	
8	**Predominant geological formations**	The major geological formation is granitic gneiss, Younger granites and schist. Recent alluvium along the river course.	
9	**Hydrogeology**		
	Major Water Bearing Formations		
	Shallow aquifers of alluvium along the stream courses up to 10m and weathered zones of gneisses Granites and occur between the depths of 9 to 25m bgl.		
	Deeper aquifers of jointed and fractured gneisses, granites and Schists occur between the depths of 30 to 197 m bgl.		
	Pre-monsoon Water Levels during 2006	1.72 – 19.48 m bgl (average 4.77m)	
	Post-monsoon Water Levels during 2006	1.22– 17.61 m bgl (average 3.47m)	
	Long term water level trends (1997-2006) in m/year:	NHS (Dug wells)	From National Hydrograph Stations (NHS) water levels have shown rising trend in the range of 0.003 to 0.404 & average rise of 0.125 m/year, while at 24 NH Stations water levels have recorded falling trend in the range of 0.003 to 0.588 with the average of 0.473 m/year.

		NHS (Piezometers)	At four National Hydrograph Stations (Piezometers) water levels have shown rising trend in the range of 0.005 to 0.487 with the average of 0.251 m/year, at eight piezometers water level have shown falling trend in the range of 0.057 to 1.528 with the average of 0.535 m/year.
10	**Ground water exploration by C.G.W.B. (as on 31-03-2007)**		
	No of wells drilled-VRB Project Regular exploration program (2001 to 2003) Hydrology project		EW: 47, OW: 12, PZ: 12 EW:21, OW: 12 PZ:13
	Depth range-VRB Project Regular exploration program (2001 to 2003)		09 to 90 m bgl 181 to 197m bgl
	Discharge- VRB Project Regular exploration program (2001 to 2003)		0.22 to 11.20 litres / second 0.00 to 5 litres / second
	Transmissivity (Overall)		1 to 350 m^2 / day
11.	**Ground water quality**		
	Presence of chemical constituents more than the permissible limit		Chemical quality of Ground water is suitable for all purposes in major parts of the district with low sodium type of ground water except in few pockets where Nitrate & Chloride concentration is high in few pockets (parts of Hospet, Siruguppa, Hadagali & south of Kudlugi taluks). SAR ranged 0.1 to 9.4 and % Sodium ranged from 27.47 to 75.37.
	Type of water		Low sodium type
12.	**Dynamic Ground Water Resources** (ham) (2004)		
	Net Annual Ground Water Availability		52961 ham
	Existing gross Ground Water Draft for all use		27202 ham
	Projected demand for Domestic and Industrial uses up to 2025		6502 ham
	Stage of Ground Water development as on March 2004 (%)		51.36
13.	**Awareness and Training Activity**		
	Mass Awareness Programmes organised		1 at Bellary
	Water Management Training Programmes organised:		Nil
14.	**Efforts of artificial recharge & rain water harvesting**		
	Projects completed by CGWB (No and amount spent)		Nil

	Projects under technical guidance of C.G.W.B (numbers)	Nil
15.	**Ground water control and regulation**	
	Number of OE Blocks Number of Critical blocks Number of blocks notified	Nil Nil Nil
16.	**Major ground water problems and issues**	Water logging conditions in Tungabhadra command areas especially in Tungabhadra low level and high level canal area which are showing rising water level trends, salinity due to water logging and soil deterioration due to intensive irrigation and extensive use of fertilizers. Power cut, shortage/ fluctuation is another burning issue in lifting available ground water.

BELLARY DISTRICT

1.0. INTRODUCTION

1.1. General

The new Bellary district was formed in 1997. It is famous for its world heritage site at Hampi as listed in UNESCO, which has splendid ruins of ancient city/capital of Vijayanagar spread in an area of 26sq. kms. on right bank of Tungabhadra river. Tungabhadra River forms the natural boundary dividing the district on the west from Dharwar and on the north the Raichur district. Agriculture is the main occupation and 75% of the labour force is dependent on agriculture. Bellary district consists of two widely differing natural divisions-the eastern division is flat and almost treeless, Western division with constant succession of wild, rugged hills and comparatively having high elevation.

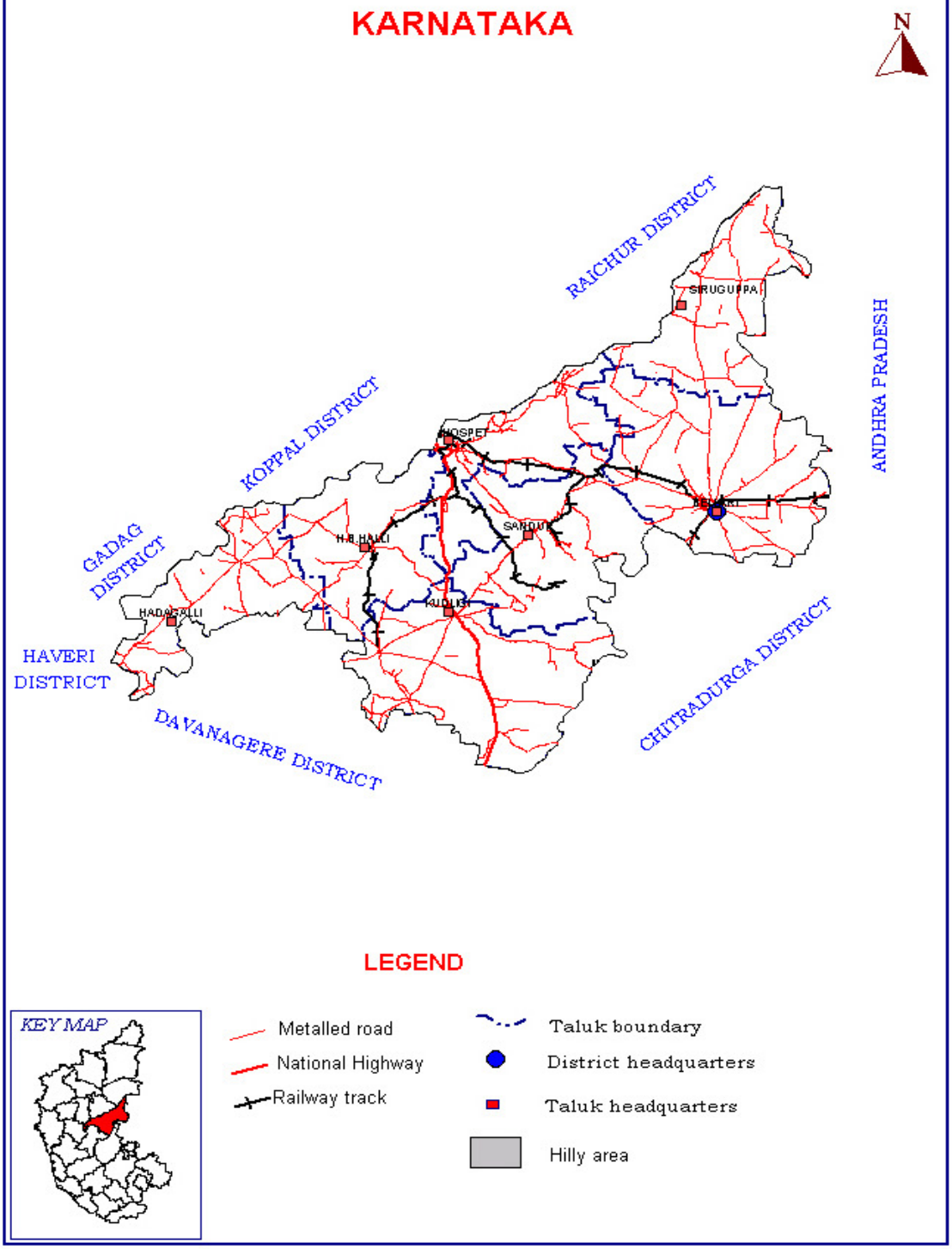
The population in the district is around 20, 27,140 (as per 2001 census), out of which rural population is 1320290 (65.13%). The density of population is 241 per square kilometres. The Scheduled caste population is 37421 and Scheduled tribe population is 36438. The sex ratio is 970 females for every one thousand males. The irrigation in the district is mainly is from surface water source wherein about 58 % of the area is irrigated from canals, tanks, and lift irrigation. However about 38% of the total irrigated area is coming from ground water source mainly through bore wells followed by open wells respectively. The district falls in Krishna river basin. The cultivable land is about 541473hactares (2000-2001 census) out of which 81505 hectares (15%) is irrigated. The district is bestowed with good surface water resources provided by rivers, canals, and tanks. The river Tungabhadra is having good potential for multipurpose, major, medium and minor irrigation projects. The water of Tungabhadra are reputed for its sweetness and made use for water supply. The total number of minor irrigation schemes in the district is about 24055 covering 549 villages in the district. Out of 24055, 2860 are dug wells, 17768 are shallow tube wells, 104 are surface flow structures and 3322 are lift irrigation indicating surface water as main source of irrigation.

1.2. Location

The district Bellary is elongated from south-west to north-east and is located in the eastern part of the Karnataka state and lies between the north latitude 14^0 $30^{'}$: 15^0 $47^{'}$ east longitude 75^0 $40^{'}$: 77^0 $11^{'}$. The geographical area of the district is about 8420 Sq.kms. The district is having south-west to north-east spread of about 186.7 kms. And east west spread of 161 kms respectively. Physiographically it is occupied by hills in the central part with plains on the east and west. Bellary district is bounded on the north by Koppal and Raichur districts, on the west by Gadag and Haveri district, on the south by Davanagere and Chitradurga districts of Karnataka state and on the east by Anantapur and Kurnool districts of Andrapradesh. The Sandoor hills are the main physical features in the district which starts from Mallapuram on the bank of Tungabhadra and runs 48 kms in the south easterly direction up to Bellary. A map showing administrative set-up of the district is given in figure-1.

Fig-1

ADMINISTRATIVE SET-UP
BELLARY DISTRICT
KARNATAKA



1.3. Administrative set up

The district comprises of seven taluks namely Bellary, Hadagali, H.B.Halli, Hospet, Kudlugi, Sandur and Siruguppa. Among the seven taluks Bellary taluk is the largest having an area of 1689sq kms. This is 20% of the total area of the district. Hospet taluk is the smallest with total geographical area of 934 sq. kms. The district is having one revenue sub division at district head quarter at Bellary (Figure-1).

1.4 Communication

The district is well connected by high ways and other main roads. Fairly good network of roads exists connecting taluk head quarters with the district head quarters and hoblis to various taluk head quarter. Total there are 288.60kms of NH, 631.93kms of SH, 1323.30 kms of major district roads and village road length of 1200.65 kms serves as communication system. Added to this the South Central railway line (Hubli-Guntakal) passes through Hospet and Bellary. Overall 310 kms length of railway roads falling in all the taluks except in Hadagali and Siruguppa taluks adds the communication network.

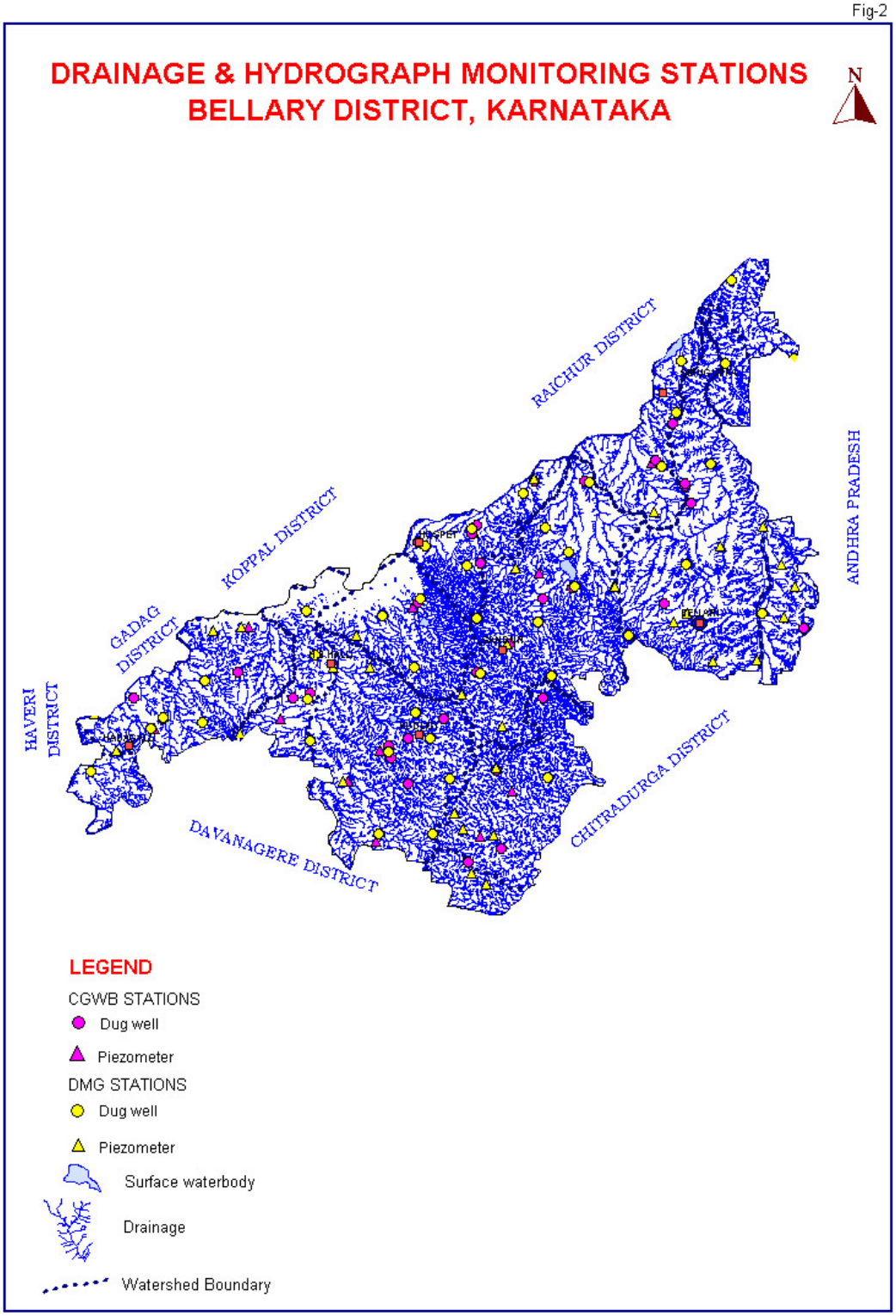
1.5 Drainage

The district falls in Krishna basin. The Tungabhadra perennial river forms major drainage system in Bellary district. Tungabhadra enters the district at Kuruvatti village in Hadagali taluk and forms the boundary for nearly 300 kms and drains from south western part, than flows north east to east west and drains out of the district. Major interstate irrigation project constructed across this at Mallapuram village in Hoospet taluk with an catchment area of 28179 sq.kms. Chikka Hagari and Hagari/Vedavathi are the tributaries of Tungabhadra runs south to north from the southern tip of the district. These are seasonal rivers flows during monsoon season. Chikkahagari River originates in Guddada Ranganahills near chitradurga and drains into bellary district flows south to north and joins Tungabhadra at Mallapuram after a travel of 64 kms in the district. A Medium irrigation project across this river exists at Malavi in H.B.Halli taluk. Hagari/Vedavathy the other tributary originates near Mallaianagiri hills in chikmagalur distyrict6 and enters the eastern part of the Bellary district and drains Hadagali and Kudlugi taluks before joining to Tungabhadra with a travel of 92 kms at Bagavadi village in Siruguppa taluk. Number of minor streams which rises locally and ultimately drains into Tungabhadra. Naarihalla is one among them which is damed (medium irrigation project) at Taranagar in Sandur taluk useful for irrigation in the taluk. The drainage in the district is dendritic to sub-dendritic in nature. Dense drainage is noticed in the eastern and western part of the district and sparse drainage is noticed in the central part. The drainage analysis in Hagari, Garanihalla, Chinnahagari and Vedavathy river/stream indicates that the length of the streams ranged 96 to 172 sq.kms., The drainage area ranged from 3522 to 7329 sq.kms, falls in 5th and 6th order stream, drainage density ranged from 0.72 to 1.70 L/AU km/km^2 and average slope ranged from 1.65 to 1.78 DL/AU. The drainage map of the district is in the figure-2.

1.6 Crops and irrigation practices

As per 2001 census, 84.74% of land holdings are having less than 4ha, which cover 53.04% of the total area. The major crops grown are the cereals with an area 234771ha where jowar (37.89%), paddy (28%), maize (22.90%, and Bajra (7.9%) are the major cereals. This follows the cash crops in an area 220646ha in which other cash crops and cotton are the major crops.Then follows oil seeds with an area

Fig-2


DRAINAGE & HYDROGRAPH MONITORING STATIONS
BELLARY DISTRICT, KARNATAKA
N
RAICHUR DISTRICT
ANDHRA PRADESH
KOPPAL DISTRICT
GADAG DISTRICT
HAVERI DISTRICT
DAVANAGERE DISTRICT
CHITRADURGA DISTRICT
LEGEND
CGWB STATIONS
Dug well
Piezometer
DMG STATIONS
Dug well
Piezometer
Surface waterbody
Drainage
Watershed Boundary

of 174943ha in which sunflower as the major crops. Lastly pulses with an area of 33426ha in which other pulses and gram are the major crops. The net sown areacomprises 56.47% of the total geographical area, in which 15.80% of the area is being sown more than once. As per the records about 20.40% of the net sown area is irrigated through surface water source, and about 13.15 of the area is irrigated through ground water. The surface water irrigation practices is through canals with the total length of 456 kms from T.B. major irrigation project and two medium irrigation projects (Hagaribommanahalli and Naarihalla) with the other surface water sources like tanks and lift irrigation. As per the census records, the district has 24055 minor irrigation schemes, of which 2860 pertains to dug wells, 17768 tube wells, 104 surface water flow schemes and 3322 lift irrigation schemes.

1.7 Activities carried out by CGWB

Bellary district is covered under Vedavathi River Basin Project studies during 1971 to 1980. The main objective of this project is to improve the methodology of Ground Water Resources Evaluation and to establish parametric indices for optimum development of scarce ground water resources and to bring out necessary user maps. Under this project 47 exploratory wells, 12 observation wells and 10 pizometers were constructed. The result reveals that total depth between 27 to 97 m, water bearing fractures encountered between the depths of 16 to 36 and from 64 to 95m. The discharge range between 0.22 to 11.20 lps. Central Ground Water Board has carried out Systematic Hydrogeological surveys, Reappraisal Hydrogeological surveys and Groundwater Exploration in the district. The deep drilling up to 200m depth was carried out under Ground Water Exploration program during 2001 to 2003. Overall 21 Exploratory wells and 12 Observation wells and one pizometer were drilled. The groundwater exploration have revealed the existence of potential zones at deeper depth of 181 to 197m with discharge range one to 5lps. Total 13 numbers of purpose built piezometers constricted in the district and were constructed during 1998-99 for continuous water level monitoring, in which automatic water level indicators being installed. Besides this, Central Ground Water Board maintains a good network of observation wells (NHS) in the district, which are monitored periodically to keep a close vigil of water level variations.

2.0 RAINFALL AND CLIMATE

The climate of Bellary district is quite moderate shows dryness in major part of the year and a hot summer from March to May months where mean maximum temperatures ranges from 23.2°C to 40.4°C. June to September is the southwest monsoon period where the temperature 19.7°C to 35.1°C, October and November is the post monsoon retreating monsoon season with clear bright weather with the mean daily temperature ranges from 14.4°C to 31.1°C. During December to February weather remains dry and comparatively cool season. The skies clouded or overcast during southwest monsoon. During October and November some of the depressions and cyclonic storms originates in Bay of Bengal moving in a westerly to north westerly direction which passes through the district causing wide spread heavy rains and high winds. The mean maximum temperature in the district is 40.4°C. and the mean minimum temperature is 14.3°C (January month). Relative humidity ranges from 48 to 74% in the morning and in the evening it ranges from 27% to 61%. The winds are light to moderate with some strengthening in the south west monsoon. During October to April, the winds blow from directions between north east and south

east and are calm in morning. Winds blow southwest and northwest direction during May to September with an average velocity of 12 kmph. These high winds combined with higher temperature result in high degree of evaporation to the tune of 12.5 mm/day in May against a minimum of 5.4 mm/day in the month of December.
Bellary district receives rainfall from southwest monsoon from June to September and northeast monsoon from October to December. Overall on an average, there are 43 normal rainy days (1901-1970), where minimum in Bellary taluk with 32.4 rainy days, maximum in Sandur taluk with 56.4 rainy days. Actual rainy days recorded during the year 2005 ranged from 41 to 67 wherein Kudlugi taluk is the minimum with 41 rainy days and maximum is in Sandur taluk again with 67 rainy days. As per the 1951 to 1970 rainfall data analysis, the precipitation during southwest monsoon accounts for 60% of the total amount of rainfall and during northeast monsoon it is 24% the remaining 11.62% is sporadic in summer. September is the wettest month in the year. The analysis of the last ten years rainfall data (1996-2005) shows that the highest rainfall occurred in Sandur taluk with 752.1mm and the lowest at Bellary with 452mm and over all annual normal rain fall in the district is 611mm. Again it is proved that south west monsoon contributes 63% of the total rainfall in the district and north east monsoon with 25.36%. Deficiency in rainfall is observed in the four taluks for the last ten years in the range of 2.40% (Kudlugi taluk) to 26.02% (Bellary taluk). The excess rainfall in the range of 15.41% (Siruguppa taluk) to 23% (Sandur taluk) was observed.

3.0 GEOMORPHOLOGY AND SOIL TYPES

The district may be classified as Northern Maidan region with monotonous, treeless, and expansive plateau landscape. The step like landscape, hills and ridges are the general features of the northern maidan region. The central part of the Bellary district is occupied by hills and plains to east and west. The Sandur hills run North West of the district dividing the district in to two distinct parts. The eastern part consists of Hospet, Bellary and Siruguppa taluks. The western part consists of Hadagalli, Hagaribommanahalli, Kudlugi and Sandur taluks. The Tungabhadra River forms the eastern and northern boundary of the district. The average elevation of the district is 493.71m amsl. The Sandur hills are the main physical features with valley and its lush green forest growth. It extends from Mallapuram on the bank of river Tungabhadra and runs for 48 kms in the south easterly direction up to Bellary. The highest elevation in the ridge is the famous Kumaraswamy hills which is 1084m amsl. Ramanmalai (993.1m amsl) and jambunatha hill (908 m amsl) are the major ridges in the district. The other ridges in the district are Ramagod (1058 m amsl) and Donimalai (1027m amsl). Some of the isolated peaks in the district are Kallahalli gudda (836m amsl), Narasimhadevaragudda (775 m amsl), Gudekote (836m amsl) and Bellary hills (602m amsl). The sandur hills, the mallappanagudi and kallahalli gudda ranges are of dharwar schists while the rest of the hills and clusters are of older granitic formation.

The soils of the district are derived from Granites, Gneisses and Schistose rocks. The Sandy loam soil mixed with black and grey soil occurs along the stream beds. These are originated from gneisses and granites. They are permeable and mildly alkaline in nature. The thickness of the soil varies from 0.2 to 1.00m. The Red soil are the major type of soil in the district, found mainly at elevated places especially at fringes of hills due to decomposition of rocks and surrounding granitic and gneissic

hills. These soils are with high permeability and neutral PH. Black soil with high initial infiltration rate when dry and cracked. On getting wet cracks will close and infiltration rate will be very low. These are derived from schistose rocks. The Black soil is found in the prolonged submerged areas and canal command areas having low Permeability. It is calcareous and mildly alkaline in nature.

4.0 GROUND WATER SCENARIO

4.1 Hydrogeology

Hydrogeologically, the district forms a part of hard rock terrain comprising granitic gneiss, younger granites and schistose formation of Archean age. The alluvium occurring in old river course and in flood plains of granitic and gneissic terrain, which are noticed in Hagari river course of Kudlugi, Bellary and Siruguppa taluks. The wells constructed in these areas tapping alluvial aquifers are with perporated cement ring dug wells and fitted centrifugal pumps. Even cavity wells were noticed near kottur area. The granitic gneiss and gneissic granite which form major aquifers in the district recorded a weathered and semi weathered zone up to 25m. Schistose formation has weathered formation with less granular and fractured as openings than granites and gneisses. Occurrence and movement of ground water are controlled by the degree of weathering, fracturing and the geomorphologic set up in the area. The hydrogeological details of the district are presented in the figure-3.

4.2.1 Occurrence of ground water

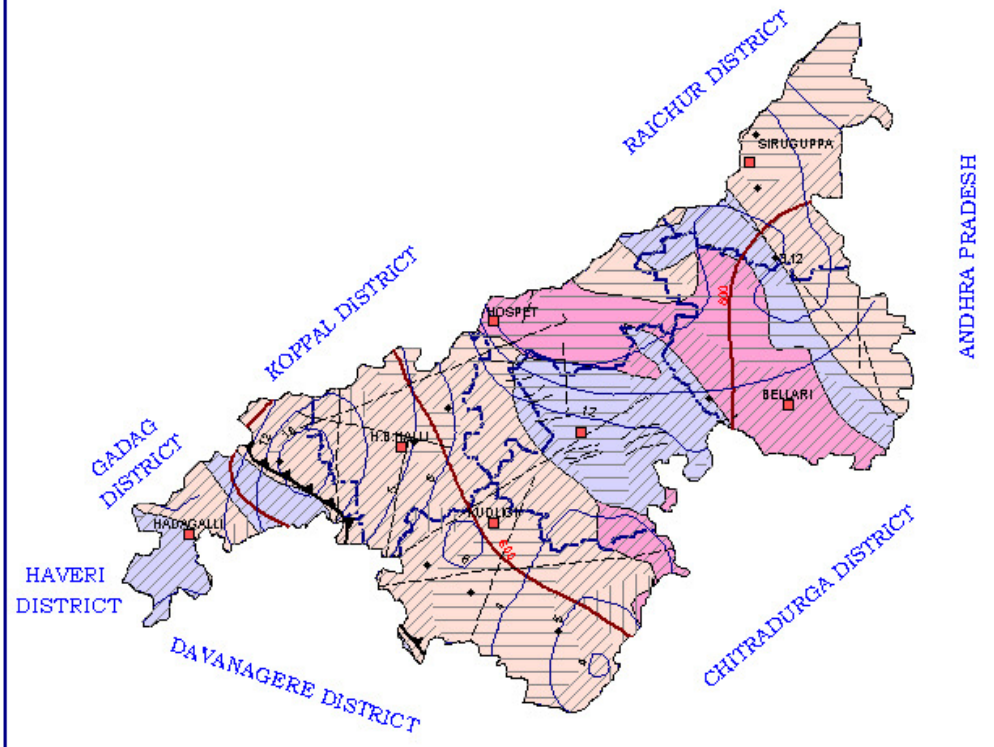
The ground water occurs under phreatic and semi confined conditions in weathered and fractured rocks. The principal rock types are granites, gneisses, and schist has no primary porosity but possess fractures and joints as secondary porosity which forms water bearing and yielding properties of these rocks. The ground water in the above rock types reported that the potential aquifers exist down to the depth of 138mbgl in the gneissic and granitic rocks where as schistose rocks holds less potential zones due to its compactness and clay filled weaker zones. Alluvial aquifers with the thickness of up to 25 m yields copious water as observed in PD halli. The deep-seated fracture is common to the depth range of 80 to 110m along major lineaments. The principal source of recharge is rainfall. In command areas seepage from reservoirs canals and percolation from applied irrigation water form additional recharge source.

4.2.2 Depth to water level

Out of 21 National Hydrograph Stations (NHS-dug wells) located in Bellary district, the depth to water levels recorded during May-2006 was in the range of 1.72 to 19.48m bgl. The depths to water levels recorded during post monsoon period (November 2006) were in the range of 1.22 to 17.61m bgl. The average depth to water level during pre-monsoon is 6.78m and in post monsoon it is 5.94m. The pre-monsoon and post-monsoon depth to water levels is depicted in Figure-4 and Figure-5. Further the depth to water level between 0.00 to 5.00m in both pre and post monsoon periods were observed in parts of Hospet taluk, most of the part of Siruguppa taluk and in some parts of west and North West of Bellary in Bellary taluk due to Tungabhadra canal irrigation activity. The major portion of the district shows 5.00m to 10.00m water level during May-2006, as well as during November 2006. The major part of Kudlugi taluk, part of Hadagali and sandur taluk and east of Bellary

Fig-3

HYDROGEOLOGY
BELLARY DISTRICT
KARNATAKA



LEGEND

Geology

- Schist
- Granite
- Gneiss

Ground Water Prospects

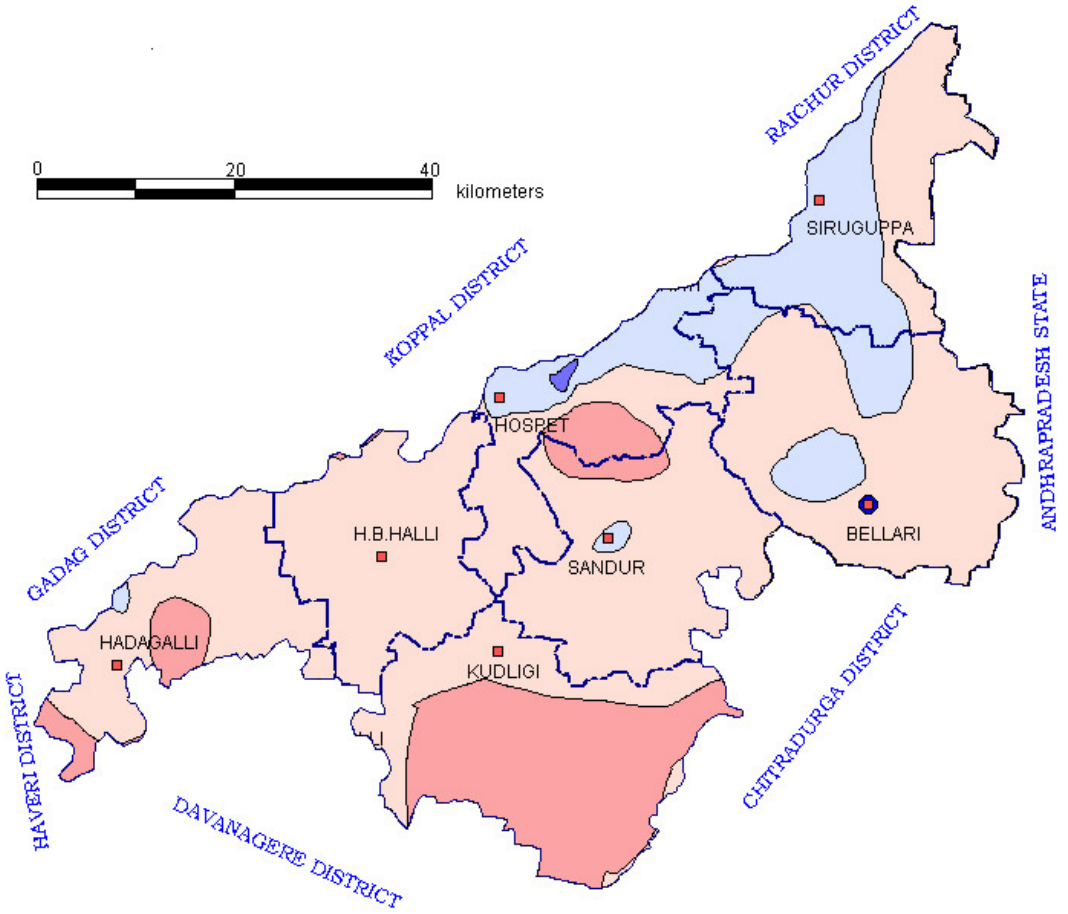
- Yield upto 1 litres per second
- Yield upto 5 litres per second
- Yield >5 litres per second
- 5 Borewell with Yield in litres per second

- Lineament
- Shear
- 600mm Isohyet
- 10 Decadal mean water level in m bgl
- Taluk boundary
- Taluk headquarters

Fig - 4

DEPTH TO WATER LEVEL PRE-MONSOON (MAY-2006)

BELLARY DISTRICT, KARNATAKA



LEGEND

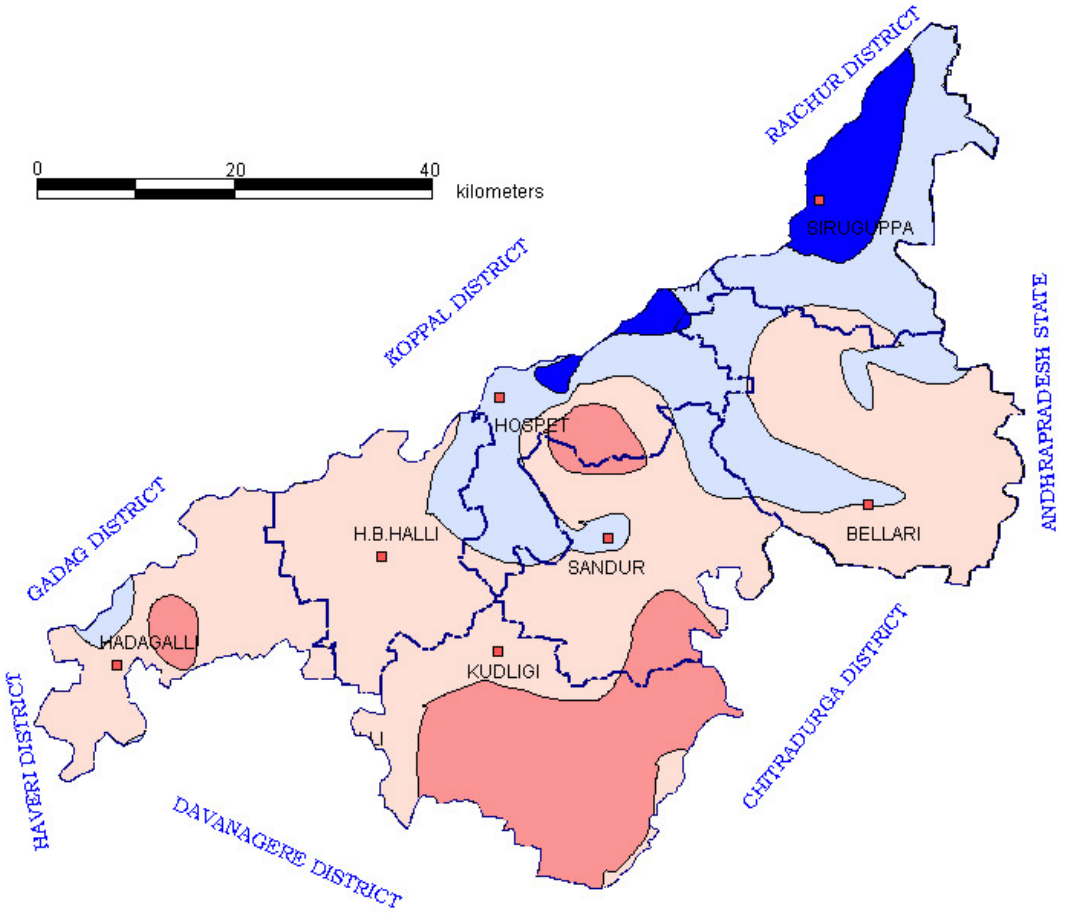
Depth to Water Level (m bgl)

- < 2
- 2 - 5
- 5 - 10
- 10 - 20

Fig - 5

DEPTH TO WATER LEVEL POST-MONSOON (NOVEMBER-2006)

BELLARY DISTRICT, KARNATAKA



LEGEND

Depth to Water Level (m bgl)

- < 2
- 2 - 5
- 5 - 10
- 10 - 20

taluk is covered either with hill ranges and partly bad land topography. Such areas are left out for want of sufficient control over the water level data. In the remaining part, due to uneven topography, the depth to water level changes with a short distance. The water levels in the 5-piezometer national hydrograph stations ranged from 4.05 to 31.72m bgl during May 2006 and 3.59 to 37.83m bgl during November 2006.

4.2.3 Seasonal water level fluctuation

Consequent upon seasonal rainfall, the water levels record a rise indicating the build up of storage in ground water reservoir. During the non-monsoon period, this gets depleted due to exploitation and natural discharge. Therefore, the water levels, in general show a receding trend from December to May. The seasonal water level fluctuation for the year 2006 is available for 21dug well national hydrograph network stations. Where 85.71 of the NH Stations have shown a rise in water levels in the range of 0.07 to 5.46 m, 14.29 percent of the stations have recorded a fall in water levels in the range of 0.08 to 0.50m. The seasonal water level fluctuation for the year 2006 is available for 13 piezometer hydrograph network stations, which is in the range of 0.59m to 1.90m. The average water level fluctuation in pizometer during 2006 is 1.24m.

4.2.4 Long-term water level trend

The long term water level trend is analyzed in 43 NH Stations for the period from 1997 to 2006, where 19 stations have shown rising trends in the range of 0.003m/y to 0.407 m/y and the average rise in water levels is 0.125 m/y. Similarly falling trend were observed in 24 national hydrograph network stations in the range of 0.008m/y to 1.675 m/y with the average fall of 0.473 m/y. The average maximum rise in water levels over the years is observed in Kudlugi taluk is 0.239 m/y and the least 0.061 m/y in Siruguppa taluk. Maximum fall in water levels are observed in Sandur taluk with 1.209 m/y and minimum fall is in Bellary and Kudlugi taluks with 0.214 m/y. Similarly the water level trend in 13 piezometers over the years for the period 1997 to 2006 showed rise in water level in five piezometers in the range of 0.005 to 0.487m/y with the average rise in water level is 0.251 m/y. Similarly fall in water level in 8 piezometers in the range of 0.057m/y to 1.528m/y with an average fall of 0.535m/y.

The last ten years (1997 to 2006) Pre monsoon water level data indicates that mean pre monsoon water level is in the range of 1.68m to 15.67m with an average of 6.14m. However rise in pre monsoon water level were observed in 11 stations in the range of 0.008m/y to 0.588 m/y with an average of rise of 0.155 m/y. Further fall in pre monsoon water levels were observed in 20 stations in the range of 0.027 to 0.780 m/y with an average fall of 0.213 m/y. Similarly the post monsoon water levels in the district for the last ten years indicates that rise in water levels in 13 stations in the range of 0.005 m/y to 0.369 m/y with an average rise of 0.12 m/y. The fall in post monsoon water level in the last ten years were observed in 19 stations in the range of 0.029 m/y to 0.783 m/y with an average fall of 0.280 m/y.

4.2.5 Aquifer systems encountered in the area

The study of aquifer geometry and parameters have been attempted in Bellary district by Central Ground Water Board, South Western Region, Bangalore, under its systematic and reappraisal hydrogeological surveys, ground water exploration

programme and in Vedavathy River Basin Project through drilling exploratory bore wells at select places. Overall 18 exploratory wells, 2 observation wells, 11 piezometers and 28 water table wells were drilled in VRB project. And in regular exploratory drilling program between 2000 and 2003, 21 exploratory wells, 12 observation wells were constructed in seven taluks of the district. The aquifer zones are weathered / fractured & jointed granites, gneisses and schists occurring at various depths from 7to 197m bgl.
The aquifer geometry in shallow zone is limited to 25 m, it has exploited through dug wells from the weathered mantle of the formation. The dug well has shown the specific capacity ranges from 0.50 to 727.86m^3/day/m/dd. The transmissivity in granites/gneiss ranged from 0.24 to 292.38m^2/day. The findings of VRB project indicates the fractured rock transmissivity ranged from 50 to 350m^2/day and fractured block transmissivity is ranged from 40 to 50m2/day. In schistose formation it ranged from 1 to70 m^2/day. The gross storativity of the fractured block is of the magnitude of 10^{-3} in granites and 10^{-4} in schist.

The exploratory bore wells drilled in the district where depths ranging from 96 to 200.00m bgl. The discharge ranges from <1.0 to 8.20 lps. The yield-cum-recuperation tests conducted on the wells show that the drawdown range of 1.20m to 30.61m, Specific capacity ranged from 2.06 250 m^3/day/m/dd, transmissivity of aquifer material in general range from 1.54 to 345 m2/day and the static water level recorded is in the range of 1.68m to 32.15m bgl.

4.3 Ground water resources

Ground water resources for Bellary district is estimated taluk wise and presented in the table-1, which indicates that the Net annual ground water availability in the district is 52961 ham, Gross ground water draft is 4132ham, and Ground water balance available for future ground water development is 34117 ham. Taluk wise data viz. Net ground water availability, Existing ground water draft for irrigation, Existing gross groundwater draft for domestic and industrial water supply, Existing gross ground water draft for all use, Allocation for domestic and industrial use for next 25 years, Net ground water availability for future irrigation development, Average crop water requirement, Balance of ground water irrigation potential and the Stage of ground water development is shown in the table.

Based on the stage of ground water development, 100% area in Hospet taluk, and almost 96 % of the area in Sandur taluk falls in safe category where there is scope for further ground water development. In Siruguppa, Bellary and Kudlugi taluks it ranged from 40 to 51% of area falling in safe category, where proper graound water management practices to be followed for further ground water development. Hadagali taluk falls in OE category where it is required to recharge ground water with artificial recharge methods and further ground water development is to be avoided. 50% of the area in Kudlugi taluk falls in Semi critical where it is to adopt proper management practices for avoiding further critical stage. Bellary aout 60% and Siruguppa 49% of the area not covered under canal irrigation falls under OE which also requires attention. Similarly in Kudlugi 10 % of the area falls in OE where proper ground recharge schemes to be implemented. Taluk wise stage of ground development computed as on March 2004 is presented in the figure-6.

Fig - 6

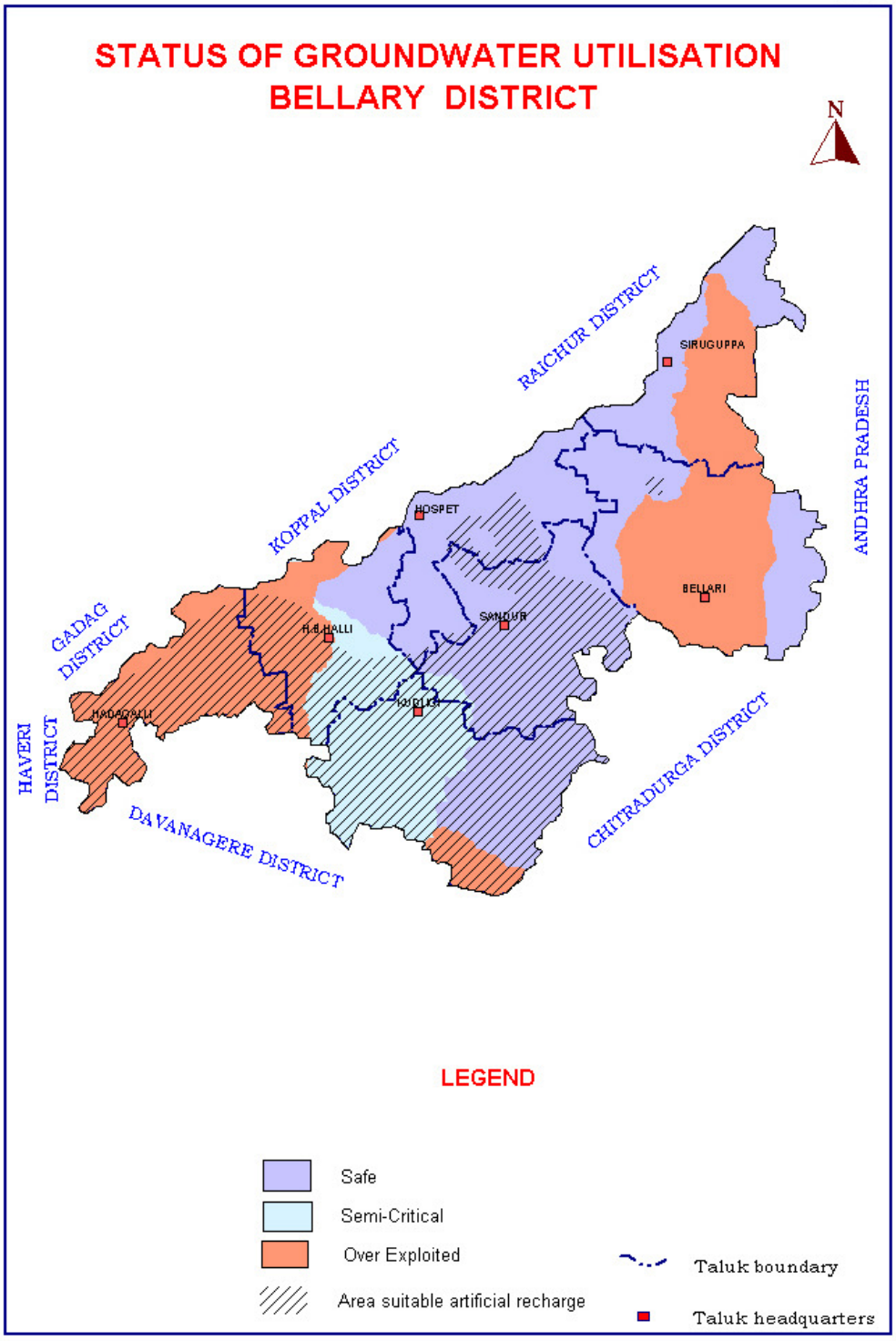

STATUS OF GROUNDWATER UTILISATION
BELLARY DISTRICT
N
RAICHUR DISTRICT
SIRUGUPPA
ANDHRA PRADESH
KOPPAL DISTRICT
HOSPET
BELLARI
SANDUR
H.B.HALLI
GADAG DISTRICT
HADAGALLI
HAVERI DISTRICT
KUDLIGI
CHITRADURGA DISTRICT
DAVANAGERE DISTRICT
LEGEND
Safe
Semi-Critical
Over Exploited
Area suitable artificial recharge
Taluk boundary
Taluk headquarters

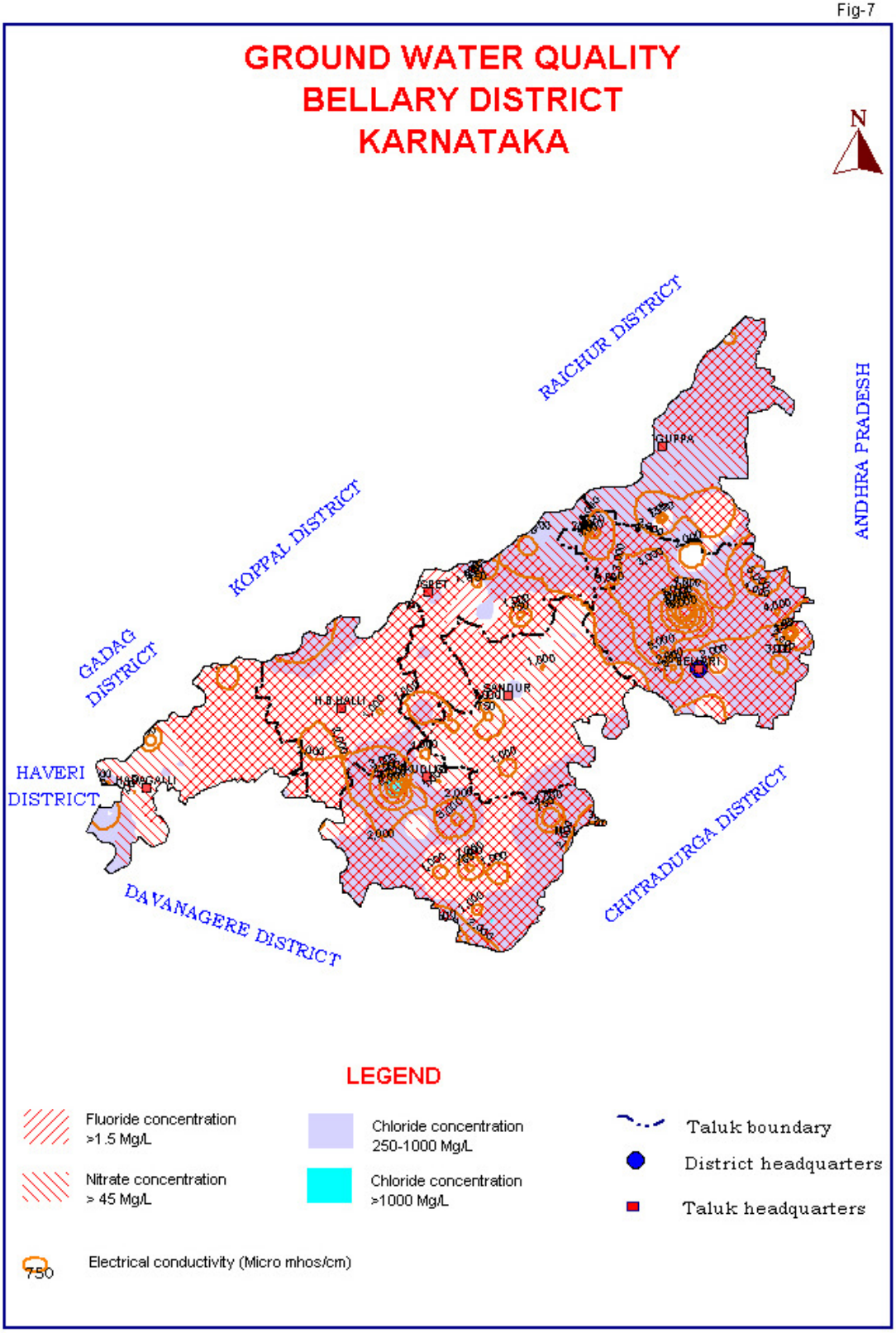
Table-1 Taluk-wise Groundwater Resource of Bellary district as on March 2004

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	WATER AVAILABILITY FOR FUTURE IRRIGATION	AVERAGE CROP WATER REQUIREMENT	BALANCE GROUND WATER IRRIGATION POTENTIAL AVAILABLE	CATEGORISATION (%)			
									SAFE (%)	SEMI-CRITICAL (%)	CRITICAL (%)	OE (%)
	HAM	HAM	HAM	HAM	HAM	HAM	(M)	HAM	%	%	%	%
Bellary	12703	2202	683	2886	1111	9447	0.89	10585	41			59
Hadagali	6242	5565	518	6083	875	608	0.82	743				OE
H.B.Halli	7544	6047	549	6596	881	699	0.71	980	24	32		44
Hospet	6654	1393	948	2341	1351	3910	0.85	4623	Safe			
Kudlugi	9634	6047	342	6389	532	3198	0.76	4213	40	50		10
Sandur	8778	1638	567	2204	889	6252	0.88	7136	96	4		
Siruguppa	1606	778	525	1303	863	10003	0.89	11208	51			49
Total	52961	23670	4132	27202	6502	34117	0.82	39488				

4.4 Ground water quality

The water samples from National Hydrograph Stations were analysed to decipher the shallow aquifer water quality. The results indicate that the water is alkaline in nature with average P^H value of 8.6 and overall range between 7.8 to 9.1. The average values of other important parameters like Ca-74ppm, Mg-68.88ppm, TH-469ppm, Cl-401ppm, F-1.18ppm etc., which are falling in desirable to permissible class as per "Indian standard drinking water specification'' except pH value is slightly higher, which falls beyond permissible limit. The Nitrate and Chloride contents are found more in few pockets in Hospet, Sirguppa and parts of Hadagali, and south of Kudlugi taluks. This is due to intensive irrigational activities in the command area especially in Hospet and in siruguppa taluks where farmers use maximum Nitrogen, Phosphate and sulphate fertilisers. It is observed Nitrate concentrations are beyond 100 ppm in the range of 106 to 380 ppm and the average Nitrate concentration is 144.33 ppm. Similarly, Chloride concentrations are observed in the range of 78 to 923 ppm with an average of 401 which falls in permissible class. However most part of the Bellary district where Chloride is exceeding the desirable limit of 250 ppm. Fluoride concentration ranged from 0.2 to 3.2 ppm with an average of 1.18 which is well within the permissible limit but exceeding the desirable limit and many samples exceed the permissible limit of 1.5 ppm. Based on this, ground water quality map of the district is presented in the Figure-7. Considering the ground water quality in the district for irrigation purposes it is found that the Specific conductance ranged from 870 to 4760 (average 2189 m mhos/cm at 25° c), Sulphate is in the range of 38 to 826ppm (average 241.83 ppm) and sodium is in the range of 41 ppm to 449 ppm (average 241.16). The Sodium Adsorption ratio calculated ranged from 0.1 to 9.4 indicating Low Sodium Type of ground water falling in excellent class. Based on percent Sodium it ranged from 27.47 to 75.37 falling desirable to permissible class. The Residual carbonate values calculated indicates less than 1.00 where it is excellent for irrigation purposes.

Fig-7


GROUND WATER QUALITY
BELLARY DISTRICT
KARNATAKA
N
RAICHUR DISTRICT
ANDHRA PRADESH
KOPPAL DISTRICT
GADAG DISTRICT
HAVERI DISTRICT
DAVANAGERE DISTRICT
CHITRADURGA DISTRICT
GURPA
SIRET
H.B.HALLI
SANDUR
HOSAPETE
BELLARI
LEGEND
Fluoride concentration >1.5 Mg/L
Nitrate concentration > 45 Mg/L
Chloride concentration 250-1000 Mg/L
Chloride concentration >1000 Mg/L
Taluk boundary
District headquarters
Taluk headquarters
750
Electrical conductivity (Micro mhos/cm)

4.5 Status of ground water development

4.5.1 Bellary taluk

The Bellary taluk with 99 villages with a population 625494 where besides surface water, ground water also is the source of drinking water. The remaining part where surface water is not available, groundwater is the main source for both drinking and irrigation purposes. There are 829 bore wells fitted with hand pumps, 116 bore wells used for piped water supply schemes, 143 bore wells used for mini water supply schemes. These are the major abstraction structures for drinking water needs in the taluk. Bellary taluk having total geographical area of 1689 sq.kms of which 71.64 % (121096ha) is of cultivable land, in which the net irrigated area is about 14.52 % (17585ha). Out of 14.52% about 4.2% (5125ha) of the net irrigated area comes from ground water. So the ground water for irrigation is being developed from shallow dug wells, dug-cum bore wells and shallow tube wells. Thus as per 2001 census there are 1687 shallow irrigation bore wells are the major ground water development structures for irrigation purpose followed by 580 shallow irrigation dug wells. The ground water developed from these structures is utilized for irrigation through adopting sprinklers (18 dug wells+64 shallow bore wells), drip irrigation (2 dug wells+43borewells), open channel (344 dug wells+1077 bore wells), underground channels (192 dug wells+438) bore wells) and others (23dugwells+65 bore wells). These are the major ground water development management practices in the taluk. The stage of ground water development is concerned 41 % of the area is safe as the pre-monsoon mean (May-96 to May-2005) water level is in between 4.59 to 6.25 m in most of the area. Further 59% of the area is falling under OE category where it demands proper ground water augmenting projects to recharge the ground water system. Shallow zone ground water can be developed for irrigation through dug wells in topographic lows and through shallow/deep bore wells in the other areas. The four exploratory bore wells drilled by the CGWB under VRB project have yielded 1.31 to 3.54 lps for the drilled depth up to 90.00mbgl. The exploration for deeper aquifer during 2001 to 2002 have constructed 4 exploratory wells and two observation wells in the depth range of 188 to 200m where deeper aquifers being explored. The yield was in the range of 1.1 to 6.3lps is useful and facilitating drinking water needs.

4.5.2 Hadagali Taluk

Hadagali taluk is mainly rain fed. The surface water utilisation /availability is limited to western part of the taluk, which falls under irrigation scheme/minor irrigation schemes. Groundwater is the main source of drinking water and irrigational purposes in Hadagali taluk. In general, ground water developed through dug wells, dug cum bore wells and bore wells. Bore wells are the main ground water development structures for both drinking and irrigation purposes. The statistical analysis of ZP, the yield range of 0.5 lps to 2.5 lps and all the villages in the taluk have been provided with drinking water supply like piped water supply schemes, mini water supply schemes and hand pumps. There are 438 bore wells fitted with hand pumps, 71 bore wells used for piped water supply schemes and 137 mini water supply schemes through bore wells, fulfilling drinking water needs and support the above fact. Hadagali taluk having total geographical area of 94853ha of which 75.95 % (72048ha) is of cultivable land, in which the net irrigated area is about 18.13 % (130635ha). Out of 18.13% about 12.44% (8965ha) of the net irrigated area comes from ground water which is major and only 5.69 % of the net irrigated area fall under surface water irrigation in western part of Hadagali taluk. So the ground water for

irrigation is being developed from shallow dug wells, dug-cum bore wells and shallow tube wells. Thus as per 2001 census there are 3133 shallow irrigation bore wells are the major ground water development structures for irrigation purpose followed by 188 shallow irrigation dug wells. The ground water developed from these structures is utilized for irrigation through adopting sprinklers (23 dugwells+16 shallow bore wells), drip irrigation (2 dug wells+0 bore wells), open channel (140 dugwells+1981 bore wells), underground channels (0 dugwells+924 bore wells) and others (23 dugwells+212 bore wells). These are the major ground water development management practices in the taluk. The CGWB studies reported that the unit draft ranges for dug well 0.003 to 0.02 MCM. DCB are 0.008 to 0.025 MCM bore wells are 0.03 to 0.05 MCM. Considering the Annual ground water development and water level trend during various seasons over the period the Hadagali taluk is categorised under OE (Overexploited). The pre-monsoon mean (May-96 to May-2005) water level is in between 12.18 to 15.67 m in most of the area. Considering the OE category where it demands proper ground water augmenting projects to recharge the ground water system. The five exploratory bore wells drilled by CGWB under VRB project have yielded 0.13 to 5.55 lps for the drilled depth up to 65.00mbgl. The exploration for deeper aquifer during 2001 to 2002 have constructed 3 exploratory wells and two observation wells in the depth range of 144 to 200m, where deeper aquifers being explored. The yield was in the range of 0.25 to 5.1 lps is useful and facilitating drinking water needs through ground water.

4.5.3 Hagari Bommanahalli Taluk

H.B.Halli yet another taluk is of mainly rain fed. The surface water utilisation/availability is limited to 856 ha (Department of information and statistics) area of the taluk, which falls under irrigation through Tungabhadra canal. Groundwater is the main source of drinking water and irrigational purposes in H.B. Halli taluk. In general, ground water developed through dug wells, dug cum bore wells and bore wells. Bore wells are the main ground water development structures for both drinking and irrigation purposes. All the villages in the taluk have been provided with drinking water supply like piped water supply schemes, mini water supply schemes and hand pumps. There are 323 bore wells fitted with hand pumps, 681 bore wells used for piped water supply schemes and 133 mini water supply schemes through bore wells, fulfilling drinking water needs and support the above fact. H.B. Halli taluk having total geographical area of 97599ha of which 67.36 % (65744 ha) is of cultivable land, in which the net irrigated area is about 16.50 % (10853ha). Out of 16.50% about 13.23% (9698 ha) of the net irrigated area comes from ground water which is major and only 3.37 % of the net irrigated area fall under surface water irrigation through canals of Tungabhadra. So the ground water for irrigation is being developed from shallow dug wells, dug-cum bore wells and shallow tube wells. Thus as per 2001 census there are 3206 shallow irrigation bore wells are the major ground water development structures for irrigation purpose followed by 3 shallow irrigation dug wells. The ground water developed from these structures is utilized for irrigation through adopting sprinklers (0 dugwells+1025 shallow bore wells), drip irrigation (0 dug wells+51 bore wells), open channel (0 dugwells+2139 bore wells), underground channels (0 dugwells+2304 bore wells) and others (3 dugwells+687 bore wells). These are the major ground water development management practices in the taluk. Considering the annual ground water development and water level trend during various seasons over the period the H.B. Halli taluk is categorised under Semi critical with 32 % and OE (overexploited)

with 44% in non command areas. In this taluk almost all irrigation dug wells are dry during pre monsoon period with the water level of more than 16.00m below ground level. However the irrigation bore wells are in operation and the yield reduces as the summer months approaches. The long term water level trend (1997 to 2006) at Hampasagara pizometer shows fall with 0.567 m/y and the water level during May 2006 is 21.35m bgl. Considering the OE and semi critical category where it demands proper ground water augmenting projects to recharge the ground water system. Further while taking ground water developmental activities priorities needs to be given for meeting the drinking water requirements of rural and urban areas. The five exploratory bore wells drilled by the CGWB under VRB project have yielded 0.15 to 6.50 lps for the drilled depth up to 87.00 mbgl. The exploration for deeper aquifer during 2001 to 2002 have constructed 3 exploratory wells and two observation wells in the depth range of 200m where deeper aquifers being explored. The yield was in the range of 0.61 to 5.50 lps is useful and facilitating drinking water needs through ground water.

4.5.4 Hospet taluk

About 26.74 % of the total geographical area of Hospet taluk is covered by forest. In the remaining part where surface water is the main source for both drinking and irrigation purposes, to a lesser extent is from ground water source. The low level ground water development in the taluk is attributed to the Tungabhadra canal water irrigation available for entire area except pockets of uplands. There are 966 bore wells fitted with hand pumps, 66 bore wells used for piped water supply schemes, 98 bore wells used for mini water supply schemes. These are the major abstraction structures for drinking water needs in the taluk. Similarly, in the irrigation sector ground water being developed through dugwells, dug cum borewells and shallow tube wells. Hospet taluk having total geographical area of 93374ha of which 49.73 % (46439 ha) is of cultivable land, in which the net irrigated area is about 20.61 % (9572 ha). Out of 20.61% about 9.66% (4489 ha) of the net irrigated area comes from ground water which is less when compared the surface water irrigation with 11.01 % of the net irrigated area through canals of Tungabhadra. So the ground water for irrigation is being developed from shallow dug wells, dug-cum bore wells and shallow tube wells. Thus as per 2001 census there are 1611 shallow irrigation bore wells are the major ground water development structures for irrigation purpose followed by 864 shallow irrigation dug wells. The ground water developed from these structures is utilized for irrigation through adopting sprinklers (3 dugwells+5 shallow bore wells), drip irrigation, (11 dug wells+18 bore wells), open channel (685 dugwells+1232 bore wells), underground channels (153 dugwells+231 bore wells) and others (12 dugwells+125 bore wells). These are the major ground water development management practices in the taluk where the use of sprinklers and drip irrigation activities are negligible. Considering the annual ground water development and water level trend during various seasons over the period the Hospet entire taluk is categorised under Safe. The Mean water level during pre monsoon period (May-96 to May 2006) ranged from 1.81 to 6.23m. The long term water level trend (1997 to 2006) from NHS shows average rise 0.1428 m/y. Considering the Safe category where Shallow zone ground water can be developed for irrigation through dug wells in topographic lows and through shallow/deep bore wells in the other areas. The one exploratory bore wells drilled by the CGWB under VRB project have yielded 0.70 lps for the drilled depth up to 86.00 mbgl. The exploration for deeper aquifer during 2001 to 2002 have constructed 3 exploratory wells and two observation wells in the

depth range of 200m where deeper aquifers being explored. The yield was in the range of 0.13 to 8.20 lps is useful and facilitating drinking water needs through ground water.

4.5.5 Kudlugi taluk

About 21.07 % of the total geographical area of Kudlugi taluk is covered by forest. Groundwater is the main source of drinking water and irrigational purposes in Kudlugi taluk. In general, ground water developed through dug wells, dug cum bore wells and bore wells. Bore wells are the main ground water development structures for both drinking and irrigation purposes. All the villages in the taluk have been provided with drinking water supply like piped water supply schemes, mini water supply schemes and hand pumps. There are 708 bore wells fitted with hand pumps, 102 bore wells used for piped water supply schemes and 226 mini water supply schemes through bore wells, fulfilling drinking water needs and support the above fact. Kudlugi taluk having total geographical area of 159706ha of which 61.38 % (98034 ha) is of cultivable land, in which the net irrigated area is about 11.03 % (10819ha). Out of 11.03% about 10.26% (10060 ha) of the net irrigated area comes from ground water which is major and negligible 0.77 % of the net irrigated area fall under surface water irrigation through localised tanks. So the ground water being the overall source for irrigation and being developed from shallow dug wells, dug-cum bore wells and shallow tube wells. Thus as per 2001 census there are 3522 shallow irrigation bore wells are the major ground water development structures for irrigation purpose followed by 309 shallow irrigation dug wells. The ground water developed from these structures is utilized for irrigation through adopting sprinklers (7 dugwells+77 shallow bore wells), drip irrigation, (9 dug wells+68 bore wells), open channel (283 dugwells+1917 bore wells), underground channels (9 dugwells+1421 bore wells) and others (1 dugwells+39bore wells). These are the major ground water development management practices in the taluk. Considering the annual ground water development and water level trend during various seasons over the period the Kudlugi taluk is categorised under Semi critical with 50 % and OE (overexploited) with 10% in non command areas. Overal 40 % falls under Safe category having further scope for ground water development. Most of the irrigation dug wells are having deep water levels/ dry during pre monsoon period as observed in Gajanur, Kottur and Kudlugi. However the irrigation bore wells are in operation and the yield reduces as the summer months approaches. The long term water level trend (1997 to 2006) at NHS shows fall in the range of 0.008m/y to1.675 m/y with an average of 0.740 m/y. Considering the 50 % under semi critical and 10 % OE category where it demands proper ground water augmenting projects to recharge the ground water system. Further while taking ground water developmental activities priorities needs to be given for meeting the drinking water requirements of rural and urban areas. The eleven exploratory bore wells and four observation bore wells drilled by the CGWB under VRB project have yielded negligible to 11.20 lps (C.J.Halli) for the drilled depth up to 58.00 m bgl. The exploration for deeper aquifer during 2001 to 2002 have constructed 3 exploratory wells and two observation wells in the depth range of 187 to 200m where deeper aquifers being explored. The yield was in the range of 0.03 to 4.0 lps is useful and facilitating drinking water needs through ground water.

4.5.6 Sandur taluk

About 225.55 % of the total geographical area of Sandur taluk is covered by forest. In the remaining part where Ground water is the main source for both drinking and irrigation purposes, to a lesser extent is from surface water source. The high level ground water development in the taluk is attributed to the limited availability of surface water from Tungabhadra canal. There are 748 bore wells fitted with hand pumps, 67 bore wells used for piped water supply schemes, 74 bore wells used for mini water supply schemes. These are the major abstraction structures for drinking water needs in the taluk. The irrigation sector the ground water being developed through dug wells, dug cum bore wells and shallow tube wells. Sandur taluk having total geographical area of 94359 ha of which 39.29 % (37078 ha) is of cultivable land, in which the net irrigated area is about 14.00 % (5194 ha). Out of 20.61% about 9.18% (3405 ha) maximum of the net irrigated area comes from ground water when compared to the surface water irrigation with 4.82 % of the net irrigated area through canals of Tungabhadra and tanks. So the ground water for irrigation is being developed from shallow dug wells, dug-cum bore wells and shallow tube wells. Thus as per 2001 census there are 1055 shallow irrigation bore wells are the major ground water development structures for irrigation purpose followed by 775 shallow irrigation dug wells. The ground water developed from these structures is utilized for irrigation through adopting sprinklers (10 dugwells+45 shallow bore wells), drip irrigation (0 dug wells+2 bore wells), open channel (761 dugwells+766 bore wells), underground channels (0 dugwells+134 bore wells) and others (4 dugwells+108 bore wells). These are the major ground water development management practices in the taluk where the use of sprinklers and drip irrigation activities are negligible. Considering the annual ground water development and water level trend during various seasons over the period the Sandur entire taluk (96%) is categorised under Safe except 4 % falling under semi critical. The Mean water level during pre monsoon period (May-96 to May 2006) ranged 7.55m. The long term water level trend (1997 to 2006) from NHS shows average rise 0.0832 m/y. Considering the Safe category where Shallow zone ground water can be developed for irrigation through dug wells in topographic lows and through shallow/deep bore wells in the other areas. The three exploratory bore wells drilled by the CGWB under VRB project have yielded 0.12 lps to 2.9 lps for the drilled depth up to 90.00 m bgl. The explorations for deeper aquifer during 2001 to 2002 have constructed one exploratory well to the depth of 200m where deeper aquifers being explored. The yield was in the range of 1.05 lps is useful and facilitating drinking water needs through ground water.

4.5.7 Siruguppa taluk

Siruguppa taluk where considerable amount of ground water developed is in the urban areas for developmental activities and that the use of ground water for agricultural purposes is very limited except in the non command areas. The low level ground water development in the taluk is attributed to the Tungabhadra canal water irrigation available for entire area except pockets of uplands. There are 610 bore wells fitted with hand pumps, 73 bore wells used for piped water supply schemes, 131 bore wells used for mini water supply schemes. These are the major abstraction structures for drinking water needs in the taluk. In irrigation sector the ground water being developed through dug wells, dug cum bore wells and shallow tube wells. Siruguppa taluk having total geographical area of 104278 ha of which 96.88 % (101034 ha) is of cultivable land, in which the net irrigated area is about 14.27 % (9572 ha). Out of 14.27 % about 1.34 % (1357 ha) of the net irrigated area

comes from ground water which is negligible when compared the surface water irrigation with 12.93 % of the net irrigated area through canals of Tungabhadra. However the ground water for irrigation is being developed from shallow dug wells, dug-cum bore wells and shallow tube wells. Thus as per 2001 census there are 554 shallow irrigation bore wells are the major ground water development structures for irrigation purpose followed by 141 shallow irrigation dug wells. The ground water developed from these structures is utilized for irrigation through adopting sprinklers (1 dugwells+1 shallow bore wells), drip irrigation (1 dug wells+1 bore wells), open channel (1 dugwells+104 bore wells), underground channels (329 dugwells+28 bore wells) and others (7 dugwells+3 bore wells). These are the major ground water development management practices in the taluk where the use of sprinklers and drip irrigation activities are negligible. Considering the annual ground water development and water level trend during various seasons over the period the Siruguppa taluk is categorised 51 % under Safe and 49 % under OE. The Mean water level during pre monsoon period (May-96 to May 2006) ranged from 2.97 to 6.13m. The long term water level trend (1997 to 2006) from NHS shows average rise 0.0.061 m/y where as average fall in non command area is 0.567 m/y. Considering the Safe category where Shallow zone ground water can be developed for irrigation through dug wells in topographic lows and through shallow/deep bore wells in the other areas. Where as in non command areas where it demands proper ground water augmenting projects to recharge the ground water system. The two exploratory and one observation bore wells drilled by the CGWB under VRB project have yielded 5 to 7 lps for the drilled depth up to 76.30 m bgl. The exploration for deeper aquifer during 2001 to 2002 have constructed two exploratory wells in the depth range of 200m where deeper aquifers being explored. The yield was in the range of 1.73 to 2.34 lps is useful and facilitating drinking water needs through ground water.

5.0 GROUND WATER DEVELOPMENT

As per resource estimation overall stage of Ground water development is 51.36% where in different taluks it ranged from 22.71 to 97%. Hospet and sandur taluks falling in Safe category with the stage of ground water development 35.18% and 25% where the balance ground water potential may be utilised with different abstraction structures suitable with reference to its topography and the aquifer geometry. The taluks like Hadagali, H.B.Halli where the ground water development reached almost saturation point with 87 to 97% falling in semi critical to OE category. Especially in H.B. Halli taluk almost all the dug wells are dry during pre monsoon period and water levels are deep during post monsoon period besides a large number of bore wells were drilled in these areas and putting stress on ground water potential. At these areas the farmers drilled the bore wells without taking into the consideration of the spacing criteria between well to well. This has to be educated and a proper farm management practice is to be adopted for judicial use of available ground water. The Groundwater Resource Estimation of the district indicates that the net ground water availability for future irrigation development is 34117 HAM, and the Balance of ground water irrigation potential is 39488 HAM. Based on this and the present status of ground water development i.e. through shallow dug wells and bore wells alone where the deeper aquifers are not much exploited, it is proposed that the ground water development structures viz. dug wells and dug cum bore wells and bore wells in those areas falling under Safe and semi critical category. Dug wells are the ideal structures in command areas of Hospet, Siruguppa, and Bellary

taluks. Dug cum bore wells and bore wells are suitable in the other areas. In case of DCB extension bores of 100 to 152mm drilled from the surface of the dug well, both these may be drilled up to a depth of 40 to 80m and to tap deeper aquifers it has to be drilled up to 200 m.

It may be taken into consideration while designing the various abstraction structures; emphasis for a farm budget model can be evolved for the structure with a designed discharge of 2 to 5 lps with an irrigable command of 1.25 to 3.00ha. Ground water development may also be considered on the banks of rivers and streams in Hospet, bellary and Siruguppa taluks in general.

5.2 Water Conservation and Artificial Recharge

The taluks Hospet, Siruguppa and parts of Bellary are falling in command area. These areas the water table is shallow, low rate of ground water exploitation and gradual rise of water table over the years resulting in ruling out of any Artificial Recharge schemes. As per the Resource estimation, 59% of the area in Bellary taluk, 49% Siruguppa, 44% in H.H. Halli and 10% area of Kudlugi taluks falls under Over Exploited category which requires immediate intervention by way of conservation and artificial recharge to ground water in order to arrest further declining trend in water levels. Artificial recharge through percolation tank, check dam and nalla bunds are the solutions to recharge ground water in the district. Further Dug well Recharge schemes where the shallow dug wells are dry like in HB.Halli and Kudlugi taluks can be taken up so that available surface runoff available in their field can be recharged into the groundwater system. Kudlugi taluk is the largest next to Bellary, where in predominately undulating and hilly comprising of undulating and rugged terrain where the runoff is high. Under these conditions, it is advisable to go for watershed treatment methods, which can help in augmenting the ground water resources. Further considering the topography, the structures like gully plugs, cement plugs, nalla bunds and contour bunds may be constructed by which runoff can be arrested and recharged in to the ground water. As per the statistical data the district has 74 ZP tanks distributed in Kudlugi, HBhalli, Sandur, Hadagali and Hospet taluks, of which Hadagali taluk falling in OE category having least number of surface water tanks with six, this is unusual considering its nature of large geographical area falling in non command area. There is a scope for further construction of percolation tanks, check dams and other artificial recharge structures to enhance the recharge in to the ground water system in Hadagali, H.B.Halli, and Kudlugi taluks. Most of the existing tanks are silted and dried up. Desilting the tanks and construction of additional tanks will help in recharging the phreatic zone. Sub surface dykes are suitable along the river course where ever thickness of alluvium is more.

6.0 GROUND WATER RELATED ISSUES & PROBLEMS

In command areas of Hospet, Siruguppa and Bellary taluks are having shallow water level between ground level to 3.00m during both pre and post monsson period especially in the areas of Tungabhadra low level and high level canal which are showing regular rising trend water table (Emmiganur and Tekkalakota) are water logged and in some places prone to water logging leading to ground water contamination. This is attributed to seepage from canal to shallow aquifer, less ground water exploitation, unrestricted canal water irrigation, no proper drainage

system and major part of the surface water applied for irrigation is by flooding method in to the nallahs during the intensive irrigation period which are again causing water logging. Due to water logging quality deterioration where Peddavanka water shed in Siruguppa taluk reported higher salinity. In non command areas like H.B.Halli Kudlugi taluks and other areas ground water pollution is due to poor drainage, use of fertilizers in agriculture and indiscriminate dumping of domestic and agricultural waste on the land. The studies by CGWB reports that the ground water having Fluoride contamination which are geogenic in origin occurring in western and northern part of Hadagali and control points of Kudlugi taluks. The soils in canal irrigation and in some other parts are deteriorated due to intensive irrigation and extensive use of fertilisers. However the state government has taken up land development/treated through water shed development project in which it is identified an area of 431436ha are not available for irrigation due to bad soil. It is reported that 150349ha land were developed/treated through water shed development projects and still remains balance of 231408ha of land. This directly or indirectly contributes to ground water pollution. The other most common problem is power cut and voltage fluctuation in lifting the ground water for their irrigation purposes. In many of the villages water scarcity exists due to defunct domestic bore wells for want of proper maintenance.

7.0 AWARENESS & TRAINING ACTIVITY

Central Ground Water Board has organised Mass Awareness programme on "Protection and Conservation of ground water" at Zilla Panchayat meeting hall, Bellary on 10/03/2004. The program was inaugurated by Shri. S.N.Jayaram, IAS, Deputy Commissioner, Bellary district. Shri. G.S. Shivaswamy, KAS, CEO, ZP, Bellary presided over the function. Shri. Veeranna Joint Director, Depatment of Mines and Geology (Northern Circle), Governmant Karnataka, and about 200 representatives from Zilla Panchayat, Taluk Panchayat and Educational institutions were participated in the programme. As part of this programme, drawing competition was organised for school children and certificates were distributed. Working models of artificial recharge and rainwater harvesting were exhibited. Documentaries of ARS and rainwater harvesting with case studies and quality of ground water were shown.

8.0 AREAS NOTIFIED BY CGWA / SGWA

None of the taluks in the district are notified under CGWA / SGWA.

9.0 RECOMMENDATIONS

The major problem in command areas of Bellary district is water logging. So preventive measures/flush out excess irrigation water of water logging through construction of drains along canal seepage paths, exploitation of ground water, avoiding over irrigation to the crops, lining of canals, adoption of soil conservation methods and recommended cropping patterns. Further it is to take adequate measures to tap ground water in downstream through Jack wells/infiltration wells and practicing conjunctive use would improve both water logging and quality in major part of command areas. The state government has to speed up the projects on land development/treating of balance un developed soil of 231408ha through watershed

development projects. Maintenance like desilting of surface water structures like tanks in non command areas is must to recharge ground water. Judicious use of ground water in command areas especially in Hadagali, H.B.Halli and Kudlugi taluks is advised. Pilot experimental studies to recharge ground water in south and western part of Bellary traluk, H.B.Halli, Kudlugi and Hadagali taluks are suggested. The power cut /shortage/fluctuation is to be regulated through Electricity Board. The Stage of ground water development is OE in Hadagali, H.B.Halli and parts of Sirugppa 59%, and semi critical in H.Bhalli and Kudlugi taluk (32% & 50 %) demands department like CGWB to construct pizometers up to 100m to monitor water levels on long term basis and draw up check measures if there is decline in ground water level and quality. The present management practices for irrigation such as sprinklers, drip irrigation, underground channels etc., where the number of sprinklers and drip irrigation structures is to be increased for optimum use of available developed ground water depending upon cropping pattern. The villages located in undulating topography of the district facing drinking water scarcity. Special source finding projects may be taken up, and also construction of ARS, since these places are having enough scope for implementing artificial recharge structures to augment ground water. Some of the villages with satisfactory water supply system, facing drinking water scarcity for want of mechanical maintenance of existing defunct bore wells. So periodical checking of water supply system will improve the system efficiently. In addition to this, the abandoned bore well/dug wells can be utilised for recharging aquifers with surplus runoff during rainy days. Exploratory drilling in the district beyond 90.00m bgl is limited which requires to be intensified to explore deeper aquifers.

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