जल वर्ष 2007 Water Year 2007

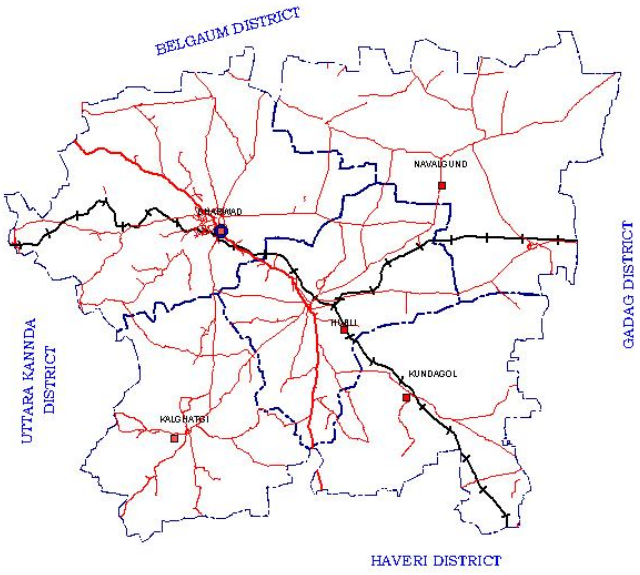
स्वच्छ सुरक्षित जल – सुन्दर खुशहाल कल

CONSERVE WATER - SAVE LIFE

GOVERNMENT OF INDIA

MINISTRY OF WATER RESOURCES
CENTRAL GROUND WATER BOARD

GROUND WATER INFORMATION BOOKLET
DHARAWAD DISTRICT, KARNATAKA STATE



SOUTH WESTERN REGION
BENGALORE
FEBRUARY 2013

जल वर्ष 2007 Water Year 2007

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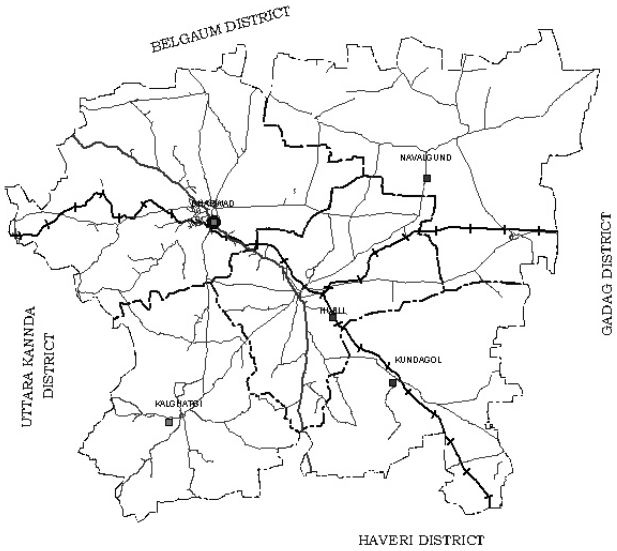


SOUTH WESTERN REGION
BANGALORE
FEBRUAY 2013

सुशील गुप्ता
अध्यक्ष
केन्द्रीय भूमि जल बोर्ड,
जल संसाधन मंत्रालय,
भारत सरकार,
भूजल भवन, एन एच. - 4,
फरीदाबाद.

Sushil Gupta
Chairman
Central Ground Water Board,
Ministry of Water Resources,
Government of India,
Bhujal Bhawan, NH-IV,
Faridabad.

FOREWORD

Groundwater is an essential component of the environment and economy. It sustains the flow in our rivers and plays an important role in maintaining the fragile ecosystems. The groundwater dependence of agrarian states like Karnataka is high. Recent studies indicate that 26 percent of the area of Karnataka State is under over exploited category and number of blocks is under critical category. In view of the growing concerns of sustainability of ground water sources, immediate attention is required to augment groundwater resources in stressed areas. Irrigated agriculture in the state is putting additional stress on the groundwater system and needs proper management of the resources.

Central Ground Water Board is providing all technical input for effective management of ground water resources in the state. The groundwater scenario compiled on administrative divisions gives a better perspective for planning various ground water management measures by local administrative bodies. With this objective, Central Ground Water Board is publishing the revised groundwater information booklet for all the districts of the state.

I do appreciate the efforts of Dr. K.Md.Najeeb, Regional Director and his fleet of dedicated Scientists of South Western Region, Bangalore for bringing out this booklet. I am sure these brochures will provide a portrait of the groundwater resources in each district for planning effective management measures by the administrators, planners and the stake holders.

Sushil Gupta
CHAIRMAN

PREFACE

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, vulnerability area 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 30 districts of Karnataka state, incorporating the data up to the period 2011-12.

The Dharwad 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 Dr Anantha Kumar Aras , Asst Hydrogeologist, and under the guidance of Dr K.R.Sooryanarayana, Scientist-D, Central Ground Water Board, South Western Region, Bangalore. The figures were prepared by Sri.J.Sivaramakrishnan, 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, academicians, hydrogeologists and engineers to plan and manage the water resources in a better way in the district.

(Dr. K.Md.Najeeb)
Regional Director

DHARWAD DISTRICT AT A GLANCE

Sl.NO	ITEMS	STATISTICS
1	**GENERAL INFORMATION**	
	Administrative divisions	5
	Number of Taluks	5
	No of Panchayaths/Villages	127/379
	Population(as of 2011 Censes)	18,46,993
	Average Annual Rainfall – 2001-2010(mm)	735
2	**GEOMORPHOLOGY**	
	Major Geographic units	West-Malnad & East-Denudational hills and Pedi plain
	Major Drainage	Krishna basin & Kali river-the west flow river basin.
3	**LAND USE**(sq.km)	
	Forest area (2008-09)	352.35
	Net area Sown (2008-09)	2964.84
4	**MAJOR SOIL TYPES**	Lateritic, Clay-loamy & Black Cotton Soil
5	**AREA UNDER PRINCIPLE CROPS (2008-09)** (**in Ha)**	
	Paddy	32834
	Jowar	48190
	Wheet	38357
	Maize	41676
	Pulse	73387
6	**IRRIGATION BY DIFFERENT SOURCES (ASCR-2008-09, in Ha)**	
	Dugwells	0
	Borewells/Tubewells	15237
	Tanks/Ponds	383
	Canals	35362
	Other Sources	13
	Net Irrigated area	50995
7	**NO OF GROUNDWATER MONITORING WELLS OF CGWB (as on 31- 3- 2011)**	
	No of Dug wells	25
	No of Piezometers	4
8	**PREDOMINANT GEOLOGICAL FORMATION**	Gneissic-Granite, Schists, Phyllites
9	**HYDROGEOLOGY**	
	Major Water bearing Formation	Gneissic-Granite and Schists
	Pre Monsoon depth to Water level during 2011	2.18-17.40 mbgl
	Postmonsoon depth to Water level during 2011	1.28-15.35 mbgl
	Long term Water level trend in 10 years(2002-2011)	0.018 –1.748m/year rise & 0.011m/year fall
10	**GROUNDWATER EXPLORATION BY CGWB (As on 31-03-2011)**	
	No of Wells drilled (EW, OW, PZ, SH, Total)	22/18/0/0=40
	Depth range in (m)	150 to 200mbgl
	Discharge in LPS	2-5

	Storability (S)	12-50
	Transmissivity (m^2/day)	6-45
11	**GROUNDWATER QUALITY**	
	Presence of Chemical constituents more than permissible limit (EC, EC, F, As, Fe)	EC, FLOURIDE, NITRATE
	Type of water	Alkaline
12	**DYNAMIC GROUNDWATER RESOURCES-2004 Ham**	
	Annual Replenisable Groundwater resources	30750
	Net annual Ground water draft	13090
	Projected demand for Domestic and Industrial use up to 2025	3069
	Stage of Groundwater development	45 TO 75%, Safe/SEMI critical/ Over Exploited, category
13	**AWARENESS AND TRAINING ACTIVITY**	
	Mass awareness Programme organised Date Place No of participants	 27-12-2000 Dharwad -
	Water management training Programme organised Date Place No of participants	 - - -
14	**EFFORTS ON ARTIFICIAL RECHARGE AND RAINWATER HARVESTING**	
	Projects completed by CGWB(No&Amount spent)	-
	Project completed under technical guidance of CGWB(numbers)	-
15	**GROUNDWATER CONTROL AND REGULATION** No fo OE blocks No fo Semi Critical blocks No of blocks notified	 Navalgund (pt) Dharwad (pt) & Navalgund (pt) -
16	**MAJOR GROUNDWATER PROBLEMS AND ISSUES**	Inland Salinity

1. INTRODUCTION

The district Dharwad with an area of 4273 sq. km (427329Ha) lies in the northern part of Karnataka state between 15'02'00''to 15'48'00" north latitude and 74^0 43' 30" to 75^0 33'25'' east longitudes as depicted in **Fig.1**. Eastern region fall under Malaprabha river (Krishna basin 87%) sub-basin and the "Kali"river (west-flowing river) basin in the west, the rivers are ephemeral. The Bennihalla river (Krishna basin) and the Bedthi nadi & Shalmala Nadi (west flowing rivers) are main watersheds **(Fig-2)** in the district.

The district is well connected by national (NH-4), state highways and the rail. The Dharwad-Hubli, the twincity is a major city, Dharwad is the home to the Karnataka University and the University of Agricultural Sciences .The district comprises five taluks, 5 municipalities and 127-gram panchayats comprising 379 villages. The population of the district is 1846993 include about 939127 work forces with 15.13% growth of population (census-2011)**.** Agriculture is the main occupation in the district using both surface water and groundwater resources practicing flood irrigation method. The major crops grown are Jower, paddy, wheat and maize.

The scientific investigations carried out by CGWB through hydrogeological, geophysical, groundwater salinity studies and drilling of test bore wells to ascertain the groundwater resources scenario in terms of quality & quantity have been brought out in this volume.

2. RAINFALL & CLIMATE

The mean annual rainfall for the period 2001-2010 in the Dharwad district is 735mm. The mean pre monsoon rainfall is 146 mm, mean South West monsoon rainfall is around 468 mm and North East monsoon season is around 122 mm. Annual Normals rainfall of all the taluks are given in the Table 1. Annual rainfall during 2011 is 734mm in which 112 mm during premonsoon, 447mm during monsoon and 175mm during post monsoon (Table.2). Maximum annual rainfall of highest 1497mm is recorded during 2005 in Hubli taluk. Minimun annual rainfall of lowest 340mm is recorded during 2003 in Navalgund taluk. Overall rainfall distribution shows that northeast part is receiving lowest rainfall. Similarly southwest part receiving highest rainfall.

Table.1:Talukwise Rainfall in mm

Seasonal & Annual Normal Rainfall for the period 2001-2010 Dharwad District, Karanataka				
tation	**Pre-Monsoon**	**SW Monsoon**	**NE Monsoon**	**Annual**
	Rainfall (mm)			
Dharwad	146	529	131	807
Hubli	157	444	141	742
Khalgatgi	157	660	107	924
Kundgol	152	341	104	598
Navalgund	115	365	125	605
For District	146	468	122	735

Fig-1

ADMINISTRATIVE SET-UP
DHARWAD DISTRICT
KARNATAKA

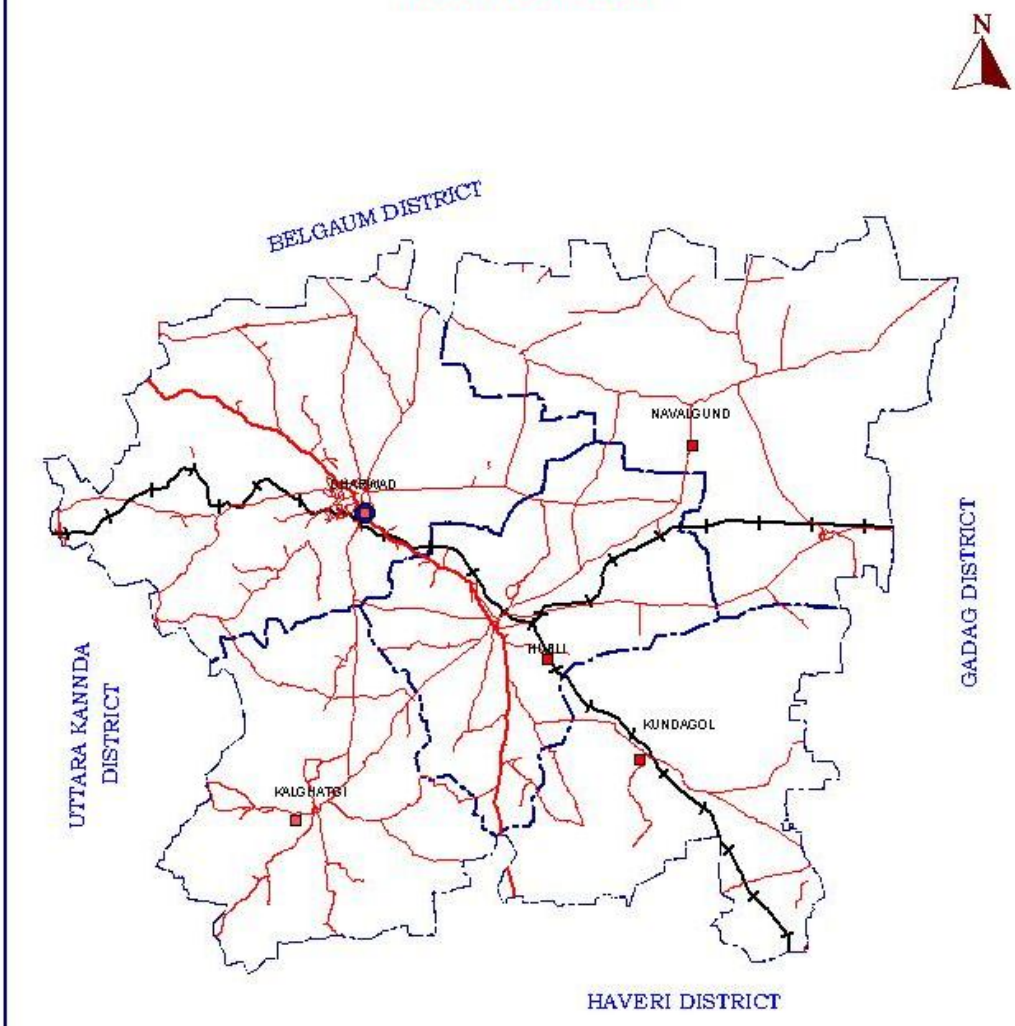
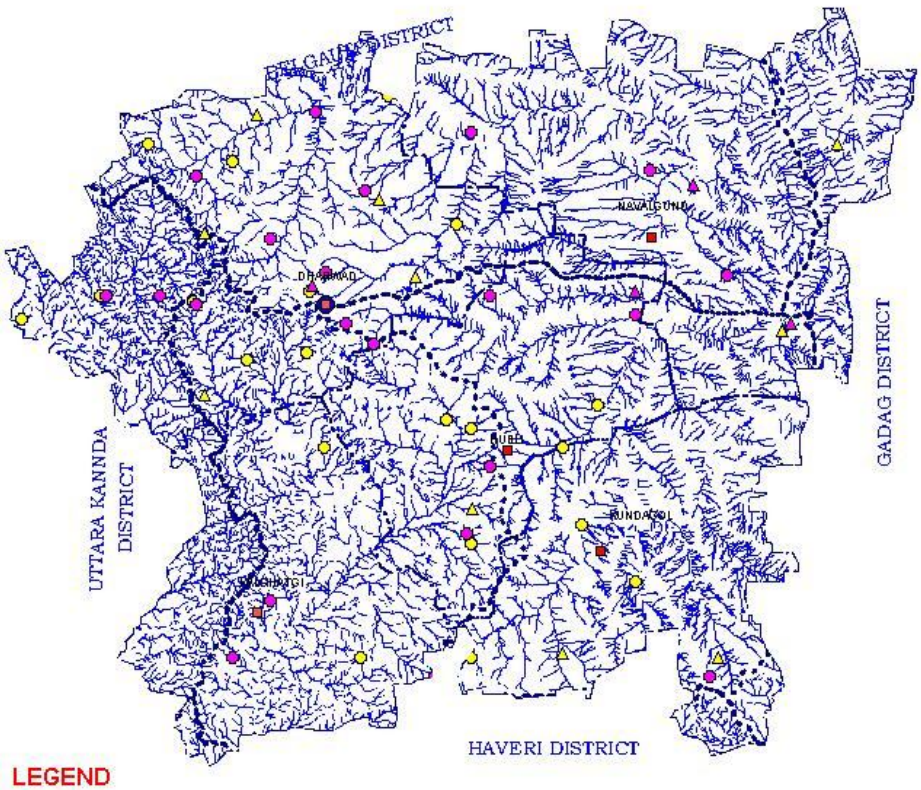


Fig- 2

DRAINAGE & HYDROGRAPH MONITORING STATIONS
DHARWAD DISTRICT, KARNATAKA



LEGEND

CGWB STATIONS

- Dug well
- Piezometer

DMG STATIONS

- Dug well
- Piezometer
- Surface waterbody
- Drainage
- Watershed Boundary

Table.2: DISTRICT AND TALUK WISE RAINFALL FOR THE YEAR 2011, DHARWAD DISTRICT, KARNATAKA

	DISTRICTS/ TALUKS	JAN	FEB	MAR	APR	MAY	PRE	JUN	JUL	AUG	SEPT	SWM	OCT	NOV	DEC	NEM	ANNUAL
		Rainfall (mm)															
	DHARWAD	**0**	**4**	**1**	**64**	**43**	**112**	**155**	**99**	**127**	**67**	**447**	**171**	**4**	**0**	**175**	**734**
1	DHARWAD	0	6	2	117	46	171	184	118	132	77	511	235	8	0	243	925
2	HUBLI	0	0	0	52	39	91	128	74	82	79	363	140	6	0	146	600
3	KALGHATGI	0	0	0	53	22	75	305	209	191	128	833	190	5	0	195	1103
4	KUNDGOL	0	13	0	44	68	125	104	73	71	23	271	179	1	0	180	576
5	NAVALGUND	0	0	2	55	39	96	53	20	157	26	256	112	0	0	112	464

The area experiences tropical climate/semiarid climate with a distinct seasons (1) summer (2) rainy season and (3) the winter. The relative humidity is generally high as over 80% in the monsoon season and less in non-monsoon periods. In April month the whirlwinds are common.

3. GEOMORPHOLOGY& SOIL TYPE

The study area falls in the western-ghat section (sahyadris) of the peninsula within the rugged foothills. An undulating central Pediplain and the eastern maidan is the prominent feature. It situated at an altitude of 753 m (N-W Dharwad Tk) to 558 mamsl.

The lateritic brownish sandy soil occurs in the western region with 19.62-to 3.6-cm/hour rate of infiltration characteristic. The black cotton soil (BCS) in the eastern part having 2.0 to 5.0 metres thickness, are high humus and low phosphate content, with normal pH-value and very low infiltration characteristic. The Loamy to kankary soil are seen along the banks of river/stream courses.

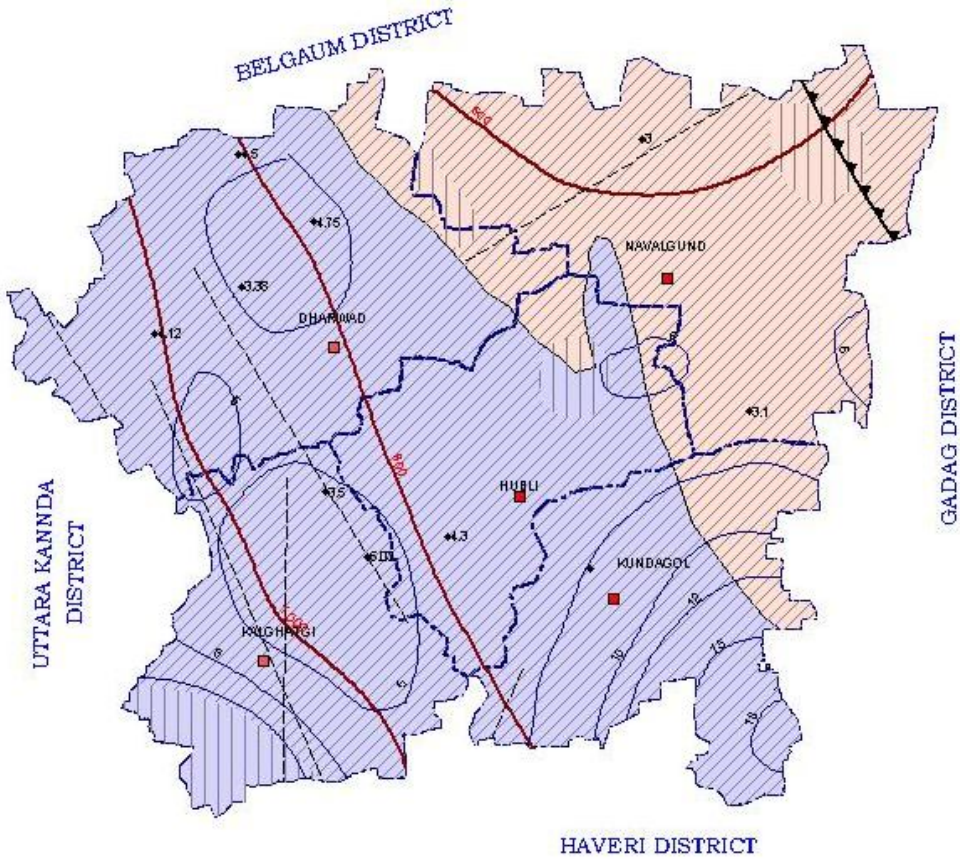
4. GROUND WATER SCENARIO

4.1 Hydrogeology

Main rock formations in the area are the Gneissic-granites and Schists, the secondary structures like joints, fissures and faults present in them (**Fig.3**)act as a porous media-the Aquifer. The lateritic layer overlying in moderate thickness and alluvium occurs along the riverbanks in less than 3.00 metres thickness acts as an aquifer locally. Ground water in the aquifer generally occurs under unconfined/phreatic and semi-confined conditions. The unconfined condition prevails within the depth range of 17.00 to 40.00mbgl. 32 exploratory borewells have been drilled at select places within the depth range of 150 to 200 mbgl reveals the presence of fractured zones; they are occasionally saturated between 20.00 and 150mbgl depths. Generally, the schistose formation has deeper ground water potential zones. The top porous part in the water table aquifer constitutes approximately 3% of volume of formation. The specific capacity of dugwells in the district ranges from 6.90 to 65.03 m3/m/dd and the aquifer transmissivity estimated in the order of 1.07 to 113.69 m^2/day. While the transmissivity of the deeper aquifers estimated in the order of 11 to 40 m^2/day and that of yield ranges from 2 to 5 lps. The specific capacity of exploratory borewells falls in the range of 32 to 65 lpm/m/d.

Fig-3

HYDROGEOLOGY
DHARWAD DISTRICT
KARNATAKA



LEGEND

Geology

- Schist
- Charnockites,gneisses, unclassified crystalline

Ground Water Prospects

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

- Lineament
- Shear
- 1000 mm Isohyet
- 8 Decadal mean water level in m bgl
- Taluk boundary
- Taluk headquarters

Water levels

The decadal mean depth to groundwater level (DTW) record reveals shallower water level in the west-central stretch of the district especially in Dharwad and Kalghatgi taluks as depicted in the Hydrogeological map, fig-3. where as the deeper level recorded in the south-south-eastern parts. The depth to water levels recorded in the range of 2.18 to 17.40 mbgl during May-2011 **(Fig-4)** and 1.28 to 19.10 mbgl during November-2011 **(Fig-5)**. Maximum rise and maximum fall both are noticed in Kundal taluk in pre monsoon and post monsoon respectively, The water level is deeper as between 10 to 20 mbgl in major part of Kundgol, parts of Navalgund, Kalghatgi and bordering Dharwad, Hubli taluks.

The water level fluctuation during may 2011 with respect to decadal mean water level shows that 75% of the wells rise in water level and only 25% wells shows fall in water level **(Fig.6)**. The water level fluctuation during November 2011 with respect to decadal mean water level shows that 85% of the wells rise in water level and only 15%wells shows fall in water level (**Fig.7**). The water level trend for the month May for the period of 2002 to 2011 shows a general rise of 0.018 to 1.748 m, with a few isolated pockets at falling (- fluctuation) trend in the order of 0.011 m. The water level trend for the month November for the period of 2002 to 2011 shows a general rise of 0.040 to 2.035 m, with a few isolated pockets at falling (- fluctuation) trend in the order of 0.072 m. A general trend recorded during 2002 to 2011 shows a appreciable rise trend and few patches of falling trend.

Generally the water table contour fall along the regional topography as it flows towards the major river courses depicting a gentle water table gradient. The contour traced also exhibits the ground water divide along the watershed boundaries (Malaprabha and Kali rivers). The ground water flow seems to be converged down to the deeper level in the eastern region. The water table traced show in the altitude range of 552.09 to 697.94 above mean sea level (amsl) and 541.20 to 692.44 amsl respectively during pre-monsoon and Post-monsoon period of 2011.

4.2 GROUND WATER RESOURCES

The main known source of groundwater in the district is recharge by annual precipitation (rainfall). The ground water potential reveals the annual resource as 37208 Ham for the year 2009, as a replenish able /dynamic resource, as indicated in table 1(A) below. The annual groundwater draft in Dharwad taluk accounts for 3801 ham and minimum of 1114 Ham in Kundgol taluk as detailed in table 1(B). Due to the prevailing socio-economical condition and an uneven distribution of potential aquifers about 2053 ham have been used for drinking & industrial purpose and11038ham for irrigation purpose with a total draft of 13090 ham during the year 2009 as shown in **Table 3(A)** and **Table 3(B).**

Fig.4

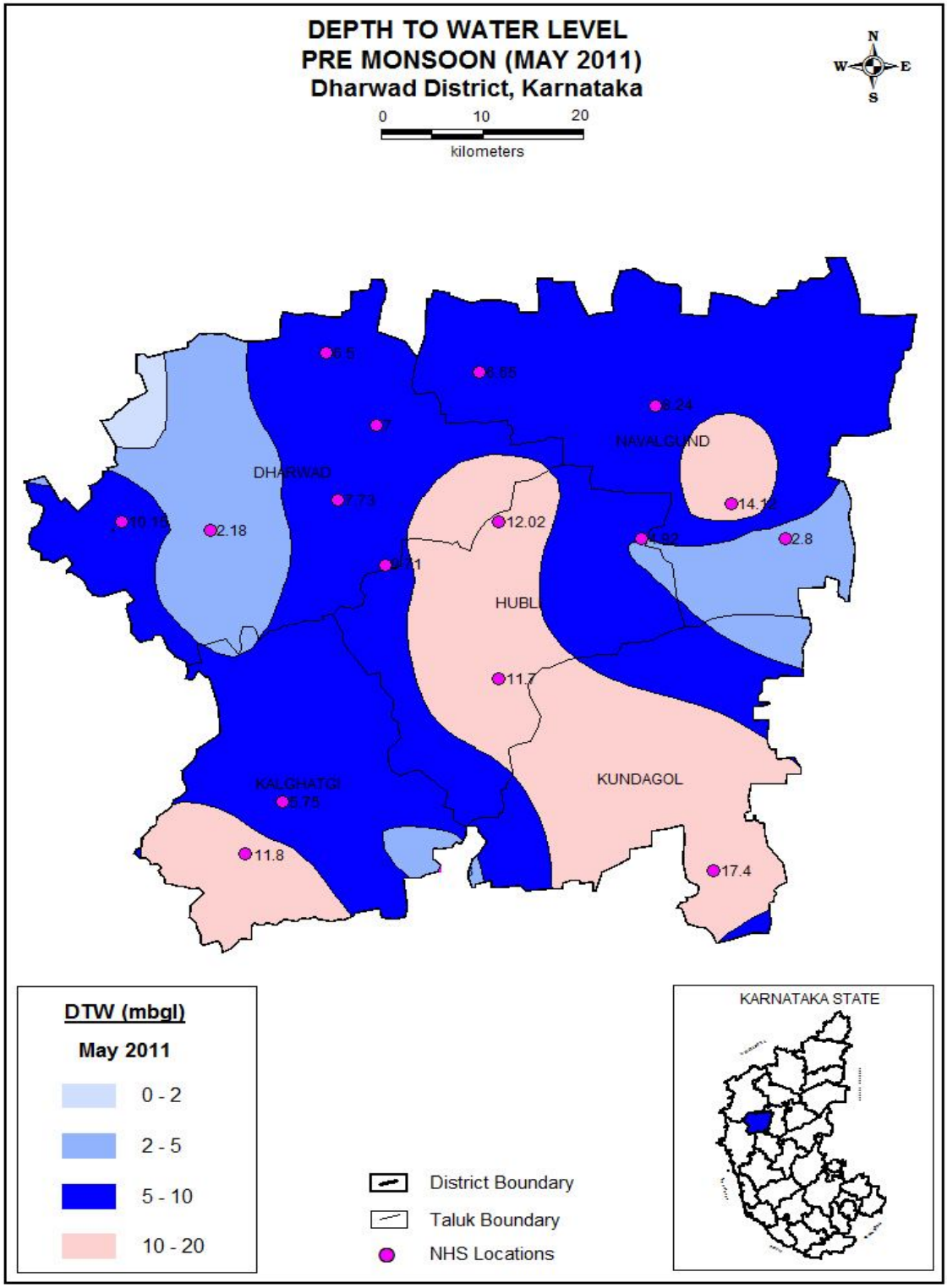

DEPTH TO WATER LEVEL
PRE MONSOON (MAY 2011)
Dharwad District, Karnataka
0
10
20
kilometers
N
W
E
S
DHARWAD
NAVALGUND
HUBL
KUNDAGOL
KALGHATGI
2.18
12.02
14.12
2.8
11.7
11.8
17.4
DTW (mbgl)
May 2011
0 - 2
2 - 5
5 - 10
10 - 20
District Boundary
Taluk Boundary
NHS Locations
KARNATAKA STATE

Fig.5

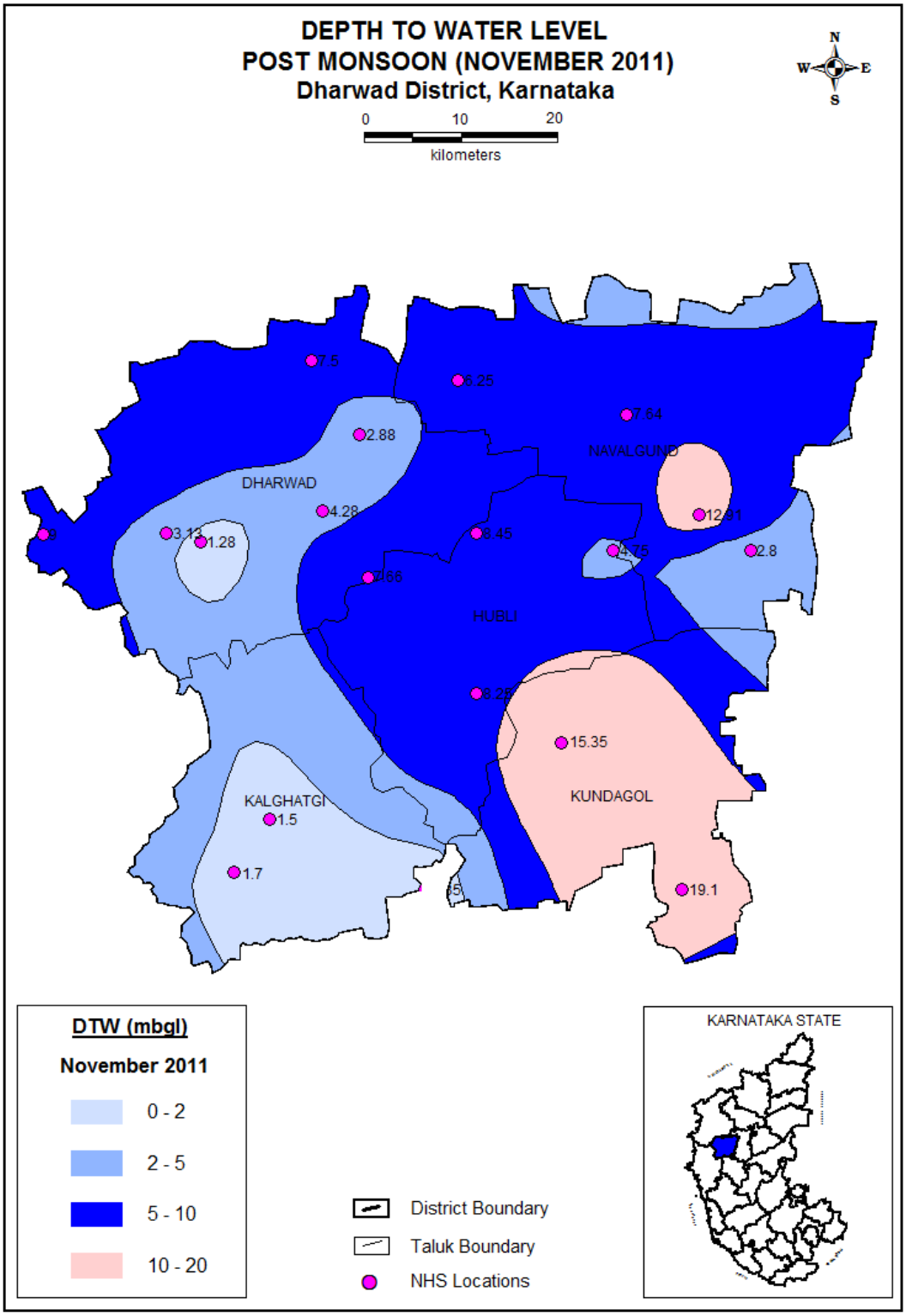

DEPTH TO WATER LEVEL
POST MONSOON (NOVEMBER 2011)
Dharwad District, Karnataka
0
10
20
kilometers
N
W
E
S
7.5
6.25
7.64
2.88
NAVALGUND
DHARWAD
4.28
12.91
3.13
1.28
3.45
4.75
2.8
HUBLI
15.35
KUNDAGOL
KALGHATGI
1.5
1.7
19.1
DTW (mbgl)
November 2011
0 - 2
2 - 5
5 - 10
10 - 20
District Boundary
Taluk Boundary
NHS Locations
KARNATAKA STATE

Fig.6

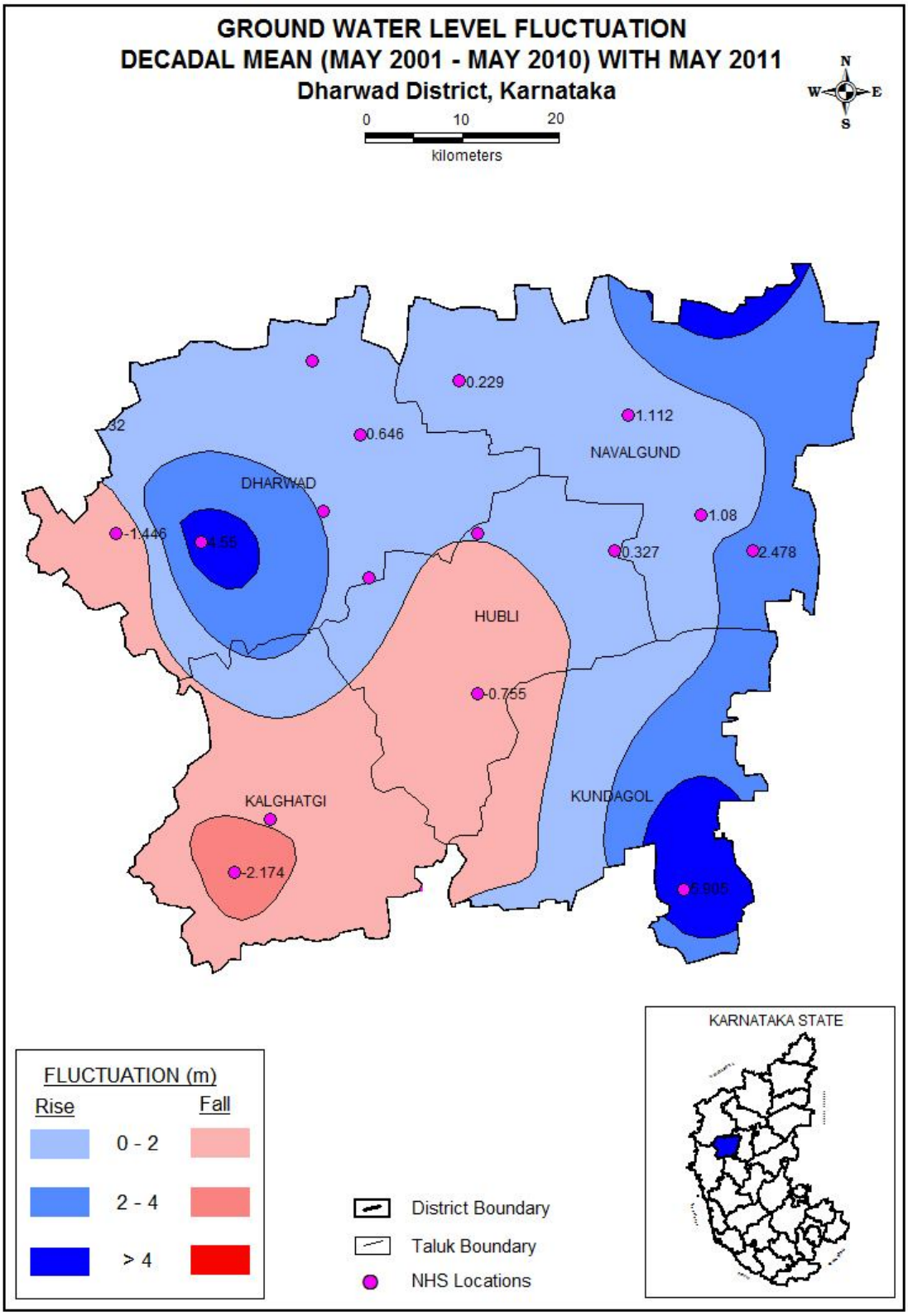

GROUND WATER LEVEL FLUCTUATION
DECADAL MEAN (MAY 2001 - MAY 2010) WITH MAY 2011
Dharwad District, Karnataka
0
10
20
kilometers
N
W
E
S
0.229
1.112
0.646
NAVALGUND
DHARWAD
1.08
-1.446
-1.55
0.327
2.478
HUBLI
-0.755
KALGHATGI
KUNDAGOL
-2.174
6.905
KARNATAKA STATE
FLUCTUATION (m)
Rise
Fall
0 - 2
2 - 4
> 4
District Boundary
Taluk Boundary
NHS Locations

Fig.7

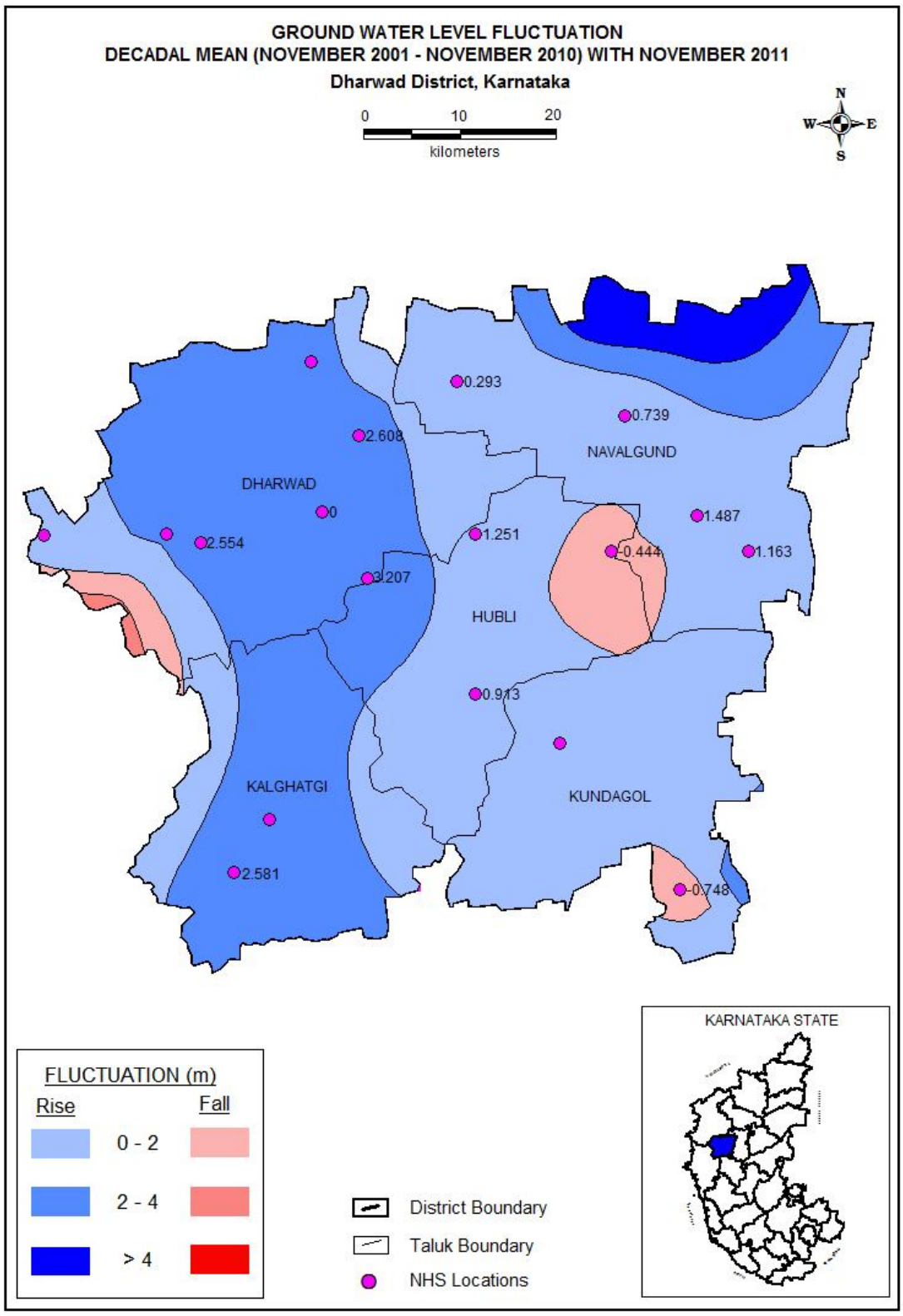

GROUND WATER LEVEL FLUCTUATION
DECADAL MEAN (NOVEMBER 2001 - NOVEMBER 2010) WITH NOVEMBER 2011
Dharwad District, Karnataka
0
10
20
kilometers
N
W
E
S
0.293
0.739
2.608
NAVALGUND
DHARWAD
0
1.487
1.251
2.554
-0.444
1.163
3.207
HUBLI
0.913
KALGHATGI
KUNDAGOL
2.581
-0.748
KARNATAKA STATE
FLUCTUATION (m)
Rise
Fall
0 - 2
2 - 4
> 4
District Boundary
Taluk Boundary
NHS Locations

Table-3(A) Ground Water Resources in the District.

Sl. No	Taluk	Recharge from rainfall during monsoon season (ham)	Recharge from Other sources during monsoon season (ham)	Recharge from rainfall during non-monsoon season (ham)	Recharge from Other sources during non-monsoon season (ham)	Gross ground water availability (ham)
1	DHARWAD	3952	401	1622	407	6382
2	HUBLI	2268	599	906	240	4013
3	KALGHATGI	5686	383	1127	357	7552
4	KUNDAGOL	1906	94	1095	152	3247
5	KUNDAGOL (POOR QUALITY)	673		412		1085
6	NAVALGUND	1680	2264	1486	1244	6674
7	NAVALGUND (POOR QUALITY)	6026		2230		8255
	TOTAL	22191	3741	8878	2400	37208

Table3 (B) Ground Water Draft in the District

Sl No	Taluk	Net Annual Ground Water Availability (ham)	Existing Gross Ground Water Draft For Irrigation (ham)	Existing Gross Ground Water Draft For Domestic And Industrial Water Supply (ham)	Existing Gross Ground Water Draft For All Uses (ham)
1	DHARWAD	5101	3214	587	3801
2	HUBLI	3152	1156	305	1461
3	KALGHATGI	4909	1988	211	2199
4	KUNDAGOL	2883	802	312	1114
5	KUNDAGOL (POOR QUALITY)	977	-	-	0.0
6	NAVALGUND	6185	3878	638	4515
7	NAVALGUND (POOR QUALITY)	7543	-	-	0.0
	Total	30750	11038	2053	13090

4.3 GROUND WATER QUALITY

The water in phreatic aquifer zones found in potable form whereas it is alkaline to saline in the deeper zones, especially in the eastern part of district. The electrical conductivity (EC) of waters observed in the range of 900 to1200 µm/cm, at places in Dharwar, Hubli and Navalgund taluks it recorded between 4000 to>7500 at 25°C. The higher concentration, ie.more than permissible limit of Nitrate (NO3) as >45 mg/litre occur in many localities as indicated in fig.5. The fluoride presence in some pockets of the central and eastern border areas noticed as around 1.5mg/l, is greater than the permissible limit as depicted in fig.5, the rest of

the area have acceptable limit of 0.2 to 1.0 mg/lit. The presence of chloride as high as >1000 mg/l in many parts of eastern region observed as in the area demarcated in the **Fig-8**, is said to be due to the extensive use of chemical fertilizers in agricultural lands.

4.4 GROUNDWATER VULNERABILITY AREA

Groundwater being a dynamic resource, getting recharged annually, primarily from the rainfall, is vulnerable to various developmental activities and is prone to deterioration in quality and quantity. The vulnerability is high in certain areas while in other areas it is comparatively stable. Based on it's susceptibility to various stress factors the district wise vulnerability map is prepared on a regional scale considering the following factors viz.

1. Area under high stage of ground water development falling in over exploited (generally with stage of development more than100%) and critical (generally stage of development within 85-100%) category as on March 2009.
2. Area having intensive cultivation/ area falling under canal command, thus prone to pollution from fertilisers/ insecticides or water logging.
3. Area having fluoride above maximum permissible limit of 1.5ppm
4. Area having nitrate above maximum permissible limit of 45ppm. (Even though nitrate is point source pollution due to anthropogenic activity and as such area cannot be demarcated, for the convenience of the user group, area having high incidence of pollution is marked. Within the marked area there may be points devoid of high nitrate and vice-versa.)
5. Industrial cluster as identified by Central Pollution Control Board, prone for pollution from industries.

In some of the districts parts of the area groundwater is vulnerable due to more than one of the above parameters, while in some others the entire district is free from vulnerability.

In Dharwad district the Ground water vulnerable area has been demarked based on facts that area under over exploited, area under inland salinity, area under exceeds the limit of Fluoride limit, and area falls under excess Nitrate content due to over use of chemical fertilizer in canal commond area. The vulnerable area spreads in all most all places in the district because of one or other groundwater quality problem in the district (**Fig.9)**.

4.5 STATUS OF GROUND WATER DEVELOPMENT (ADMIN.BLOCKWISE)

The ground water developmental activities in the district mainly concentrated in the valley regions and along the banks of rivers/streams. The borewells tapping within the depth range of 150-to 200 mbgl yield an adequate quantum of water as the presence of saturated fractured zones in exploratory wells. It is observed that the yield of dug and dug-cum-borewells exhibit wide variation but the borewell drilled along the lineament yield copious water as seen in (Devar Gudihal village) Dharwad taluk.

FIG-8

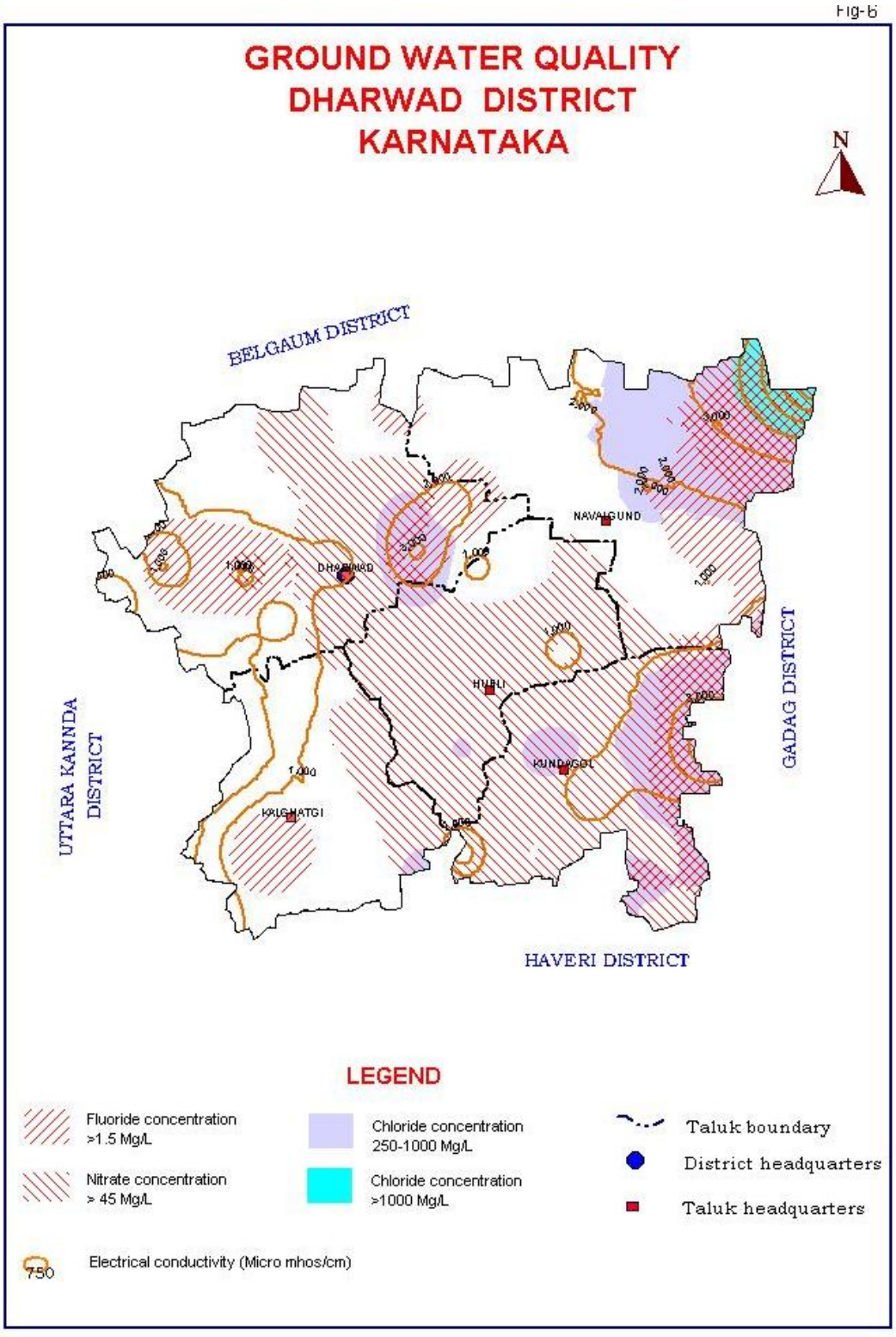


Fig-6
GROUND WATER QUALITY
DHARWAD DISTRICT
KARNATAKA
N
BELGAUM DISTRICT
NAVALGUND
DHARWAD
HUBLI
KUNDAGOL
KALGHATGI
UTTARA KANNDA DISTRICT
GADAG DISTRICT
HAVERI DISTRICT
LEGEND
Fluoride concentration >1.5 Mg/L
Nitrate concentration > 45 Mg/L
Chloride concentration 250-1000 Mg/L
Chloride concentration >1000 Mg/L
Taluk boundary
District headquarters
Taluk headquarters
750
Electrical conductivity (Micro mhos/cm)

Fig.9

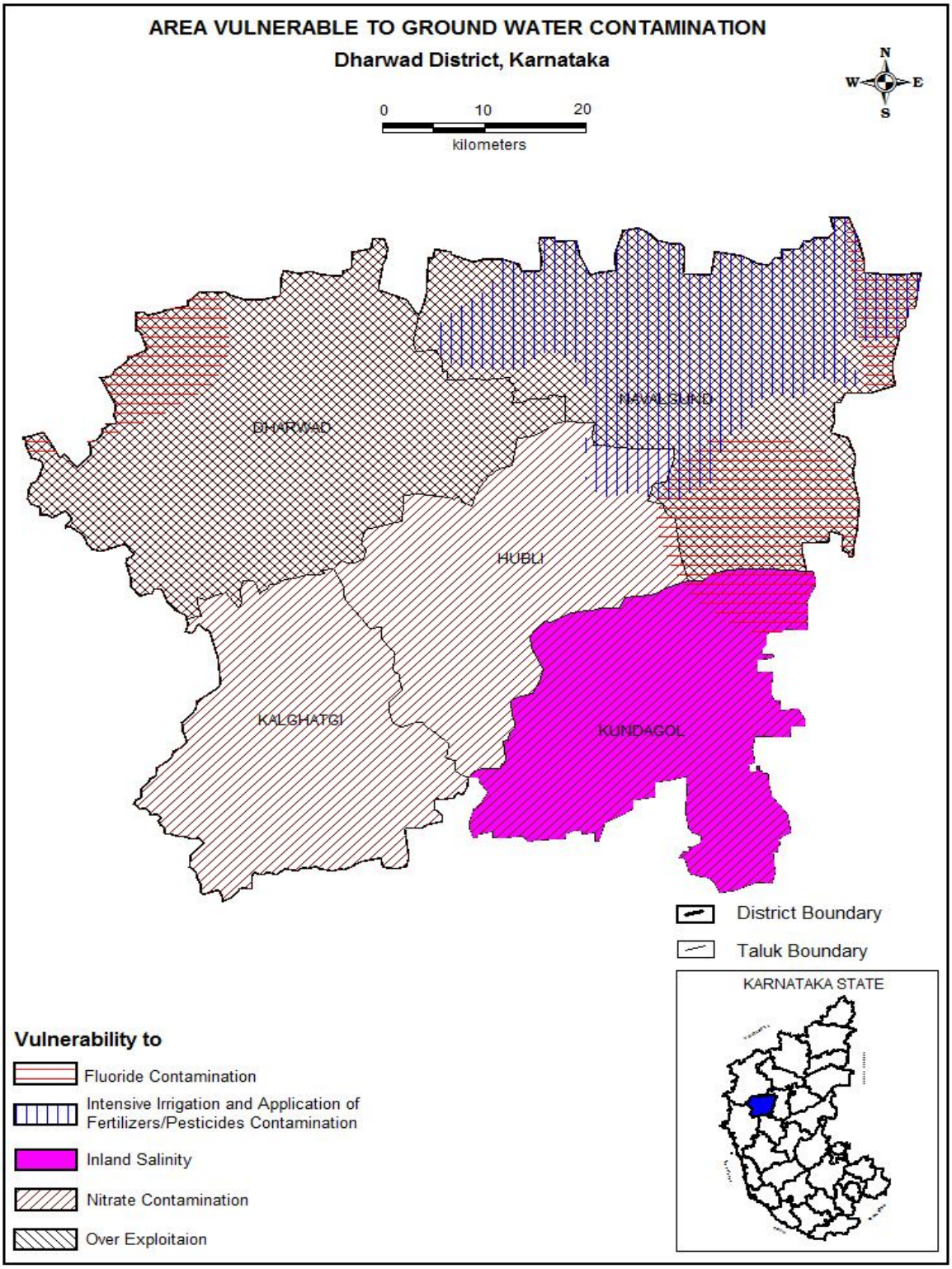

AREA VULNERABLE TO GROUND WATER CONTAMINATION
Dharwad District, Karnataka
N
W
E
S
0
10
20
kilometers
DHARWAD
NAVALGUND
HUBLI
KALGHATGI
KUNDAGOL
District Boundary
Taluk Boundary
KARNATAKA STATE
Vulnerability to
Fluoride Contamination
Intensive Irrigation and Application of Fertilizers/Pesticides Contamination
Inland Salinity
Nitrate Contamination
Over Exploitaion

Table-4 Taluk wise ground water draft data

Taluk	Existing Gross Ground Water Draft For Irrigation (HAM)	Existing Gross Ground Water Draft For domestic& Industrial purpose (HAM)	Existing Gross Ground Water DraftForAll Uses (HAM)	Stage of Groundwater Development (%)
Dharwad	3035.41	405.77	3441.18	75
Hubli	1303.49	249.18	1552.67	46
Kalghatgi	1831.09	180.72	2011.81	45
Kundagol	691.25	246.13	937.38	39
Navalgund	2690.64	426.26	3116.90	73

In all there are15951 irrigation electric motors registered in the district, DAG-2009-10. The wells in the highly weathered Gr.gneissic rock aquifer in the eastern parts get depleted resulted in drying of wells during post-monsoon periods. A major part of domestic need is met from groundwater through various drinking water supply schemes implemented by government viz mini-water supply BW-347 nos, accelerated rural water supply, Piped water supply BW-399 nos and 2500 bore wells installed with hand pumps (DAG-2006).

In general the ground water development found between 45 to 75% over the taluks, where as the district average rate accounted for 55.60%. Since the water levels in the area as a whole has not shown any appreciable decline the district is categorized as “SAFE” category in terms of development. An area of about 15% in Navalgund taluk has been identified as over exploited because of significant decline in post monsoon water level. Due to significant decline in water levels an area of 50% in Dharwad taluk and20% in Hubli taluk as shown as semi critical (**Fig-10)**

The previous record reveals a remarkable increase in the usage of ground water with a total draft of 13090 Ham of groundwater.

5. GROUND WATER MANAGEMENT STRATEGY

Since, the district with the major part of the domestic water and agriculture demand met from groundwater the water management aspect become an integral part for all round socio economical development of the region, in addition to that the environmental management and ecological stability. Hence, a proper groundwater management strategy is essential to make most economical, efficient and judicious use of water to achieve sustainable development of the resource.

5.1 GROUND WATER DEVELOPMENT

The development of water supply model should be resource based and should be from the point of view of total supply and demand.

Fig.10

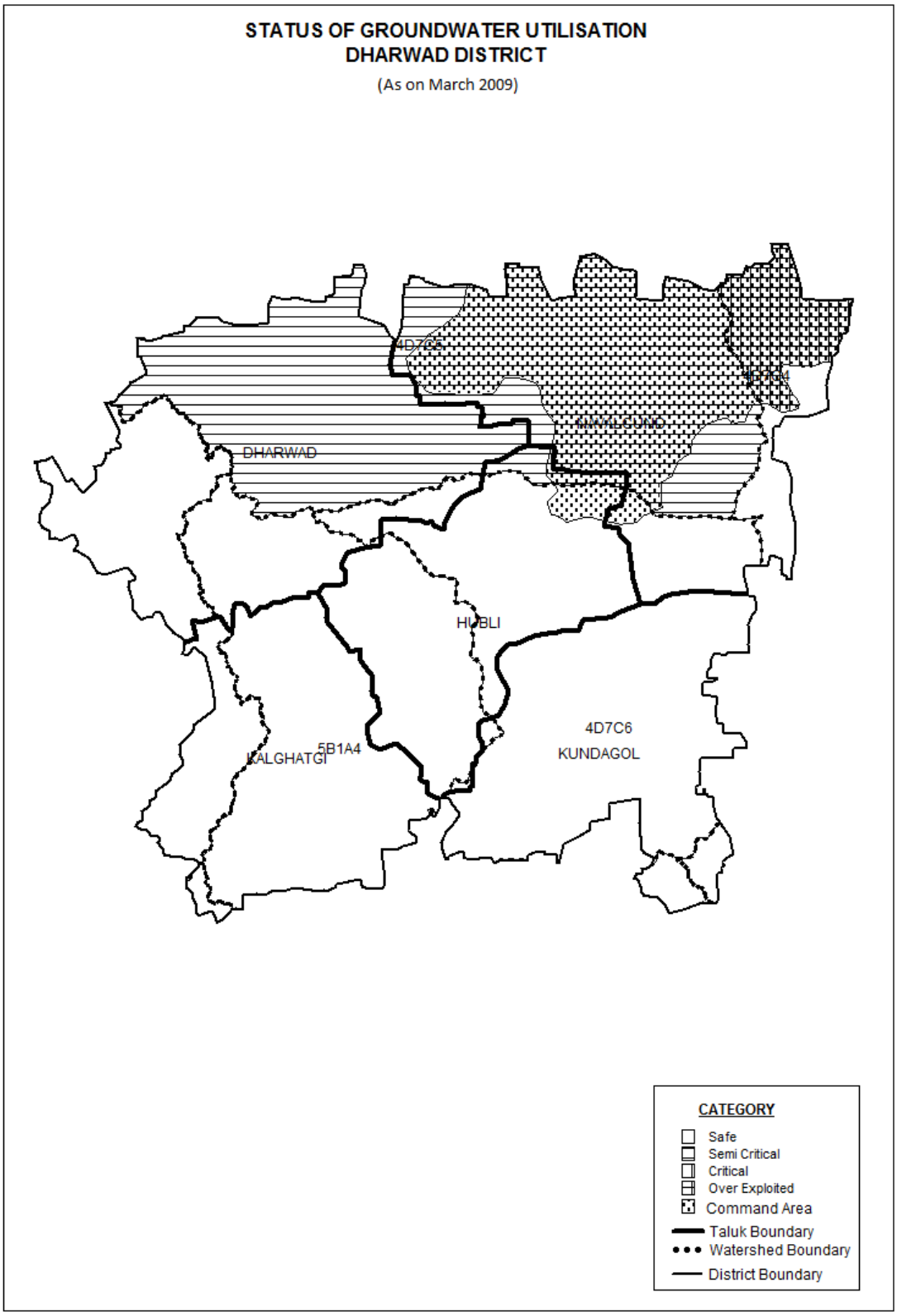

STATUS OF GROUNDWATER UTILISATION
DHARWAD DISTRICT
(As on March 2009)
4D7C5
DHARWAD
HUBLI
4D7C6
KUNDAGOL
5B1A4
KALGHATGI
CATEGORY
Safe
Semi Critical
Critical
Over Exploited
Command Area
Taluk Boundary
Watershed Boundary
District Boundary

Fig.11

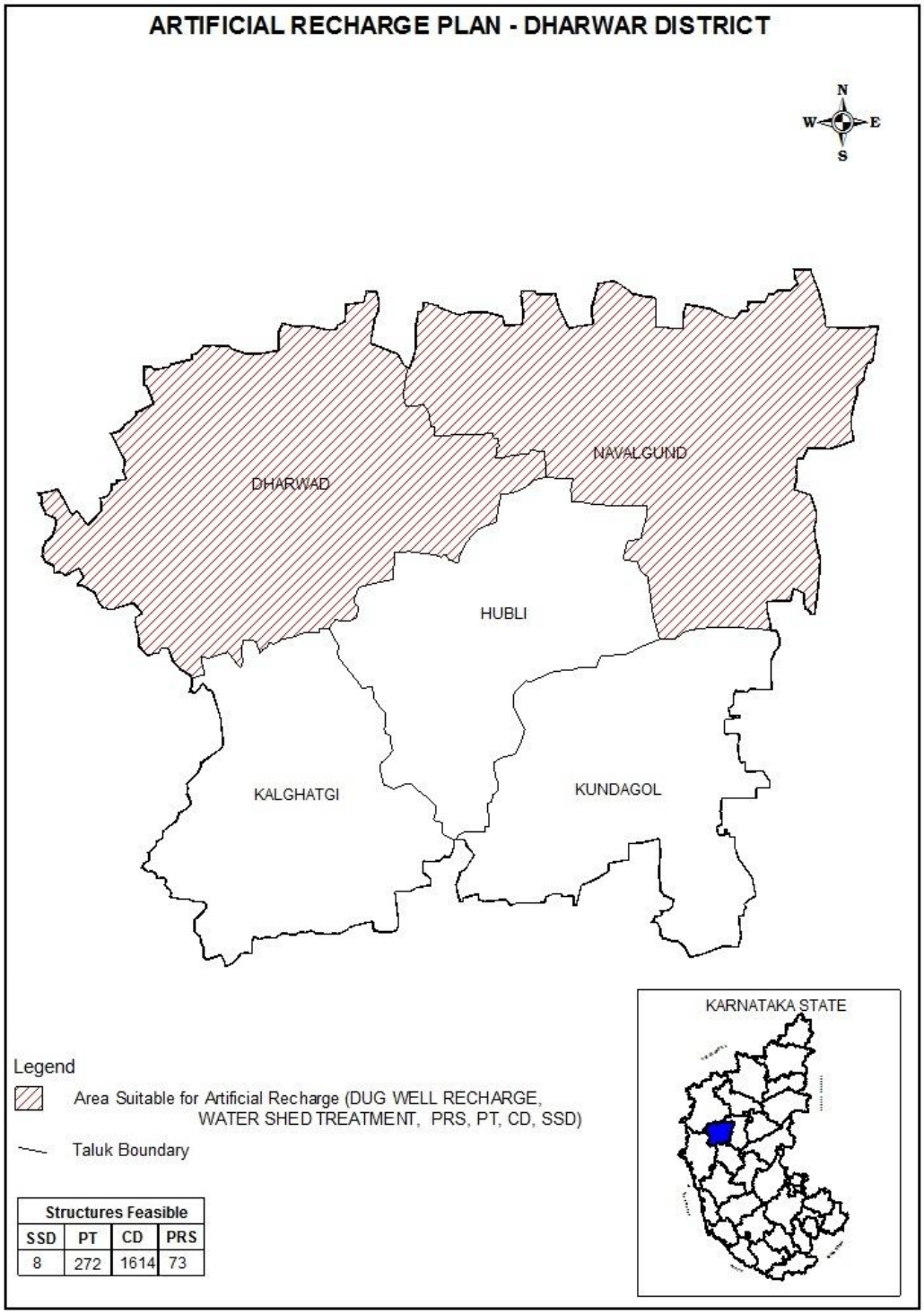
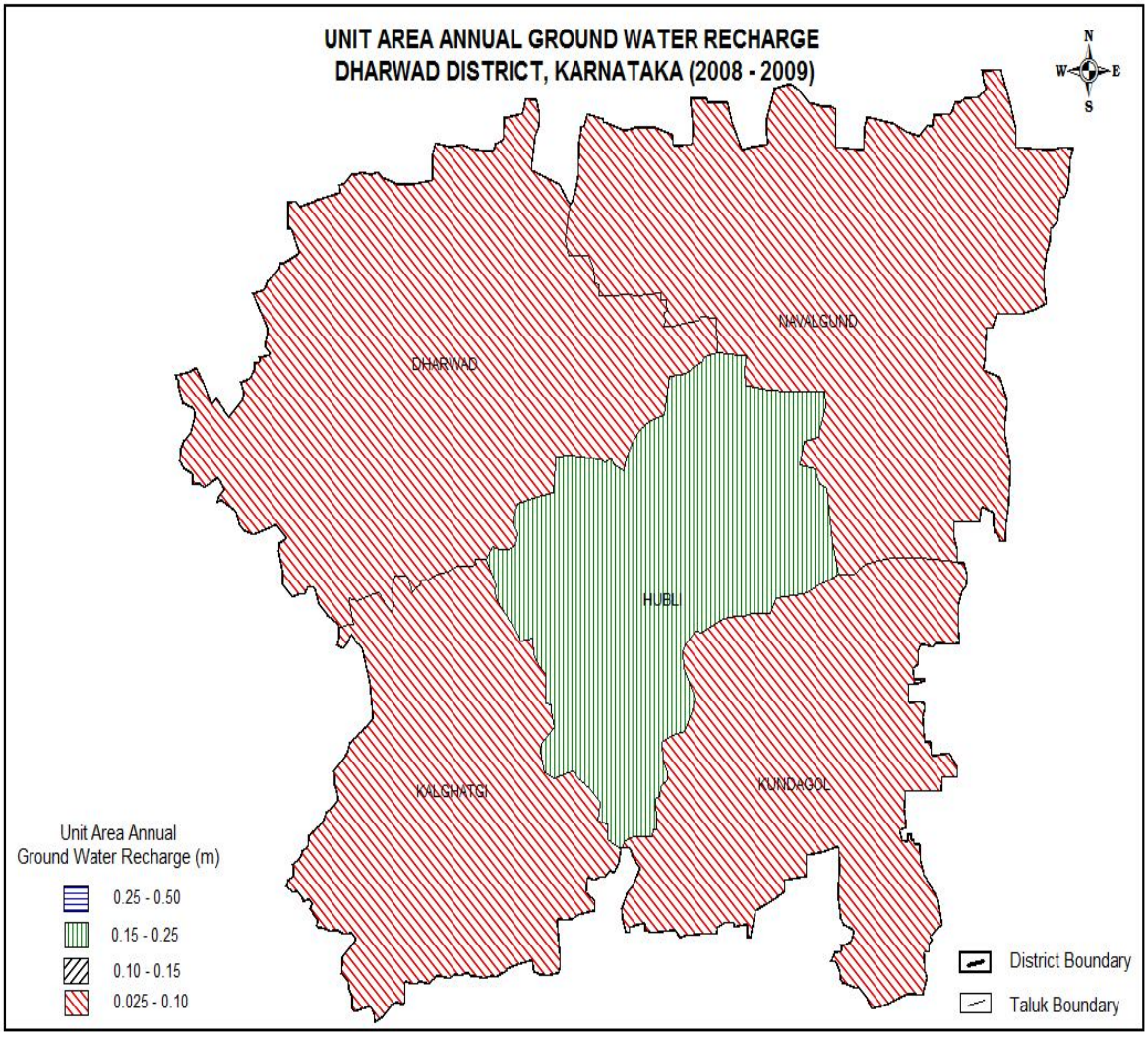

ARTIFICIAL RECHARGE PLAN - DHARWAR DISTRICT
N
W
E
S
DHARWAD
NAVALGUND
HUBLI
KALGHATGI
KUNDAGOL
KARNATAKA STATE
Legend
Area Suitable for Artificial Recharge (DUG WELL RECHARGE, WATER SHED TREATMENT, PRS, PT, CD, SSD)
Taluk Boundary
Structures Feasible
SSD
PT
CD
PRS
8
272
1614
73

Fig.12



Keeping in view, with the statistical data of water resources, population growth and its utilization pattern, additional demand within the priority areas of drinking, Irrigation and Industrial sector can be identified. And, hence the resource allocation becomes handy to ensure the optimum distribution of resources in the needy areas.

The groundwater resource have been distributed on the basis of population density in 2009 and fractional load/dependence (0.5 for cities and areas having surface water supply & 1.0 for other areas) on ground water during the year 2009 and thus the potential created for development as detailed in table-5.

Table-5 Taluk wise ground water balance data

Taluk	Allocation for Domestic and Industrial Use For Next 25 Years in HAM	Net Groundwater Availability For Future Irrigation Development. HAM	Average Crop Water Requirement (m)	Balance Ground Water Irrigation Potential Available Ha
Dharwad	723	1163	0.69	1685.51
Hubli	459	1538	0.815511	1885.93
Kalghatgi	253	2668	0.8175	3263.51
Kundagol	382	1700	0.849916	2000.20
Navalgund	1252	898	0.615658	1458.50
Total	3069	7967	3.79	10293.65

With the existing scenario the feasible abstraction structures as presented in table-6, viz DW/DCB have been proposed to utilize the resources and effectively develop the potential created for the future.

Table-6 Taluk wise proposed ground water development.

Taluk	Balance.of resource available Ham	Total structures with unit draft of 1.10 ham	irrigation potential created in the dist as on March 2004 in Ha
DHARWAD	1163	1057.27	1685.51
HUBLI	1538	1398.18	1885.93
KALGHATGI	2668	2425.45	3263.51
KUNDAGOL	1700	1545.45	2000.20
NAVALGUND	898	816.35	1458.50
Total	**7967**	**7242.7**	**10293.65**

In view of the ever-growing population and subsequent demand for various economical developmental activities adaptation of unconventional means to artificially recharge the ground water in the water level depleting areas and over exploited areas is advocated. The spacing between wells proposed > 200m metres for the eastern region to achieve optimum/sustainable yield and avoid the interference during simultaneous pumping of wells in the vicinity.

5.2 WATER CONSERVATION & ARTIFICIAL RECHARGE

As per Groundwater resources estimation 2009 part of Dharwad and Navalgund taluks area demarked for artificial recharge purpose in the district. Keeping in view of the resources availability, the recharge structures like Subsurface dykes (8No's), Percolation Tanks(272 no's), Check dams(1514No's) and Point Recharge Structures(73No's) have been proposed to maintain the Aquifer potential and their sustainable development as the area demarcated in **Fig.11**.

In view of the socio-economical development with subsequent demand for fresh water and changes in the local environment it is necessary to conserve the water resource and adopt unconventional means to artificially recharge the ground water in the water level declining/prone to decline areas and prevent further

decline in the water level and deterioration in the quality of water. In the groundwater "SAFE" category areas of the district it is advocated for the development of a water supply model so that the optimum utilization of resource is achieved.

The Conjunctive use of both surface and ground water resources practiced in the canal command area and in western parts during monsoon period would improve the resource availability during scarcity periods. The present surface water supply to twin city, Hubli-Dharwad (area 74Km^2, population about 9 lakh) can be brought down by implementing roof-top rainwater harvesting to supplement the domestic requirement during monsoon periods, the other area experiencing the drinking water scarcity can also adopt this rainwater harvesting method in a big way.

5.3 UNIT AREA ANNUAL GROUNDWATER RECHARGE

Sustainability of groundwater resource depends mainly on two factors viz. Annual groundwater recharge and annual groundwater draft. The annual groundwater recharge depends on the quantity and intensity of rain fall, the infiltration characteristics of the soil, the depth to groundwater level, the slope of the area and the geomorphology. The groundwater recharge is assessed separately for the monsoon and non monsoon period due to rainfall as well as due to other sources. The annual groundwater recharge includes all the above.

The recharge from other sources includes return seepage from irrigated area, seepage from canals, seepage from water bodies, seepage from influent rivers etc. The recharge can be expressed in metres. In the state of Karnataka, the unit area recharge is grouped into four categories viz. 0.025-0.10m, 0.10-0.15m, 0.15-0.25m and 0.25-0.50m. In Dharwad district in most of the area the unit area annual recharge is in the range of 0.0025 to 0.25m and in Hubli area is in the range of 0.15 to 0.25m (**Fig.12.**)

6. GROUNDWATER RELATED ISSUES & PROBLEMS IN THE DISTRICT

Though the study area enjoys a low to moderate annual rainfall resulted in drought (RFdeficiency) condition and saline nature of ground water especially in the taluks of Navalgund and Kundgol are experiencing shortage of safe water for domestic use. In Navalgund taluk about 15 % of the area has been over exploited as indicated in fig.10.The quality deterioration in many parts of the district can be attributed partly to the natural means of decomposing of host rock/aquifer by prevailing weather condition over the year. Indiscriminate dumping of wastes on the land and usage of chemical fertilizers in the agricultural land by human activities also leads to groundwater deterioration.

The wells sunk in schistose rock aquifers especially in Kalghatgi, Dharwad taluks and highly weathered Gr.gneissic rock aquifer in the eastern parts the wells go dry for several months during summer periods. The present water supply to the twincity-urban area (74km^2) having a population of about 9 lakh-2011 census receives from Neerasagar tank and Malaprabha river (Renuka sagar resevoir) is reported to be inadequate. The leakage in the said surface water supply network

system is estimated around 40%. A proposal is in the anvil to improve the existing source-Renukasagar through Malaprabha stage-III at a cost of 237 crores with the assistance of World Bank.

7. AWARENESS&TRAINING ACTIVITY

7.1 Mass awareness Programme(MAP) by CGWB

Mass awareness campaign on ground water protection and conservation was organised in Karnataka University, Dharwar on 27th December 2000. As a Chief guest Shri.H.K.Patil, the then honorable minister for major and medium irrigation, Government of Karnataka attended the campaign and Dr. D.K. Chadha the then Chairman of CGWB presided over the function. In the function the distinguished dignitaries addressed various aspects of ground water and it's conservation. Dr. D.K. Chadha explained in detail about the various aspects involved in ground water conservation processes, harnessing of rainwater and artificial recharge to ground water.

7.2 Presentation & lectures delivered in Public forum/Radio/TV/Institution of repute,Grassroots/association/NGO/Academic institution etc.

An investigation carried out on the "groundwater recharge &water quality" around Hubli-Dharwad by the "Centre for Arid zone Studies, University of wales, Bangor" draws the conclusion with an anticipation of a rise in the groundwater recharge by the year 2010 after the implementation of Mallaprabha III-stage, a surface water supply project to the city.

8. AREAS NOTIFIED BY CGWA/SGWA

The groundwater in a major parts of the district developed partially and thus falls in 'SAFE 'category except a small area in Navalgund taluk (about 15%) falling under over exploited category.

9. RECOMMENDATIONS

Considering the prevailing scenario of the groundwater resources and its development the following recommendations are made for achieving the sustainable development of resources in the district.

1) The dug wells found in the dried weathered, fractured zones can temporarily be modified for groundwater recharging purpose to ensure the better utility.
2) Construction of check dams and sub surface dykes at appropriate places across the nallahs and streams and the areas where water table is having declining trend on priority basis.
3) A comprehensive programme should be formulated to harvest the rainwater through existing building rooftops and check dams, surface tanks, bunds and subsurface dykes to augment the groundwater resources in terms of quality and quantity.

4) The ground water worthy areas such as topographic lows, valley portions low fluctuations zones should be developed with an adequate soil conservation measures to prevent the soil erosions.
5) Constant monitoring of ground water quality should be carried out in the district especially in the Bennihalla watershed canal command areas so as to have check on the ground water quality status and recording of trace elements and organic compound would help in categorizing the quality of water.
6) A detailed geophysical study should be conducted in the eastern part of the district to demarcate aquifer geometry, the extent of fresh water zones and salinity prone areas.
7) A comprehensive action plan for development of groundwater prepared for the district would facilitate effective implementation of groundwater development activities.
8) The highly brackish groundwater quality areas in the eastern part can be developed for growing salt tolerant crops such as Onion, Chillies, Wheat etc to control the soil salinity.
9) The farming community in the district should be encouraged with financial assistance and technical guidance to conserve and develop groundwater though modern irrigation methods.