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
UDUPI DISTRICT, KARNATAKA

SOUTH WESTERN REGION
BANGALORE
AUGUST 2012

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अध्यक्ष
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केन्द्रीय भूमि जल बोर्ड
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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.

Dr. S. C. Dhiman

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 Udupi 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 Mr. N.Vinayachandran, Scientist-C, under the guidance of Shri.B.K.Kallapur, Scientist-D, Central Ground Water Board, South Western Region, Bangalore. The figures were prepared by Sri. J. Sivaramakrishnan, Assistant Hydrogeologist. The rainfall data provided by Shri H.P.Jayaprakash Scientist-C.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.

(K.Md.Najeeb)
Regional Director

DISTRICT AT A GLANCE-UDUPI DISTRICT

SL NO	ITEM	STATISTICS	
1	**GENERAL INFORMATION**		
	i) Geographical area	3575 sq. km.	
	ii) Number of taluks	3 taluks	
	iii) Number of panchayats/villages	146/267	
	Iv) Population	1177908	
	iv) Average annual Rainfall (mm)	4136.3	
2	**GEOMORPHOLOGY**		
	Major physiographic units	03	
	Major drainages	West flowing	
3	**LAND USE (Ha)**		
	a) Forest area	100102	
	b) Net area sown	82084	
	c) Cultivable area	85766	
4	**MAJOR SOIL TYPES**	i) Sandy soil ii) Yellow loamy soil iii) Red lateritic soil	
5	**AREA UNDER MAJOR CROPS (Food crops As on 2005)**	69974 Ha	
6	**IRRIGATION BY DIFFERENT SOURCES (AREA and NO. of STRUCTURES)**	**Area (Ha)**	**No of structures**
	Dug wells	22184	27727
	Tube wells/Borewells	2149	2077
	Tanks/Ponds	4313	190
	Canals/ Lift irrigation	3724	2411 lift irrigation schemes.
	Other sources/ Surface flow	4060	585 other sources.
	Net irrigated area	27630 Ha	
	Gross irrigated area	-	
7	**NUMBER OF GROUND WATER MONITORING WELLS OF CGWB (AS ON 31.3.2007)**		
	No. of Dug wells	24	
	No. of Piezometers	04	
8	**PREDOMINANT GEOLOGICAL FORMATIONS**	Granitic gneisses, PGC with migmatites, Laterite capping, Coastal alluvium, fluviatile deposits and basic and acidic intrusives.	

9	**HYDROGEOLOGY**	
	Major water bearing formations	Gneissic complex, Laterite and alluvium
	Premonsoon depth to water level during 2011	2.8 mbgl minimum and 14.44 mbgl maximum
	Postmonsoon depth to water level during 2011	1.75 mbgl minimum and to 10.45 mbgl maximum
	Long term water level trend in 10 years (2001-2010)	Fall in water level by 0.130 to 0.387 m/year and rise in water level by 0.066 to 0.542 m/year during Premonsoon season (May 1996- May 2006). Fall in water level by 0.014 to 0.348m/year and rise in water level by 0.014 to 0.254 m/year during post monsoon.
10	**GROUND WATER EXPLORATION BY CGWB (AS ON 31.3.2007)**	
	No. of wells drilled(EW, OW, PZ, SH-Total)	30 EW, 14 OW, 02 SH, 04 PZ. Total. 50
	Depth Range (mbgl)	7 to 303.28
	Storativity (s)	0.35 to 2.87 lpm/m/ m^2
	Transmissivity (m^2 /day)	0.1 to 228
11	**GROUND WATER QUALITY**	
	Presence of chemical constituents more than permissible limit (EC, F, AS, Fe, NO3)	EC and Cl.
	Type of water	Sandy aquifers are found good and potable, Lateritic-weathered gneissic rocks it is sweet to alkaline. Salinity occurs in Coastal aquifers.
12	**DYNAMIC GROUND WATER RESOURCES (2009) IN HAM**	
	Net Annual Ground water Availability	31887
	Net Annual ground water draft	16419
	Projected demand for domestic and industrial uses	3285
	Stage of ground water development	51.49 (%)

13	**AWARENESS & TRAINING ACTIVITY**	
	Mass Awareness programmes organized	Nil
	Date Place No. of participants	
	Water Management Training Programme	Nil
	Date Place No.of participants	-
14	**EFFORTS OF ARTIFICIAL RECHARGE AND RAIN WATER HARVESTING**	-
	Projects completed by CGWB (No & Amount spent)	Nil
	Projects under technical guidance of CGWB	Nil
15	**GROUND WATER CONTROL AND REGULATION**	
	No.of OE blocks	Nil
	No.of Critical Blocks	Nil
	No.of Blocks notified	Nil
16	**MAJOR GROUND WATER PROBLEMS AND ISSUES**	Limited Coastal salinity in Udupi and Kundapur taluks

UDUPPI DISTRICT

1.0 INTRODUCTION

The coastal district Udupi of Karnataka state falls along the west coast of peninsular India and is separated from the rest of peninsula by towering high Western Ghats. The district lies between 13^{o} 04' and 13 ^{o}59' North latitude and 74 ^{o} 35' and 75 ^{o} 12' East longitude covering an area of 3575 sq km. It is about 88 km in length and about 80 km in widest part and is bounded by Uttara Kannada district in the North, by Shimoga and Chikamagalur district in the East and by Dakshina Kannada district in the South. The district is carved out of South Canara District during 1991. The district comprises administrative subdivisions Coondapur, Udupi and Karkala Taluks. This coastal district of Karnataka is blessed with various endowments of Nature. Administrative map of Udupi district is given in Fig.1

This coastal agro climatic west flowing river basin is characterized by maritime climate. It covers parts of Mulki, Shirva, Swarna Yennehole, Madisala, Sita, Haladi, Chakravani, Kollur, Baindur and Sankadagudi hole sub basins. These rivers are perennial during normal rainfall years where as tributaries and smaller streams become dry during summer. The prevailing high gradient in the hilly terrain and heavy rainfall brings great volume of water in these rivers during monsoon. These rivers join Arabian Sea and are prone to tidal effects to considerable lengths in the inland area. Drainage map of the area is shown in Fig.2.

Udupi district is essentially an agriculture district with more than 80% of population depends on agriculture for their livelihood where as only 40% of the available land is used for agriculture. Rest is either forest land or land unsuitable for agriculture. Agriculture is confined mainly to the valley area and is by and large confined to the traditional kharif cultivations depending on the monsoon. Paddy is the main crop raised by 75% of the cultivated area in kharif season. The other crops are chillies, sweet potato, ginger and vegetables. In rabi season, paddy, chilies, black gram and green gram are raised. Pulses are raised during dry season. The crops raised during summer are limited with chief crop being sugarcane, groundnut, paddy and sweet potato. Plantation crops include coconut, cashew nut, areca nut and pepper. Cardamom is also grown in valley areas.

There is no major irrigation scheme in Udupi district. The minor irrigation schemes include both surface water and ground water schemes. The ground water schemes consists of Dug wells, Shallow and Deep tube wells, while surface water schemes includes surface flow (tanks, anicuts, pick ups, barrages) and lift irrigation schemes. Lift irrigation is the major irrigation practice. Water management practices like sprinkler irrigation is taking popularity in Udupi district. Among the cultivable area of about 85,766 ha only 32841 ha (38%) is being irrigated as on 2008-09.

CGWB has carried out exploration activities in Udupi district as a part of the first phase exploration and those wells in turn helped to cater the groundwater needs of the district. Special study on salinity ingress in the coastal aquifers was carried out during 2007-08. Systematic hydrogeological survey has been carried out in Karkala taluk during 1985-86 and Re-appraisal hydrogeological survey has been conducted in all three taluks of Udupi district.

Fig-1

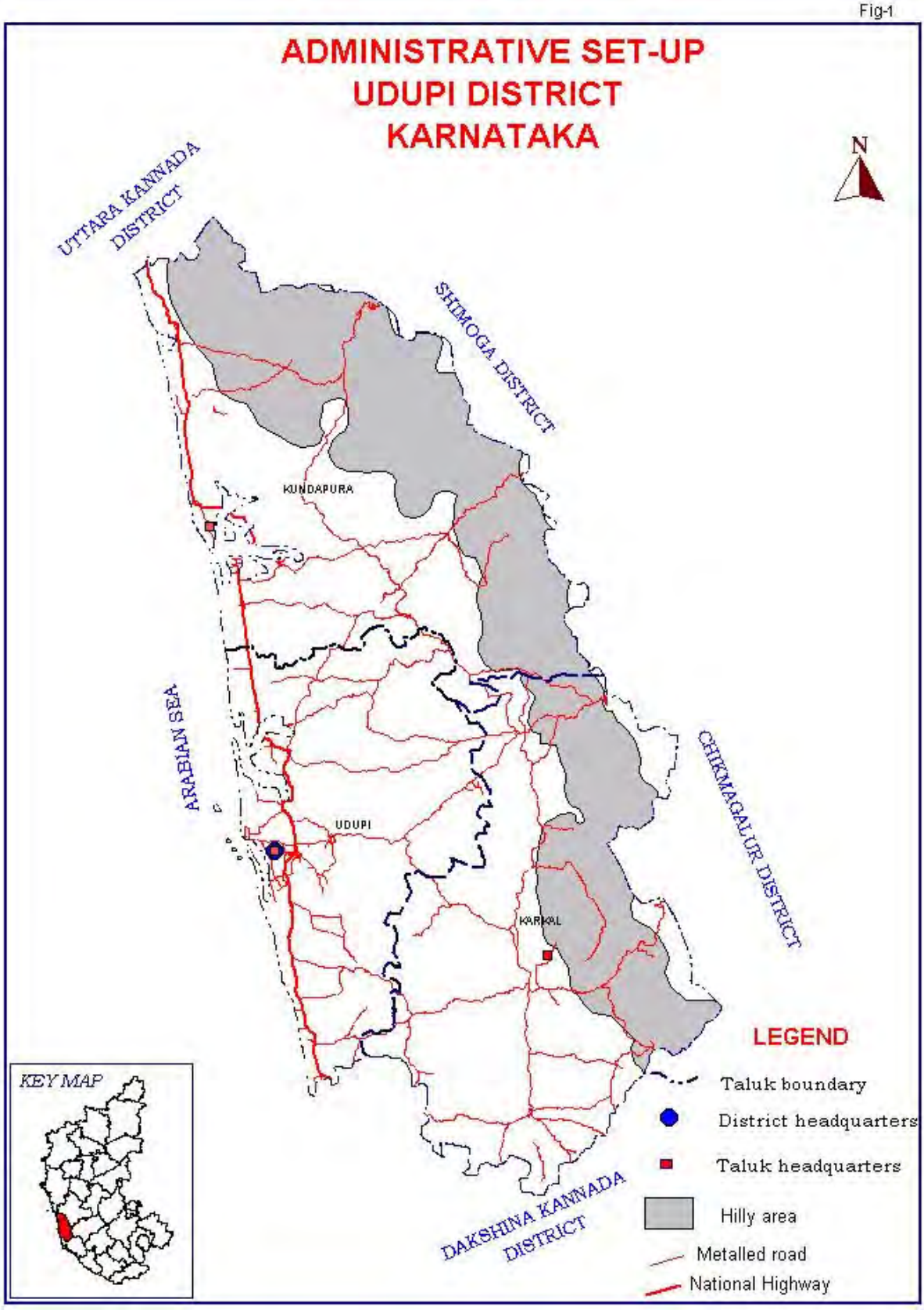
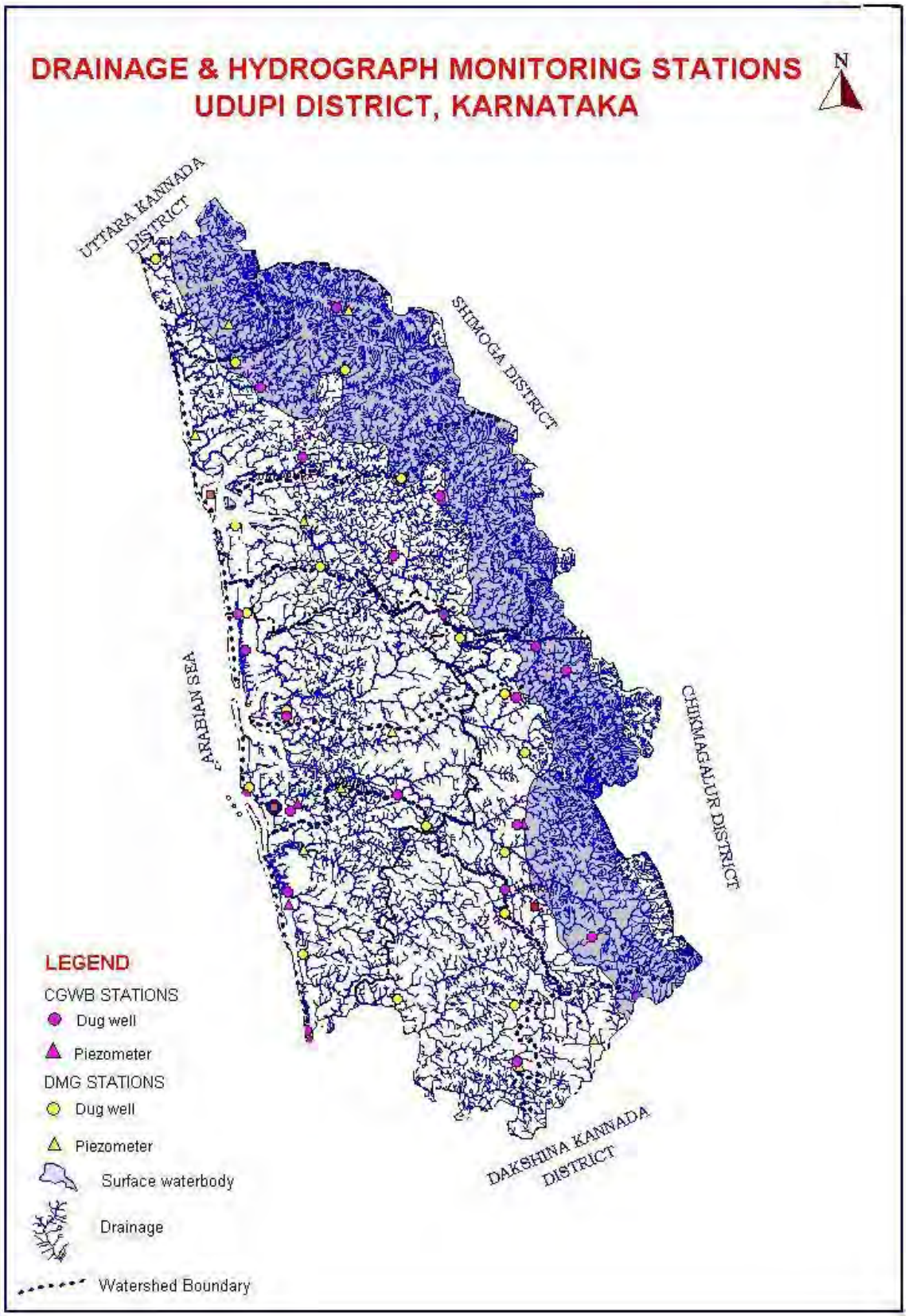

ADMINISTRATIVE SET-UP
UDUPI DISTRICT
KARNATAKA
N
UTTARA KANNADA DISTRICT
SHIMOGA DISTRICT
KUNDAPURA
ARABIAN SEA
UDUPI
KARKAL
CHIKMAGALUR DISTRICT
DAKSHINA KANNADA DISTRICT
KEY MAP
LEGEND
Taluk boundary
District headquarters
Taluk headquarters
Hilly area
Metalled road
National Highway

Fig- 2


DRAINAGE & HYDROGRAPH MONITORING STATIONS
UDUPI DISTRICT, KARNATAKA
N
UTTARA KANNADA DISTRICT
SHIMOGA DISTRICT
CHIKMAGALUR DISTRICT
DAKSHINA KANNADA DISTRICT
ARABIAN SEA
LEGEND
CGWB STATIONS
Dug well
Piezometer
DMG STATIONS
Dug well
Piezometer
Surface waterbody
Drainage
Watershed Boundary

2.0 CLIMATES AND RAINFALL

The area experiences a typical maritime climate with an average temperature of 26.5°C. Udupi district gets highest annual rainfall in Karnataka state, about 4000 mm. In this coastal district, bulk of the rainfall ie. over 85% occurs during monsoon season. The 3575 sqkm area of Udupi district has 3 rain gauge stations (1 station/1199 sq km). The temporal variation of rainfall is confined to 3 to 4 months in a year. The rainfall increases from west to east with co-efficient of variability ranging from 18.7 to 18.9%. Average Annual Rainfall is 4136.3 mm.

3.0 GEOMORPHOLOGY AND SOIL TYPES

The district comprises of three distinct physiographic units viz., (i) Narrow stretch of coastal tract (ii) Up land area (iii) The hilly terrain. The coastal areas exhibit coastal beach, spits and creeks and backwater swamps with the surface features of sandy strips and linear troughs. The coastal parallel troughs are seen around Parampalli, Kota and Manur. The area adjoining the coastal stretch exhibits forested high hilly topography with deep valleys. Most part of the district is rugged terrain and demarcates areas with slopes of less than 2%, 2 to 5% and more than 5%. About 50.68% of the district falls under 2 to 5% slope and remaining fall under more than 5% slope. Most part of Lateritic capped pediplains have an elevation ranging from 40 to 60 mamsl. which is an important physiographic feature. Upland pediplain area intercepted with low hills between Western Ghats and the coast, which is moderately cultivated. Western ghats and forested area located on the eastern part of the district.

Soil type:

The district is covered with three types of soils i) sandy soil covering the beaches and the adjoining stretches ii) yellow loamy soil and iii) red lateritic soil. The sandy soils are confined to a narrow strip of the coast having width ranging from less than 100 m to as much as a kilometer. These fine to medium texture sands are characterized by their extremely high rate of infiltration and act as a good recharge media for ground water. Yellow loamy soils are transported from origin and are found mostly along riverbanks and lower reaches of valleys. They are mostly used for tile industries. This soil type is very well suited for irrigation and shows good response to irrigation practices. Red lateritic soil is the most dominant soil type in the area. The texture of these soils varies from fine to coarse. The soil in the valleys and immediate slopes are rich in loam where as in upper slopes and pediplanes are much coarser in nature. The degree of leaching undergone by this soil type is also variable.

4.0 GROUND WATER SCENARIO

4.1 Geology and Hydrogeology

Geologically the rocks like Granitic gneisses with occasional laterite capping and unconsolidated river and marine sediments, occupy the area. The gneiss, which is wide spread in the distinct outcrops at varying magnitude especially along river courses. Basic intrusives like dolerites and gabbros and acidic intrusives like pegmatite and quartz veins and pink porphyritic granites are found all over the district. The recent alluvium and colluvial deposits occur along the riverbanks and seacoast. The exposures of crystalline rocks found as isolated hills along the shore and off shore. The black clayey marine sediments with a thickness of 0.30m to >1.00m occur as lenses along the coast and in the deltaic islands. Its occurrence is marked at a depth range of 5.00 to 6.00 mbgl.

Hydrogeology

Ground water in the region mainly occur in various geologic formations like beach alluvium, coastal sediments, laterites and in weathered and fractured granitic gneisses under phreatic and semi-confined to confined conditions, but mainly under water table conditions. Coastal alluvium along with the laterites, which underlie them, occurs as an aquifer of phreatic nature. Ground water occurs in weathered mantle and fractured crystalline formations under semi confined to confined conditions. The ground water in and below the black clayey horizons of coastal sediments found with high salinity, which marks the index bed for saline water and fresh water interface. Dug wells are the most common groundwater abstraction structures encountered in lateritic terrain. Hydrogeology of the district is represented in Fig.3 Based on the morphogenitic and geological diversities and aquifer characteristics; Udupi district can be subdivided in to **two broad hydrogeological units**

a) Hard and fissured formations in the pediplain
b) Porous unconsolidated formations in the coast.

4.1.1 Occurrence of ground water

As per the occurrence and behaviour of ground water, ground water system of the district is described under four zones in general.

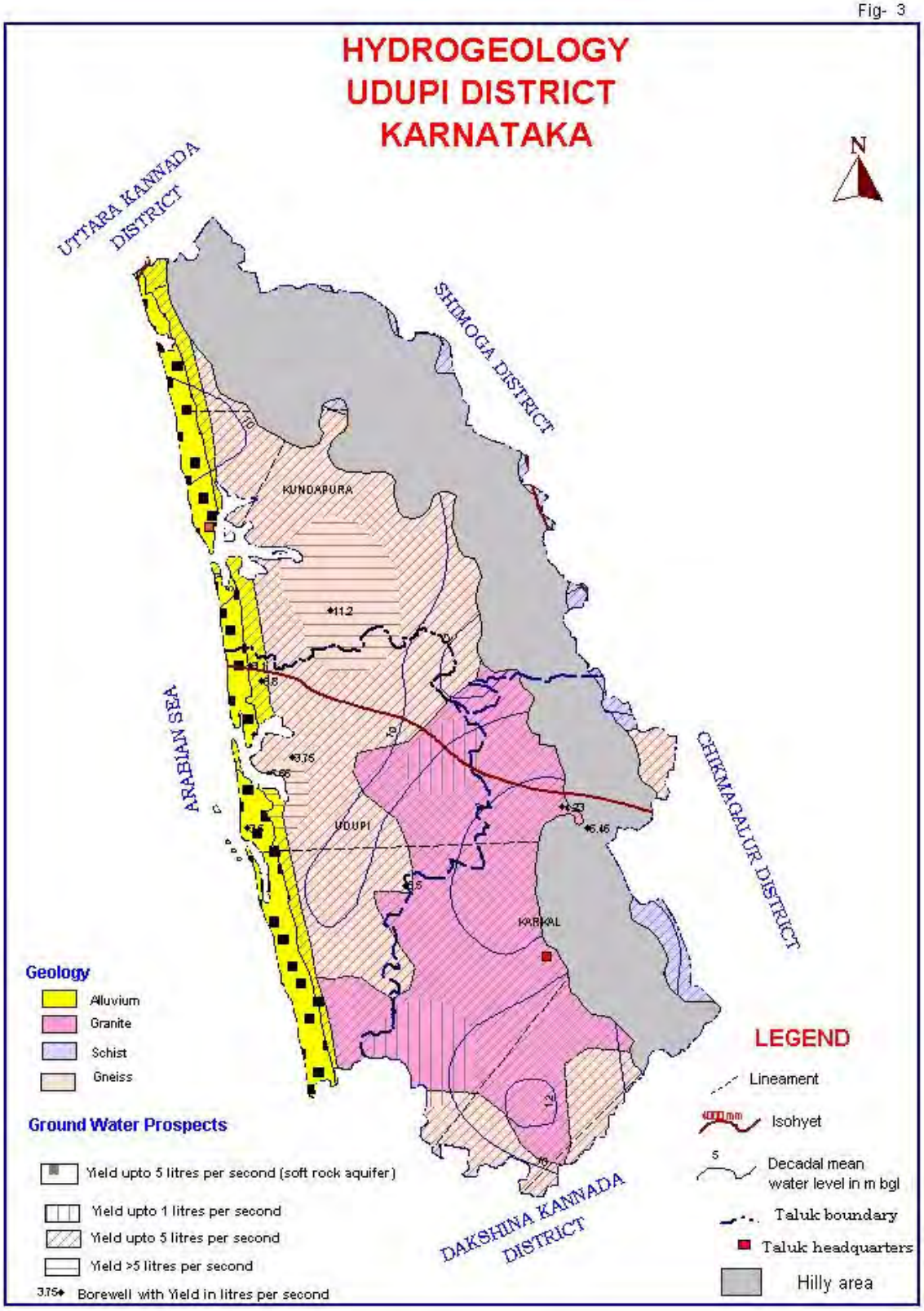
a). Shallow zones up to 25m

It generally comprises of weathered and fractured granites and gneisses. Ground water occurs in the pore spaces of weathered and fractured formation under phreatic condition. The granitic gneisses are traversed by intrusives of younger granites, pegmatities and quartz veins. In weathered granite and gneissic formations the specific capacity values ranges from 6 to 215 lpm/m and unit area specific capacity ranges from 0.2 to 19.5 lpm/m/m^2 . Transmissivity of granite gneiss in dug well section ranges from 5 to 141 m^2/day. Permeability ranges from 1.8 to 86 m^2/d. Specific capacity for laterite ranges from 7 to 1724 lpm/m and permeability range from 5 to 354 m^2/day. Yield of dug wells ranges from 18 to 297 m^3/d for sand and 18 to 36 m^3/d for clay

b). Moderately Deep zone (25-60 m)

The aquifers in the depth range of 25 to 60m are grouped as moderately deep zone category. The aquifers of this category consist of weathered and fractured granitic gneisses. Ground water occurs in the pore spaces under semi-confined conditions. T value ranges from 3 to 72 m^2/day. In general, the yield in the area is <2lps.

Fig- 3


HYDROGEOLOGY
UDUPI DISTRICT
KARNATAKA
N
UTTARA KANNADA DISTRICT
SHIMOGA DISTRICT
CHIKMAGALUR DISTRICT
DAKSHINA KANNADA DISTRICT
ARABIAN SEA
KUNDAPURA
UDUPI
KARKAL
11.2
3.75
6.45
Geology
Alluvium
Granite
Schist
Gneiss
Ground Water Prospects
Yield upto 5 litres per second (soft rock aquifer)
Yield upto 1 litres per second
Yield upto 5 litres per second
Yield >5 litres per second
3.75 Borewell with Yield in litres per second
LEGEND
Lineament
Isohyet
Decadal mean water level in m bgl
Taluk boundary
Taluk headquarters
Hilly area

c). Deep zone (60-100m)

The aquifer occurring between the depths of 60 to100 mbgl are grouped as deep zone category. Aquifers of this category also consist of semi-weathered and fractured granite and gneisses. The presence of productive fractures also seen in this zone. Ground water occurs in fractured and jointed formations under semi confined/confined conditions. In these aquifers transmissivity is in the range of 78 to 228 m^2/d. In general the yield distribution is in the range of 2 to 4 lps.

d). Very Deep Zone (Beyond 100m)

Aquifers of this category exist in semi-weathered and fractured granites and gneisses and ground water occurs under semi confined/ confined conditions in fractures and joints. In these aquifers transmissivity is in the order of 2 to 124 m^2/day and yield is in the range of 2 to 4 lps.

4.1.2 Depth to Water level

CGWB has set up 24 NHS stations all over the district and is monitoring them four times a year. Other than this, DMG, Government of Karnataka, has also set up monitoring stations along all streches of the district as depicted in Fig.2. Among the CGWB NHS stations, 4 are iAn alluvium formations, 7 are in granitic gneisses, 2 are in granites, and 11 are in laterites. Ground water levels are essentially controlled by lithology, physiographic features, and rainfall distribution in space and time. Hence in pediplain areas, depth to water level is highly variable. The water level in general shows recession from November to May**.** The depth to water level for premonsoon and post monsoon for the year 2011 (Based on NHS data) is shown in Fig 4 and 5 respectively. Behavior of ground water table during pre and post monsoon- 2011 and long-term water level trend in the last decade (2001-2010) is discussed below.

During Premonsoon, May 2011, the depth to water level varies between 2.80 to 14.44 mbgl in the district. Premonsoon water level is in the range of 5 to 10 mbgl mostly found in lateritic terrain. Depth to water level more than 10 mbgl occurs mainly in gneissic terrain as isolated patches. Water level less than 5 mgl occurs along the coastal belt.

Post monsoon water level for November 2011 varies between 1.75 to 10.45 mbgl in the district.

4.1.3 Seasonal fluctuation

Ground water level fluctuates from season to season due to the seasonal variations of rainfall. The water levels are deepest before commencement of southwest monsoon ie, in May and shallowest recorded in August/November. Rise after rains indicate the building up of ground water storage in the ground water reservoir, which gets depleted by evaporation and exploitation during non-monsoon period. In general Udupi district shows water level fluctuation between 2 and 4m (rise in water level). Fluctuation of more than 4 m occurs in eastern and southern part of the district. Decadal mean water level fluctuation for may and November months are shown in figure 6 and 7.

Fig:4

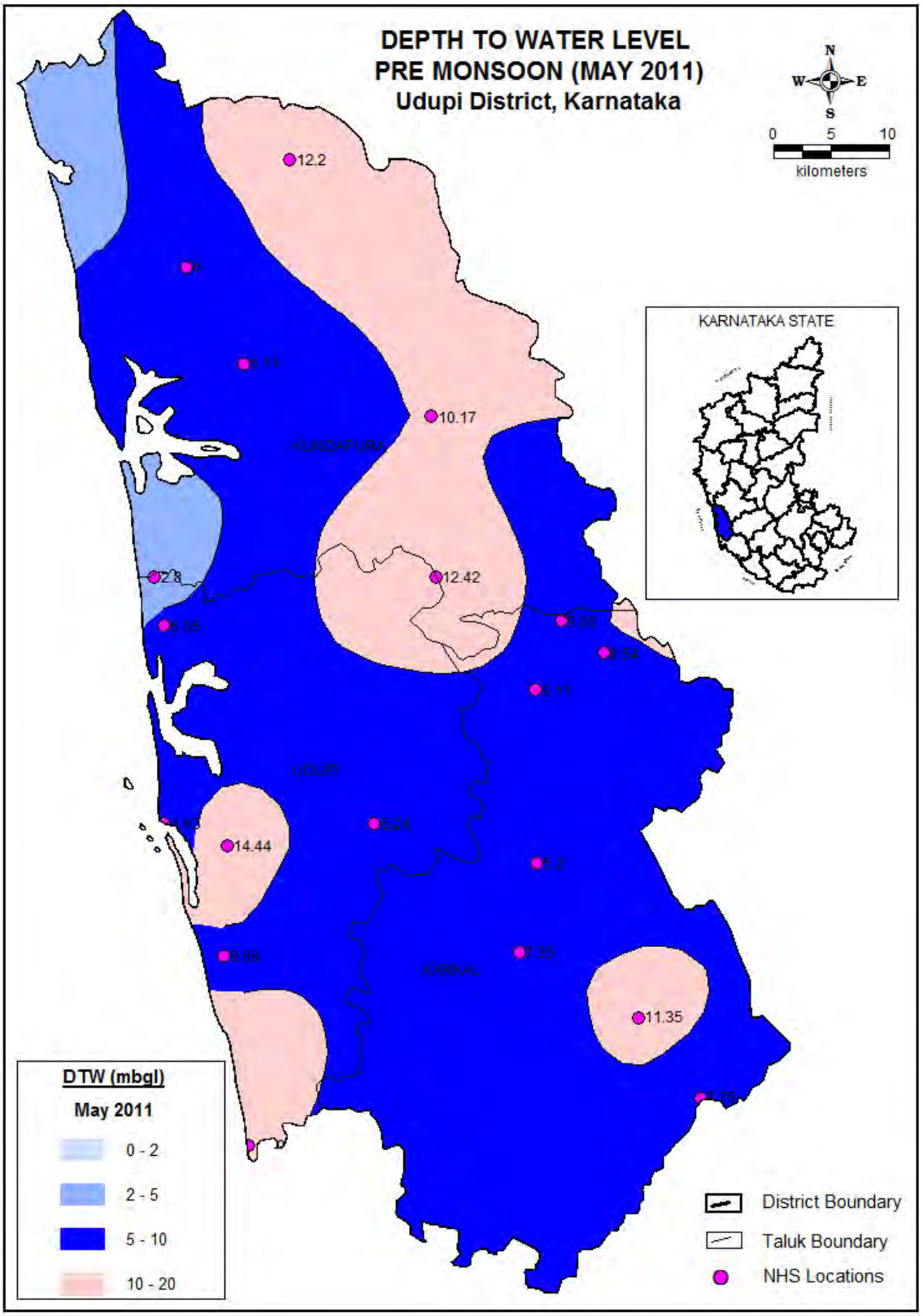
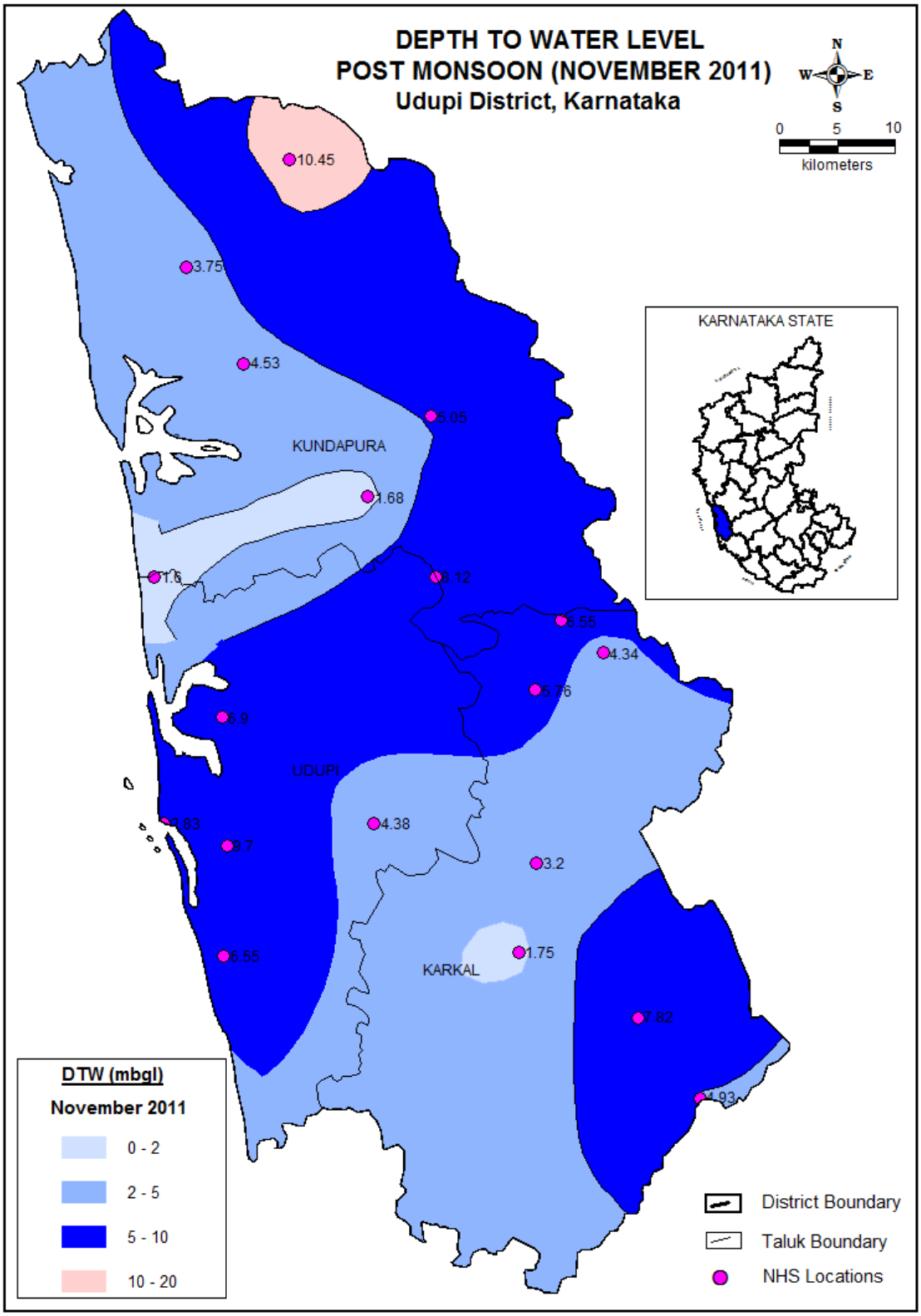

DEPTH TO WATER LEVEL
PRE MONSOON (MAY 2011)
Udupi District, Karnataka
N
W
E
S
0 5 10
kilometers
KARNATAKA STATE
12.2
10.17
12.42
14.44
11.35
KUNDAPURA
UDUPI
KARKAL
DTW (mbgl)
May 2011
0 - 2
2 - 5
5 - 10
10 - 20
District Boundary
Taluk Boundary
NHS Locations

Fig:5


DEPTH TO WATER LEVEL
POST MONSOON (NOVEMBER 2011)
Udupi District, Karnataka
N
W
E
S
0
5
10
kilometers
KARNATAKA STATE
10.45
3.75
4.53
5.05
KUNDAPURA
1.68
1.6
3.12
6.55
4.34
5.76
6.9
UDUPI
4.38
3.2
1.75
KARKAL
7.82
DTW (mbgl)
November 2011
0 - 2
2 - 5
5 - 10
10 - 20
District Boundary
Taluk Boundary
NHS Locations

4.1.4 Long-term water level trend

The comparative study of hydrograph network stations of CGWB in the district of Udupi during last decade (2001-2010) show fall in water level by 0.130 to 0.387 m/year and rise in water level by 0.066 to 0.542 m/year during Premonsoon season (May 2001- May 2010). Long term Water level trend during post monsoon (November 2001- November 2010) show fall in water level by 0.014 to 0.348m/year and rise in water level by 0.014 to 0.254 m/year. Decadal mean water level of May 2001-2010 varies from 2.02 to 13.26 mbgl, and that of November 2001-2010 varies from 1.29 to 9.59 mgbl.

4.2. GROUND WATER RESOURCES

Ground water development is low to moderate in Udupi district as indicated by the latest ground water resource assessment (2009). Status of ground water utilization is depicted in Fig.8. As per the latest ground water resource assessment carried out by CGWB, based on GEC '97 methodology, 80% of the district falls in safe and 20% in semi-critical categories from ground water utilisation point of view. Hence, ground water is available for future development. The resource was estimated watershed-wise and the same was apportioned taluk wise for administrative convenience. All three taluks have no command areas. The resource details are given below in table.1

Table: 1 Talukwise ground water Resources of Udupi district.

Taluk	Net Annual Ground Water availability	Existing Gross Ground Water Draft for Irrigation	Existing Gross Ground Water Draft for Domestic and Industrial Water Supply	Existing Gross Ground Water Draft for All Uses	Allocation for Domestic and Industrial Use for next 25 Years	Net Ground Water Availability for future Irrigation Development
	HAM	HAM	HAM	HAM	HAM	HAM
1	2	3	4	5	6	7
Karkal	13951	4490	1025	5516	1263	8198
Kundapura	8354	4614	725	5339	899	2841
Udupi	9582	4656	908	5564	1123	3803
Total	31887	13760	2658	16419	3285	14842

Table: 1(contd) Stage of Development in Udupi district as on March 2004.

Taluk	Safe area (%)	Semi critical area (%)	Critical area	OE area
Karkal	80	20	-	-
Kundapura	95	5	-	-
Udupi	70	30	-	-

Fig:6

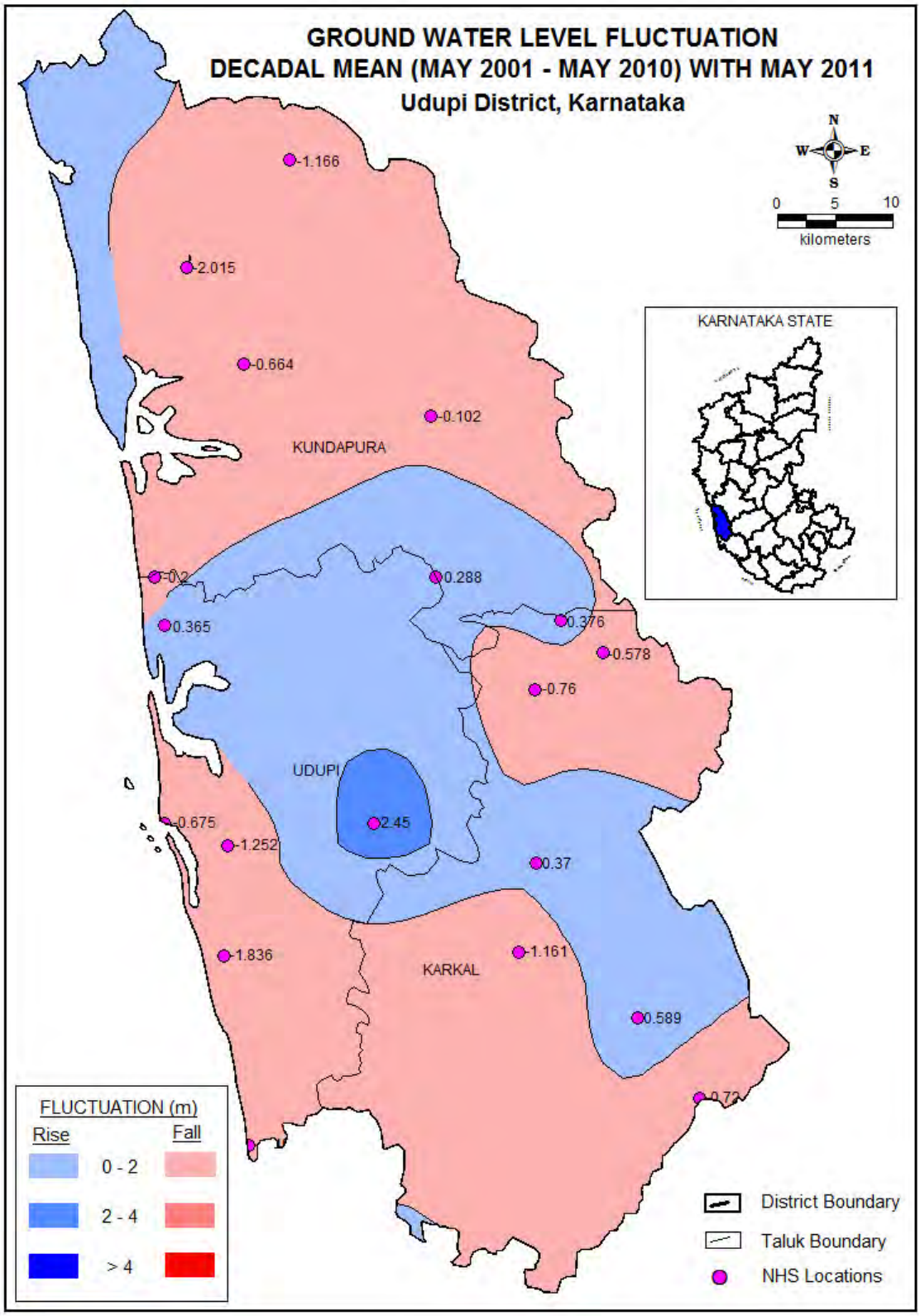

GROUND WATER LEVEL FLUCTUATION
DECADAL MEAN (MAY 2001 - MAY 2010) WITH MAY 2011
Udupi District, Karnataka
N
W
E
S
0
5
10
kilometers
KARNATAKA STATE
-1.166
-2.015
-0.664
-0.102
KUNDAPURA
-0.2
0.288
0.365
0.376
0.578
-0.76
UDUPI
-0.675
2.45
-1.252
0.37
-1.836
-1.161
KARKAL
0.589
-0.72
FLUCTUATION (m)
Rise
Fall
0 - 2
2 - 4
> 4
District Boundary
Taluk Boundary
NHS Locations

Fig: 7

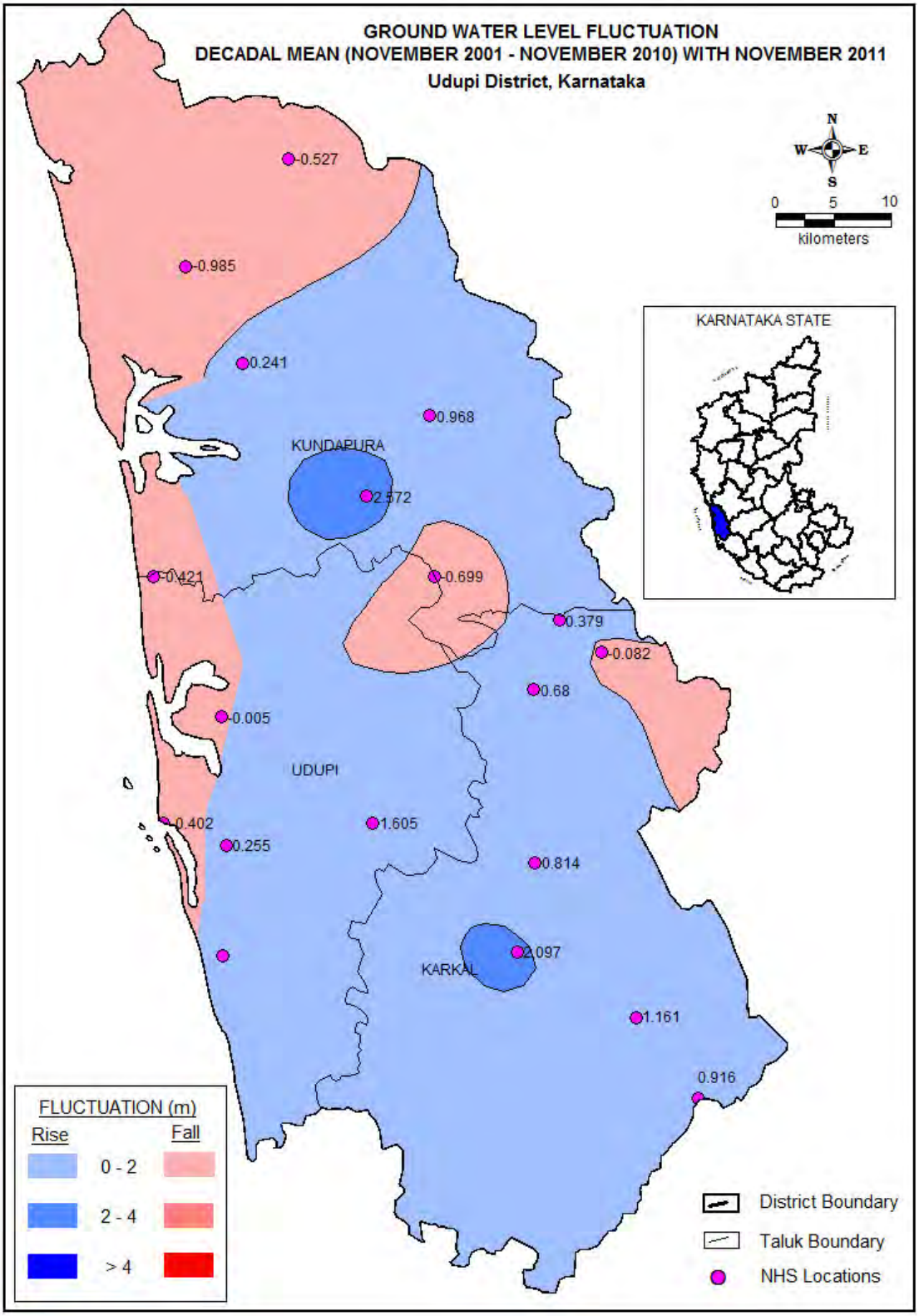
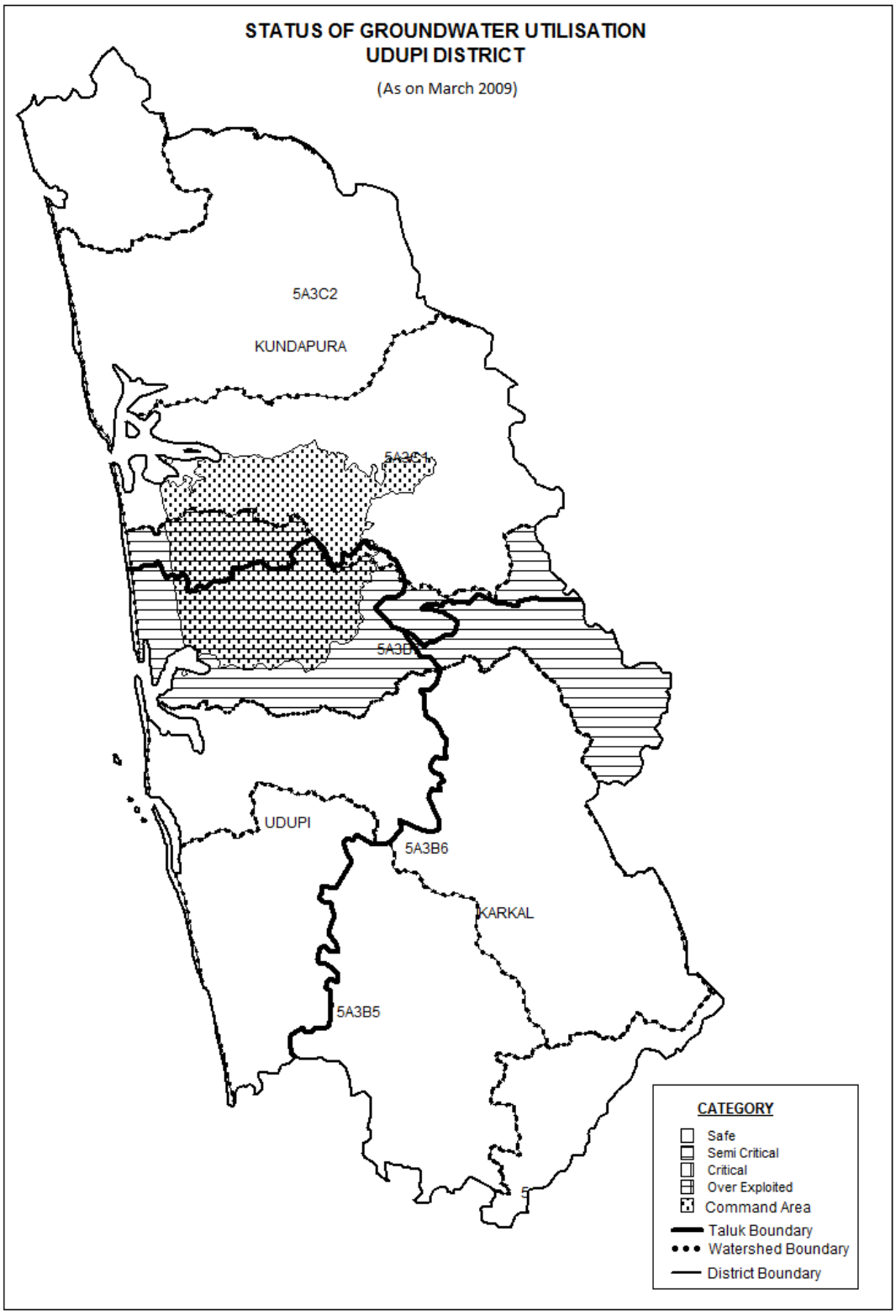

GROUND WATER LEVEL FLUCTUATION
DECADAL MEAN (NOVEMBER 2001 - NOVEMBER 2010) WITH NOVEMBER 2011
Udupi District, Karnataka
N
W
E
S
0
5
10
kilometers
KARNATAKA STATE
-0.527
-0.985
0.241
0.968
KUNDAPURA
2.572
-0.421
0.699
0.379
-0.082
0.68
-0.005
UDUPI
0.402
1.605
0.255
0.814
2.097
KARKAL
1.161
0.916
FLUCTUATION (m)
Rise
Fall
0 - 2
2 - 4
> 4
District Boundary
Taluk Boundary
NHS Locations

Fig: 8


STATUS OF GROUNDWATER UTILISATION
UDUPI DISTRICT
(As on March 2009)
5A3C2
KUNDAPURA
5A3C1
5A3B
UDUPI
5A3B6
KARKAL
5A3B5
CATEGORY
Safe
Semi Critical
Critical
Over Exploited
Command Area
Taluk Boundary
Watershed Boundary
District Boundary

4.3. GROUND WATER QUALITY

In general, the quality of ground water at certain depths in the sandy aquifer are found good and potable and in the adjoining areas covered by lateritic/weathered gneissic rocks, it is sweet to alkaline. The dug wells in the alluvial area generally yield saline water during summer months and get fresh water during monsoon periods.

The water samples collected from the dug wells /shallower zones during May-06 indicate the EC value as 500 to 10430µ/cm at 25°c in the higher order and 200 to 500µ/cm in the lower order. The EC in some of the deeper bore well located at places recorded as high as 18830µ/cm at 25°c are saline. Some parts of Udupi and Kundapura taluks have chloride concentration up to 4000 mg/l. Ground water quality of Udupi district is given in Fig. 9.

Some groundwater in the area is contaminated from the salinity of tidal recharge. This contamination is more pronounced in wells along the stream courses up to the distance where tidal effect extends. Further, Ground water in proximity to stream course is contaminated with seepage of domestic waste.

As a general rule, pumpage must be distributed in time and space and there should not be any concentration of wells to avoid saline water ingress.

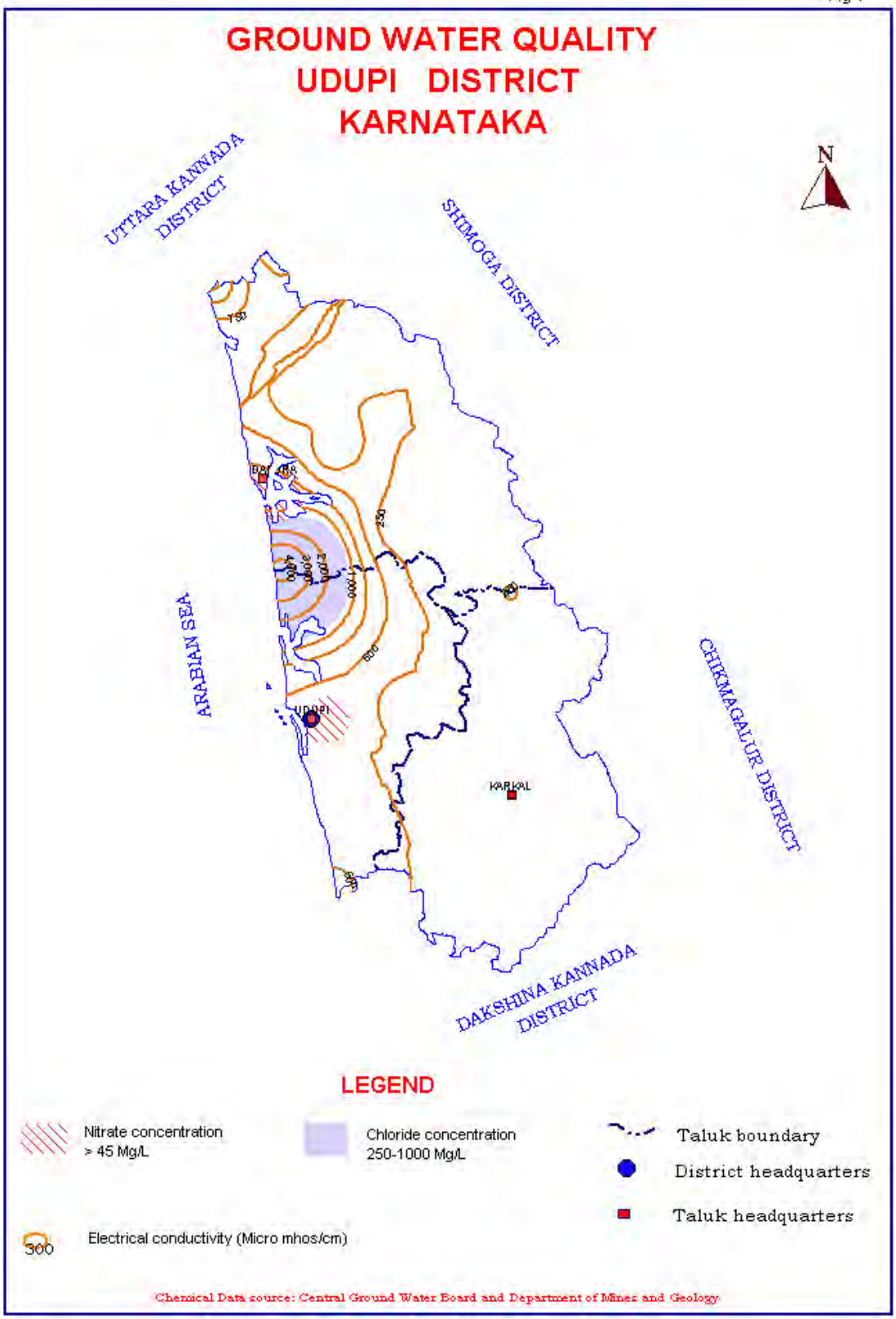
4.4. STATUS OF GROUND WATER DEVELOPMENT

Ground water development is low to moderate in Udupi district as indicated by the latest ground water resource assessment, where the entire district is falling under the category "safe" from ground water development of view. Since development of ground water for irrigation has several advantages, it is being developed in the district too, by individually/jointly owned wells. The total area irrigated through ground water structure is 32311 hectares and still a lot more potential is available for exploitation. As per latest Ground water resource Estimation carried out by CGWB, existing gross ground water draft for irrigation (HaM) is 4490, 4614 and 4656 for Karkal, Kundapura and Udupi districts respectively.

Ground water development in the area mainly taking place through dugwells and bore wells (filter points) in the coastal alluvium and coastal sedimentary formations and by deep bore wells in the adjoining gneissic/ lateritic areas. The depth range of dug wells found within 2.00 to 7.00 mbgl, the most of the wells found in the beach sand/alluvium. The filter bores sunk within the depth range of 2.00 to 4.00mbgl. At places the bore wells drilled in the lateritic formation located away from the coastal region having the depth range of 30.00 to 70.00mbgl reported to have alkalic water and salinity at places. It is reported that the saline water was struck in the bore well at around 12.00mbgl (Kalsanga). High salinity occurs in the bore wells at 70 mbgl as seen/reported in the villages Thonse, Neelavara etc. Due to the existence of interface of fresh and saline water at 3.00 to 7.00 mbgl the construction of wells along the coast is restricted to a depth of 3.00 to 7.00m.The back water influence observed up to a distance of 5.00 to 15.00 kms along the river courses and its effect observed in the wells/aquifer located about 50 to 200m perpendicular to the river bank.

Exploration activities have been conducted during the first phase of exploration programme of CGWB. Second phase of exploration programme didn't cover Udupi district. In all 50 wells were drilled in the district (30 EW, 14 OW, 4 Pz, 2 shallow holes) out of which 29 wells were constructed in the recent alluvium (Fig 10).

Fig.9


GROUND WATER QUALITY
UDUPI DISTRICT
KARNATAKA
N
UTTARA KANNADA DISTRICT
SHIMOGA DISTRICT
CHIKMAGALUR DISTRICT
DAKSHINA KANNADA DISTRICT
ARABIAN SEA
BAIKAMPADY
UDUPI
KARKAL
150
250
600
1000
2000
3000
4000
LEGEND
Nitrate concentration > 45 Mg/L
Chloride concentration 250-1000 Mg/L
Taluk boundary
District headquarters
Taluk headquarters
300
Electrical conductivity (Micro mhos/cm)
Chemical Data source: Central Ground Water Board and Department of Mines and Geology

This includes two slim holes, 4 piezometers at Bainder, Kaup Uliargoli, Siddapur and Ajekar are drilled under HP. In the crystalline rocks, maximum depth drilled was 300 mbgl and the yield of the wells varied from 0.20 to 19.90 lps. The exploratory bore wells drilled in the depth range of 100 to 200 mbgl have given yields ranging from 5.5 to 19.9 lps, depth range between 200 to 300 mbgl have the yield ranged from 0.33 to 6.66 lps. The wells drilled up to 100 m depth have given yield of 0.20 to 6.10 lps.

The porous formations of the Recent age in the coast consist of sand and clay. The thickness of alluvium ranges from 11 to 40 m. The yield prospects in alluvial formations are in the range of 13 to 31 m^3/hr. The pumping tests conducted in these wells have given 'T' values ranging from 0.1 to 228 m^2/day.

In respect of crystalline formations, the yield prospects vary considerably. The bore wells drilled along well-defined lineaments identified in Udupi –Kundapur areas have given good discharge. The saturated fractures are identified in the bore wells in the depth range of 150 to 190 mbgl. The bore wells drilled in other areas, in the depth range of 60 to 90 mbgl yield less than 20 m^3/hr.

The major water lifting devices are electric pump (25128 dugwells&379 shallow tube wells), Diesel Pump (2908 dug wells), Wind mill (378 dug wells), Solar Pump (4 dugwells), Manual/Animal operated (36 dugwells) and other devices (158 dugwells). The HP of this water lifting devices varies from 2 to 10.

The present water supply to rural area is mostly from dug wells and bore wells fitted with hand pumps, piped water supply schemes and miniwater supply schemes. There are at present 3883 borewell water supply schemes in use in the district. Drinking water supply to town area is mainly from surface water schemes.

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.

Fig:10

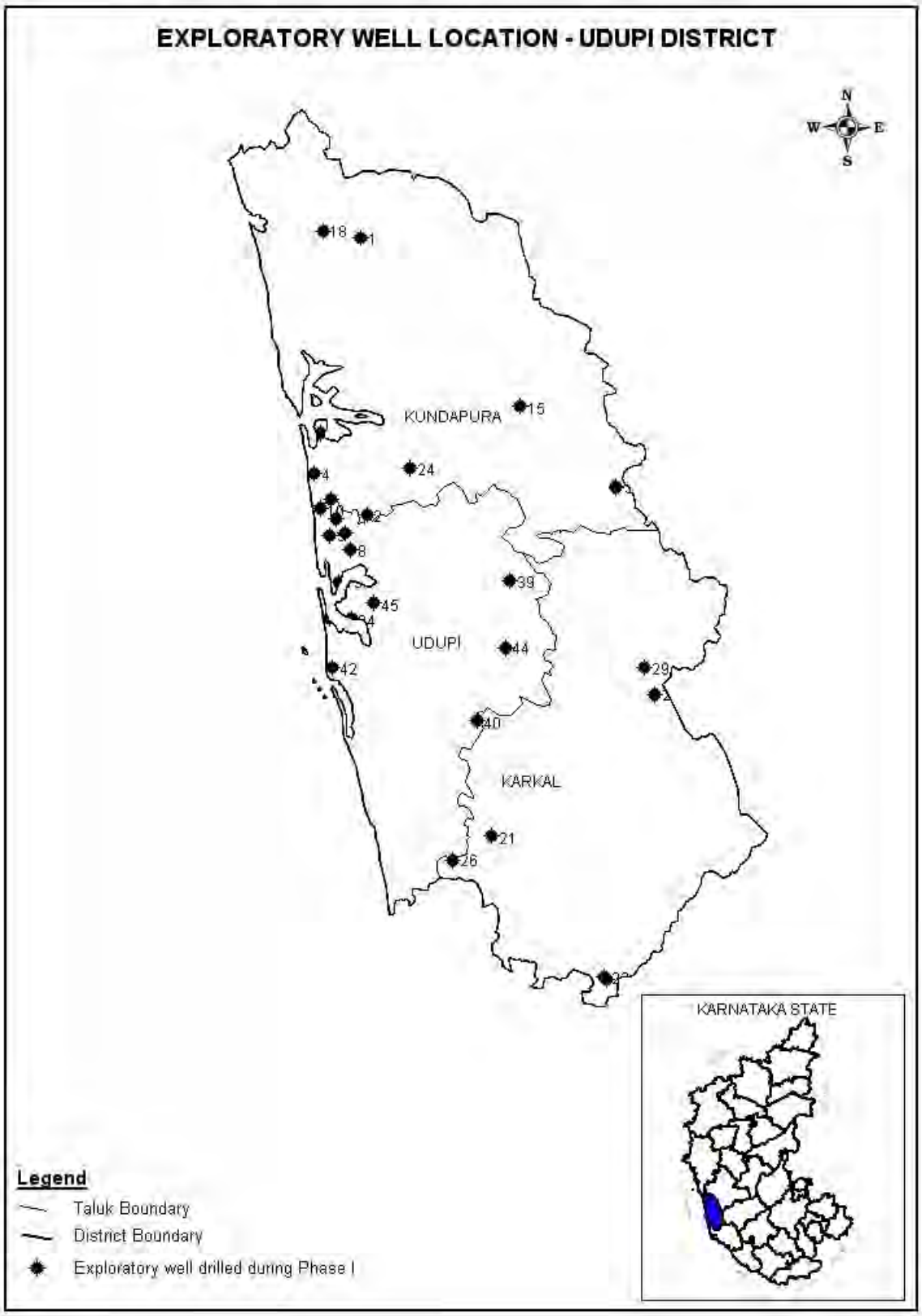
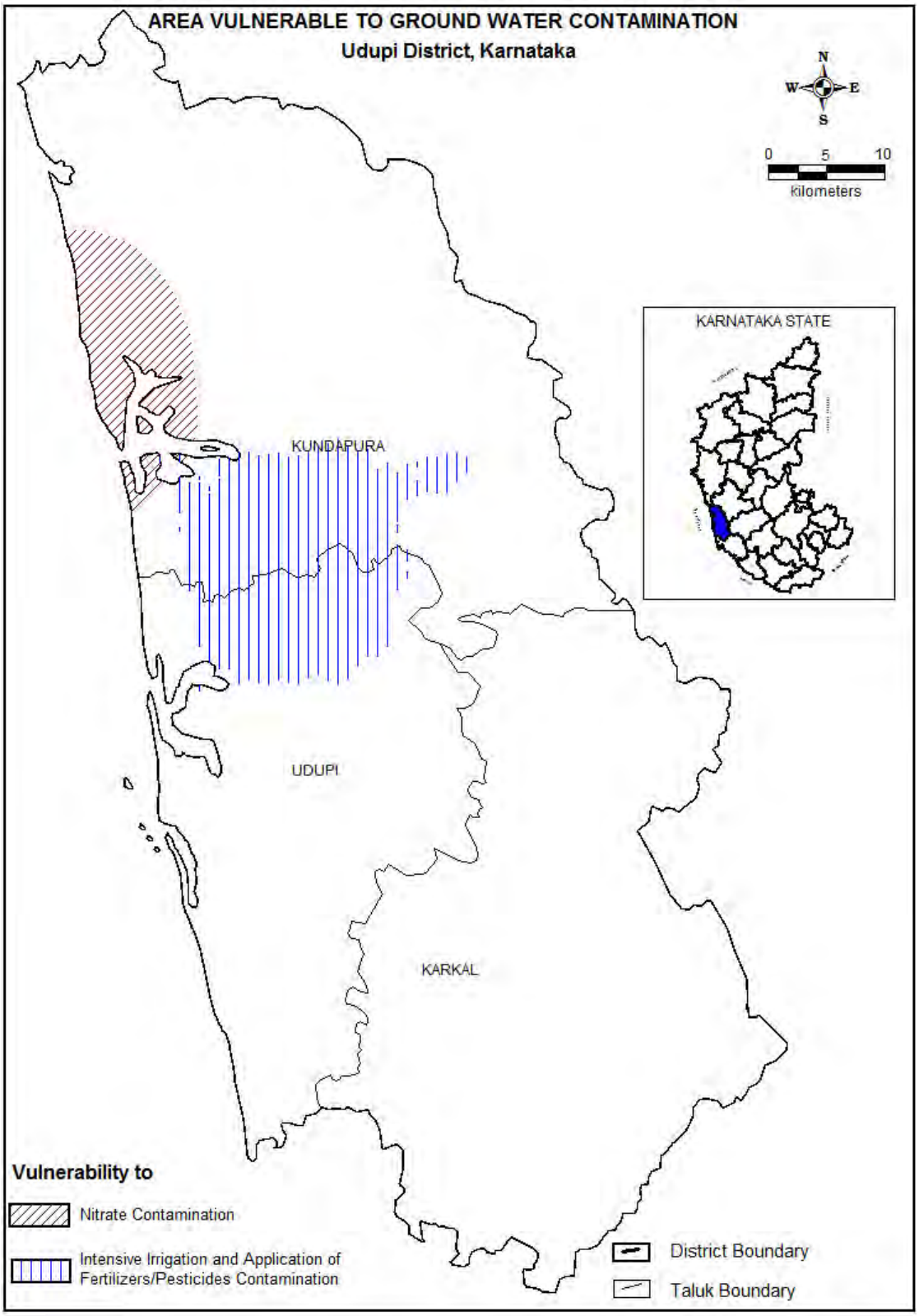

EXPLORATORY WELL LOCATION - UDUPI DISTRICT
N
W
E
S
18
1
KUNDAPURA
15
24
4
2
8
39
45
UDUPI
44
42
29
40
KARKAL
21
26
KARNATAKA STATE
Legend
Taluk Boundary
District Boundary
Exploratory well drilled during Phase I

Fig:11


AREA VULNERABLE TO GROUND WATER CONTAMINATION
Udupi District, Karnataka
N
W
E
S
0
5
10
kilometers
KARNATAKA STATE
KUNDAPURA
UDUPI
KARKAL
Vulnerability to
Nitrate Contamination
Intensive Irrigation and Application of Fertilizers/Pesticides Contamination
District Boundary
Taluk Boundary

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 Udupi district the vulnerable areas are identified as the areas where the groundwater is affected by nitrate contamination and fertilizer contamination and are shown in fig.11.

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 Udupi district the unit area annual recharge is in the range of 0.10 to 0.15 in Kundapura taluk area and in the range of 0.15to 0.25 in Karkal and Udupi taluks (fig.12)

5.0 GROUND WATER MANAGEMENT STRATEGY

5.1. GROUND WATER DEVELOPMENT

Ground water development in the district is, under "Safe" category, in 80% of the area. ie, about 51.49% of the utilizable resources is developed as indicated by the latest ground water evaluation of the district. The balance ground water irrigation potential can be brought under utilization by constructing about 17406 different types of abstraction structures in the district. Development may be carried out in phased manner with continuous monitoring of ground water levels for impact on the ground water regime. Central part of the Udupi district where major portion of Udupi taluk and NE part of Karkal taluk is suitable for artificial recharge to ground water (Fig.13). Recharge trenches, Contour bunds, Infiltration wells, Check dams, Subsurface dykes are the suitable artificial recharge structures, which can be constructed simultaneously while developing the ground water. In hard rock terrains dug wells and bore wells can be feasible with depth range of 25 to150 mbgl and in soft rock aquifers dug wells and filter points with depth up to 15 mbgl feasible. Down the Hole Hammer rig and Manual hand auger is suitable for hard rock and soft rock terrains respectively.

Design of abstraction structures

The design of the ground water development structures has to be commensurate with requirement of water, which would in turn depend up on the cropping pattern and command areas of the structure to be developed.

Dug wells have been recommended for development in areas of shallow ground water levels. Based on the hydrogeological conditions, the diameter and depth range from 3 to 6m and 10 to 12m respectively have been recommended. Water bearing zones occurring between 10 to 20 mbgl are partially weathered and can be tapped by dug-cum bore wells and where

Fig:12

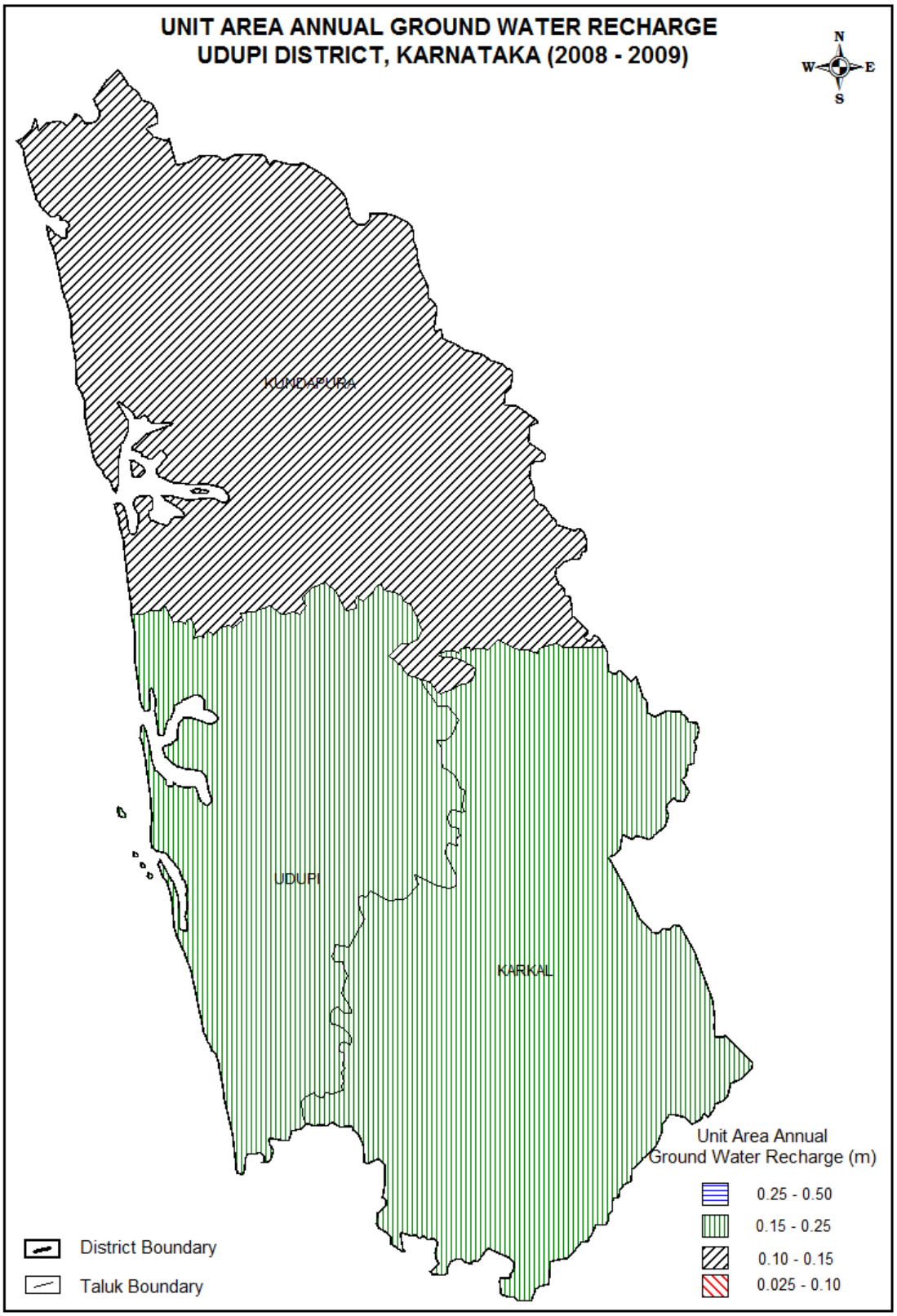
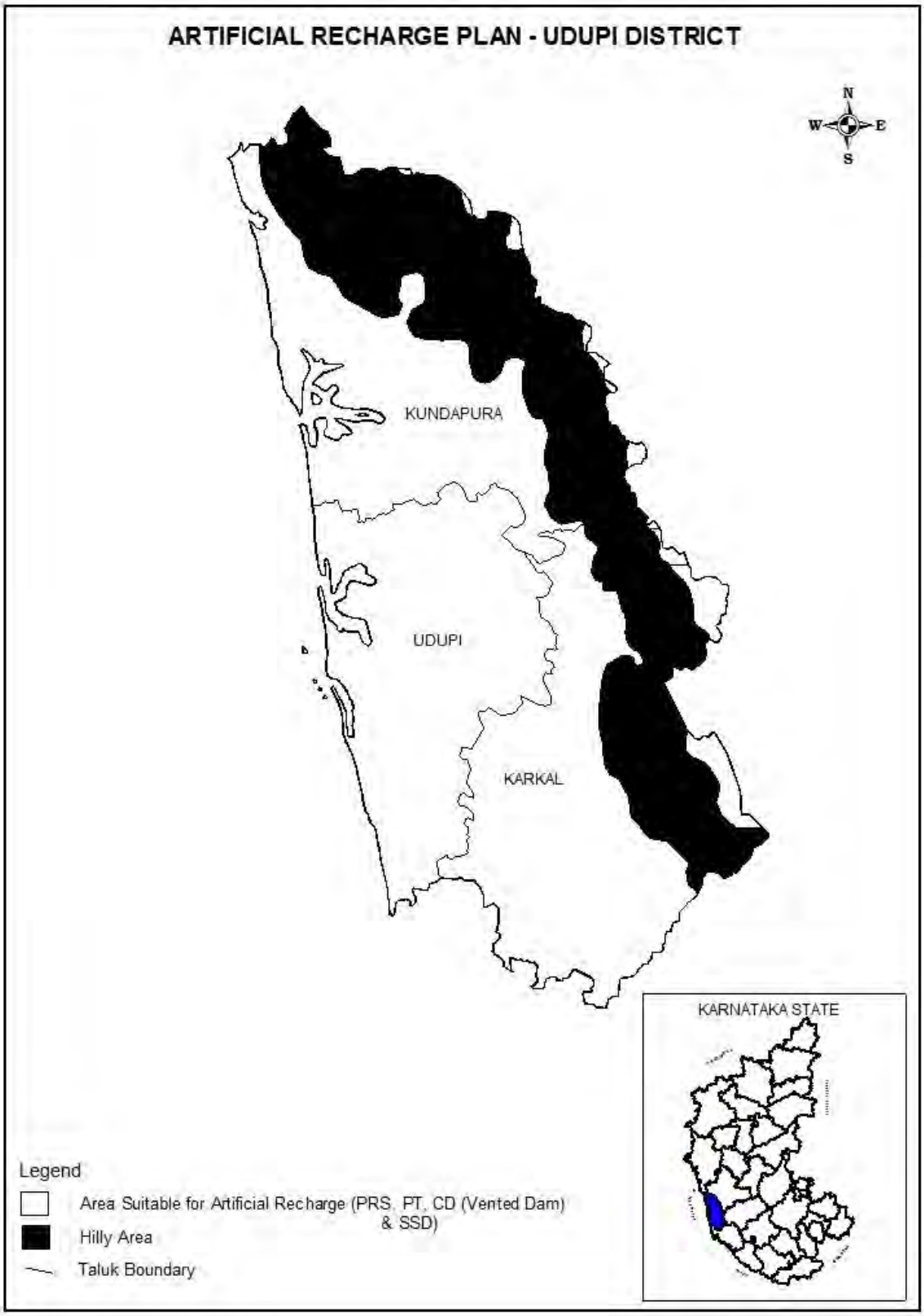

UNIT AREA ANNUAL GROUND WATER RECHARGE
UDUPI DISTRICT, KARNATAKA (2008 - 2009)
N
W
E
S
KUNDAPURA
UDUPI
KARKAL
Unit Area Annual
Ground Water Recharge (m)
0.25 - 0.50
0.15 - 0.25
0.10 - 0.15
0.025 - 0.10
District Boundary
Taluk Boundary

Fig:13


ARTIFICIAL RECHARGE PLAN - UDUPI DISTRICT
N
W
E
S
KUNDAPURA
UDUPI
KARKAL
KARNATAKA STATE
Legend
Area Suitable for Artificial Recharge (PRS, PT, CD (Vented Dam) & SSD)
Hilly Area
Taluk Boundary

water in bore wells does not flow out to the bottom of the dug wells, pumps can be installed to lift water from the bore well. Based on the studies carried out by CGWB, 15 to 20 m depth of bore wells from bottom of the dug well has been recommended. While designing the casing of tube wells in alluvial areas, mild steel casing pipes and slotted pipes with bail plug should be provided for the sand zones. The annular space around the outer surfaces of the casing/slotted pipes (20m depth) and boreholes can be shrouded with gravel

Based on the studies, design for bore wells is fixed as 150mm dia and 50 to 70 m depth in hard rock formations. While designing a bore well, if weathered rocks are encountered, mild steel casing pipes should be inserted and annular space should be grouted with cement. Deeper zones should be left uncased.

For yield variation of 2 to 4 lps and for draw down of 30m, submersible pumps with 50 m head for shallow bore wells and 70m head for deep bore wells are recommended.

The design of collector wells for developing ground water, the diameter of caisson may be 3 to4 m. Maximum length of lateral radials may be around 60m.

Spacing of the abstraction structures is essential part of the management of ground water resource, as the resource being developed is annually replenishable and with careful management, it can be over lasting. Spacing of pumpage is also equally important since its spacial distribution can greatly influence the quantum of recharge.

5.2. WATER CONSERVATION AND ARTIFICIAL RECHARGE

No water conservation programmes or artificial recharge schemes have been implemented in Udupi district.

6.0 GROUND WATER RELATED ISSUES AND PROBLEMS

Since the entire district falls under safe category, ground water development point of view Udupi district doesn't pose any challenge. As far as quality is concerned ground water is potable and good for irrigation purpose. However Salinity Ingress and coastal salinity problems occur in parts of coastal tract of Udupi district.

7.0. AWARENESS AND TRAINING ACTIVITY

WMTP & MAP are yet to be conducted in Udupi district.

8.0 AREAS NOTIFIED BY CGWA

Nil

9.0 RECOMMENDATIONS

Rainwater runoff and soil erosion may be controlled by the construction of tanks, gullys and plugs, furrows, bunds etc at appropriate sites. The summer cultivation should be intensified for creating more storage space for building up ground water storage during the monsoon period. At the same time change of cropping pattern for every season may be adopted for efficient ground water management.

Hard rock terrain and coastal alluvium can have more dug wells, dug-cum-bore wells and bore wells for a depth of 24, 60 and 200 to 300 mbgl respectively. The coastal alluvium of the district can have dug wells, filter points and collector wells of depth of 25 m and radius of 60 m respectively. Dug wells are more recommendable as ground water levels are shallow in peak requirement period.

selection of pumping system has to be done keeping in view of the following conditions like requirement of water to be pumped and total pumping head. It is recommended to have 3 HP pumps in dug wells and 3 to 5 HP submersible pumps in the dug cum bore wells. Adequate power supply for energisation of pump sets is a key factor for large scale ground water development. Diesel operated pump sets enhance the production cost of dug well water and become a burden to farmers.

In coastal areas collector wells are more suitable and the effective radius of collector wells ranges from 20 to 60m with 90 m as radius of Influence. About 17406 additional abstraction structures are feasible with an annual draft of 1.7 ham. Long term monitoring of water level and quality of ground water is recommended in particular in coastal areas and in general all over district. In all cases for effective use of ground water, precise ground water development and management practices should be adopted. As a general rule, pumpage must be distributed in time and space and there should not be any concentration of wells along the coast to avoid the saline water ingress.