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
# HASSAN DISTRICT, KARNATAKA


SOUTH WESTERN REGION
BANGALORE
MARCH 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**

## 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 Hassan 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 Smt.Bijimol Jose, under the guidance of Dr. K.R.Sooryanarayana, Scientist D and the figures were prepared by Sri Sivaramakrishnan, Asst. Hydrogeologist, Central Ground Water Board, South Western Region, Bangalore.

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

# HASSAN DISTRICT AT A GLANCE

| Sl.No. | Items | Statistics |
|---|---|---|
| 1 | **General information** | |
| | i) Geographical area (sq.km) | 6,845 sq.km. |
| | ii) Administrative Division (As on Jan-11)<br>Number of Taluks<br>Number of Panchayats<br>Number of Villages | <br>8<br>258<br>2559 |
| | iii) Population (as per 2011 census) | 1,776,221 of which male and female are 885,807 and 890,414 respectively. Population density is 261( Provisional 2011 census )<br><br>Rural-1416996, Urban-304673<br>( 2001 Census) |
| | iv). Average annual Rainfall (mm) | <br>1074<br>725 in Holenarsipur to 2297 in Sakhleshpur taluk |
| 2 | **Geomorphology**<br>i) Major physiographic units | <br>3 Physiographic Units<br><br>a) Western Malnad<br>b) Central Semi-Malnad<br>c) Eastern Plain area |
| | ii) Major Drainages | Cauvery, Hemavathy and Yagachi |
| 3 | **Land Use ( IV$^{th}$ MI Census)**<br>a). Forest area<br>b). Net area sown<br>c) Net irrigated area | <br>688 sq km<br>389853 ha<br>94499 ha |
| 4 | **Major soil types** | Red sandy soil, Red silty-clayey soil, Mixed soil, and Black soil. |
| 5 | **Area under principal crops ( Ha)**<br>**(as on 31.3.2011 agriculture statistics)**<br>Food grains<br>Pulses<br>Oil seeds<br>Horticultural crops | <br><br>216250<br>51620<br>37955<br>34624 |

| | | |
|---|---|---|
| 6 | **Irrigation by different sources (area in hectare as per 2011 MI census)**<br>Dug wells<br>Tube / bore wells<br>Reservoir<br>Surface flow schemes<br>Tanks / ponds/ Canals/ Other sources<br>Lift irrigation<br>Number of structures<br>Net irrigated area | <br><br>1797<br>52484<br>nil<br>27119<br>25868<br>2362<br>1252<br>94499 |
| 7 | **Numbers of ground water monitoring wells of CGWB**<br>(As on 31.3.2011) | 49 (dugwells)<br>08 (piezometers) |
| 8 | **Predominant geological formations** | Gneiss, Schist & Granite |
| 9 | **Hydrogeology**<br>• Major water bearing formations<br>• Pre-monsoon Depth to water level during 2011 (in mbgl)<br>• Post-monsoon Depth to water level during 2011 (in mbgl)<br>• Long term water level trend in 10 years (2002-2011 in m/yr) | Weathered & fractured Gneiss, Schist & Granite<br>0.79 – 12.00<br>1.39 – 8.32<br>• Rise from 0.02m to 0.48m<br>• Fall from 0.090m to 0.540m |
| 10 | **Ground water exploration by CGWB (as on 31.3.2006)**<br>• Total No of wells drilled<br>EW<br>OW<br>PZ<br>• Depth Range (m)<br>• Discharge (Lps)<br>• Transmissivity ($m^2$/ day) | <br>83<br>54<br>26<br>03<br>31.5 – 235.0 m bgl<br>Less than 1 lps to 16.00lps<br>2 to 63 $m^2$/day |
| 11 | **Ground water quality**<br>• Presence of chemical constituents more than permissible limit) | Nitrate<br>Calcium-Magnesium |

| | | |
|---|---|---|
| | • Type of water | Bicarbonate and Chloride type |
| 12 | **Dynamic ground water resources** (in MCM)<br>• Annual Replenish able GW resource<br>• Net annual GW draft<br>• Projected demand for domestic and industrial uses up to 2025<br>• Stage of GW development | 830.97<br>436.50<br>68.78<br>**40%** of the district is **OE**, having **> 100%** stage of development<br>(**75%** of Arsikere taluk, **60%** CR patna, **50%** of Hassan; **40% of** Holenarsipur, **10%** of Arkalgud Taluk,) and rest **60%** is safe category areas ( Alur, Sakhleshpur safe) |
| 11` | **AWARENESS AND TRAINING ACTIVITIES**<br>• Mass Awareness Programme Organised.<br>• Water Management Programmes Organised<br>Date<br>Place<br>No. of participants | 1 No ; 07.03.2009; Jajur, Arsikere Taluk<br>300 people participation<br>2 Nos<br>16th & 17th Dec. 2004<br>Hassan<br>25<br>4th & 5th March. 2009<br>Hassan<br>31 |

| | | |
|---|---|---|
| 14 | **Efforts of artificial recharge & rainwater harvesting**<br>• Projects completed by CGWB (No. & Amount spent)<br>• Projects under the technical guidance of CGWB(numbers) | Nil<br><br>Dug Well Recharge Scheme<br><br>RRR inspection |
| 15 | **Ground water control and regulation**<br>• No of OE Blocks<br>• No of Critical Blocks<br>• No of Blocks notified | **10%** of Arkalgud Taluk, **75%** of Arsikere taluk, **40%** of Belur; **60%** of CR patna, **50%** of Hassan; **40% of** Holenarsipur.<br>Nil<br>Nil |
| 16 | **Major ground water problems and issues** | Declining water level (Resource) and excess nitrate and chloride contamination. Hydro chemical quality problems in different parts on a localized scale |

# HASSAN DISTRICT

## 1.0 Introduction

Hassan district is located on the border of the Western Ghats, in the southern part of Karnataka state. It is located between 12° 30' and 13° 35' North latitude and 75° 15' and 76° 40' East longitude. Hassan town is the district headquarters and the district is divided into eight taluks viz. Alur, Arkalgud, Arsikere, Belur, Chennarayapatna,Hassan, Holenarsipur and Sakleshpur (Figure 1). Population of the district (2011 provisional census) is 17, 21,669 of which 14, 16,996 is rural and 3, 04,673 is urban.

The major part of the district is in Cauvery main basin drained by Cauvery, Hemavathy and Yagachi rivers, which flow towards east to join the Bay of Bengal. A small part on the eastern side is falling in west flowing minor river basin (Figure 2).

Agriculture is the main activity of the people in the district. The net sown area comprises 57% of the total geographical area. Paddy, ragi, jowar, groundnut and pulses are the important agricultural crops and coffee and areca nut are the main horticulture crops. About 20.5% of the net sown area is irrigated by surface water (11.4%) and ground water (9.1%) sources. Hemavathy reservoir is a major irrigation project and Yagachi is a medium Irrigation Project in the district.

Central Ground Water Board has carried out Systematic Hydrogeological Survey, Reappraisal Hydrogeological Survey and Ground Water Exploration in the entire district. Under exploration programme, 54 exploratory wells, 26 observation wells have been drilled up to march 2011. Under Hydrology Project 3 piezometers were drilled for observing the water levels.

As many as 2,597 farmers committed suicide in the Karnataka state between 2003 and 2010. The highest number of farmer suicides have been reported in Hassan in this period. As reported, there were 268 suicide cases among farmers due to agrarian distress in Hassan district during (2001-2010), The maximum number of suicide cases (11) have occurred during 2003-04 and incidentally the 2003 happens to be the year which received the lowest rainfall in the last 10 years in most of the taluks, as seen in the rainfall data given in Table 2. Stage of ground water development is also high in Arsikere (75%) and Channarayapatna (60%) taluks, where highest number of suicide cases have been reported. Taluk wise farmers' suicide cases in Hassan district is given in Table 1.

Fig-1

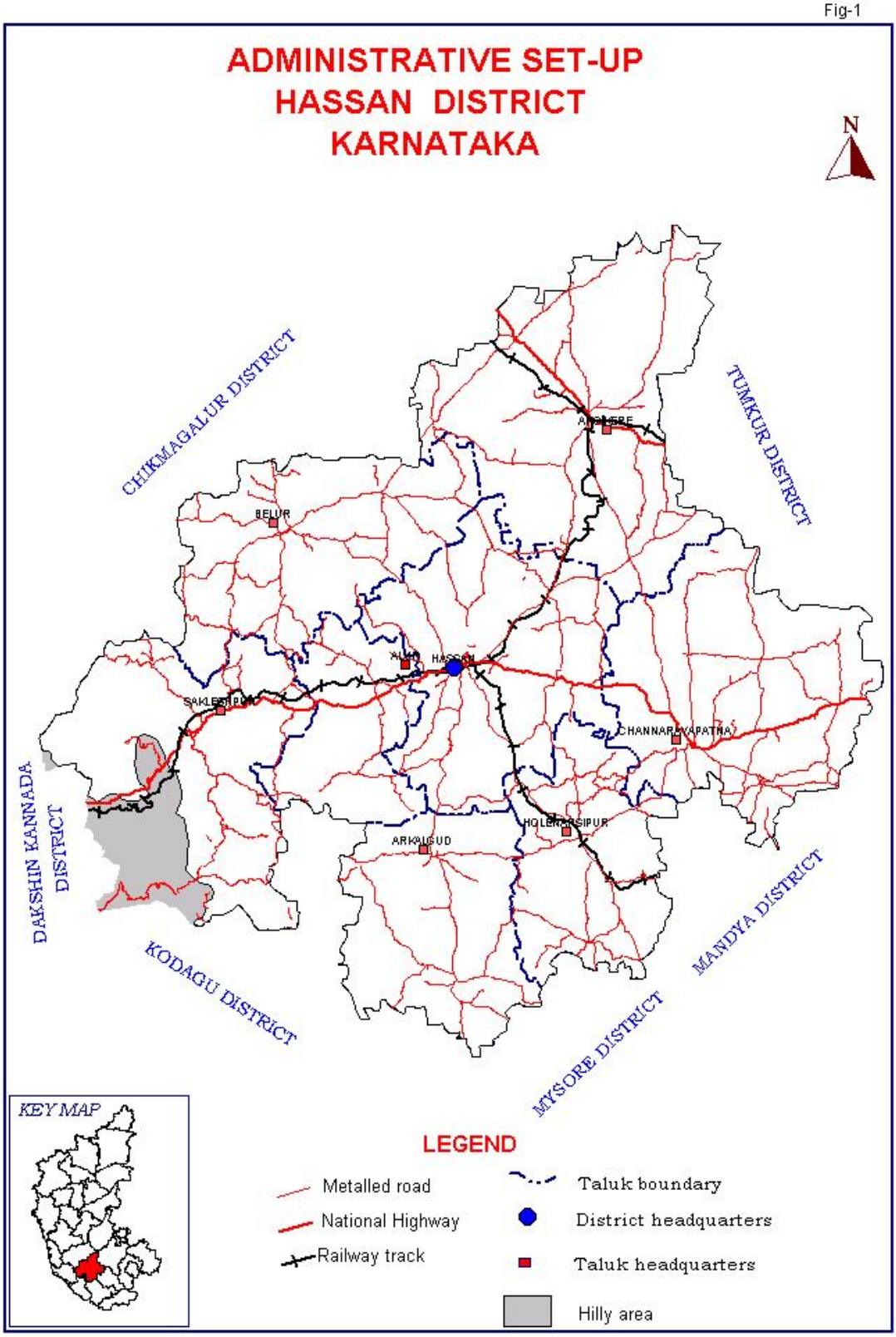

ADMINISTRATIVE SET-UP
HASSAN DISTRICT
KARNATAKA
N
CHIKMAGALUR DISTRICT
TUMKUR DISTRICT
BELUR
HASSAN
SAKLESHPUR
CHANNARAYAPATNA
HOLENARASIPUR
ARKALGUD
DAKSHIN KANNADA DISTRICT
KODAGU DISTRICT
MANDYA DISTRICT
MYSORE DISTRICT
KEY MAP
LEGEND
Metalled road
National Highway
Railway track
Taluk boundary
District headquarters
Taluk headquarters
Hilly area

Fig-2

# DRAINAGE & HYDROGRAPH MONITORING STATIONS
# HASSAN DISTRICT, KARNATAKA

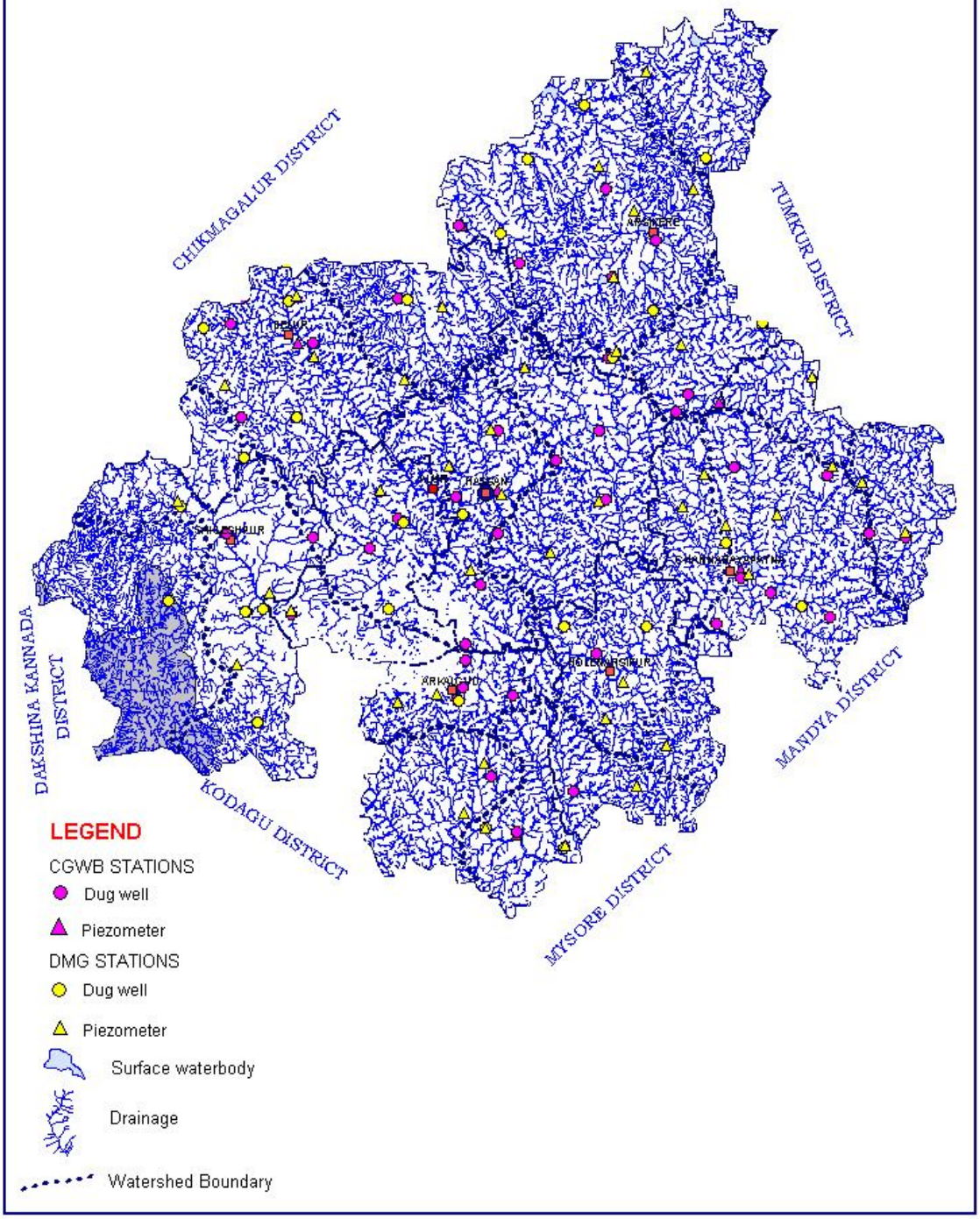


**Table-1. Talukwise statistics of farmers' suicide cases in Hassan district.**

| Sl.no | Taluk | 2003-04 | | | 2004-05 | | | 2005-06 | | | Total | | | 2006-07 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Total cases reported | Due to Crop loss | Due to other reasons | Total cases reported | Due to Crop loss | Due to other reasons | Total cases reported | Due to Crop loss | Due to other reasons | Total cases reported | Due to Crop loss | Due to other reasons | |
| 1 | Hassan | 14 | 2 | 12 | 7 | 0 | 7 | 8 | 1 | 7 | 29 | 3 | 26 | 7 |
| 2 | Arsikere | 16 | 4 | 12 | 8 | 0 | 8 | 2 | 0 | 2 | 26 | 4 | 22 | 4 |
| 3 | Alur | 5 | 0 | 5 | 5 | 0 | 5 | 2 | 0 | 2 | 12 | 0 | 12 | 2 |
| 4 | Sakleshpur | 4 | 2 | 2 | 2 | 0 | 2 | 0 | 0 | 0 | 6 | 2 | 4 | 2 |
| 5 | Arkalgud | 7 | 0 | 7 | 2 | 0 | 2 | 5 | 1 | 4 | 14 | 1 | 13 | 1 |
| 6 | Belur | 7 | 0 | 7 | 3 | 0 | 3 | 3 | 1 | 2 | 13 | 1 | 12 | 3 |
| 7 | Chennaraya-patna | 13 | 3 | 10 | 7 | 1 | 6 | 12 | 0 | 12 | 32 | 4 | 28 | 0 |
| 8 | Holenarsipur | 3 | 0 | 3 | 0 | 0 | 0 | 2 | 0 | 2 | 5 | 0 | 5 | 0 |
| | **Total** | **69** | **11** | **58** | **34** | **1** | **33** | **34** | **3** | **31** | **137** | **15** | **122** | |

*Source: Agricultural Commissioner, Govt. of Karnataka, Bangalore.

## 2.0 Rainfall

The average rainfall of the district (2001-2010) is 1074 mm. The analysis of the last 10 years data reveals that the highest (Av.2297mm) rainfall has occurred in Sakleshpur taluk, which is adjoining the Western Ghats and the lowest (Av.770 mm) in Arsikere taluk, which is in Maidan (Plain) region. The orographic influence on rainfall is clear from the spatial distribution. Therefore, rainfall is decreasing as one proceeds from the western part of the district to the eastern part. Taluk wise rainfall data from 2001 to 2010 and average annual rainfall for the year 2011 is presented in the Table 2. A perusal of the table shows that the district has received above average rainfall during 2005 and it is the wettest period in the last 10 years. Bimodal rainfall pattern in major parts of the district helps in growing short and long duration crops and also for adopting multiple cropping patterns

**Table 2.Talukwise seasonal and annual rainfall statistics 2001-10**

| Sl.No. | Taluk | Pre Monsson (mm) | SW monsson (mm) | NE Monsoon (mm) | Annual(mm) | Annual rainfall 2011 |
|---|---|---|---|---|---|---|
| 1 | Alur | 214 | 688 | 199 | 1093 | 1319 |
| 2 | Arkalgud | 179 | 550 | 232 | 961 | 851 |
| 3 | Arasikere | 182 | 360 | 228 | 770 | 682 |
| 4 | Belur | 227 | 536 | 251 | 1013 | 1088 |
| 5 | Channarayapatna | 202 | 338 | 195 | 735 | 552 |
| 6 | Hassan | 223 | 556 | 226 | 1004 | 857 |
| 7 | Holenarsipur | 169 | 357 | 199 | 725 | 663 |
| 8 | Sakleshpur | 230 | 1791 | 276 | 2297 | 2335 |

## 3.0 Geomorphology and soil types

### 3.1 Geomorphology

The district is divided into three distinct geomorphic units i.e. the Western and north-eastern hilly terrains constituting part of the Western Ghats, the Central transition zone and the Eastern Maidan (plain) region.

### 3.2 Soils

The soils of the district display a wide diversity and are quite fertile. The main soil types are Red soil, Red sandy soil, Black soil , Mixed soil and Silty clay soil. The soils in the western taluks are derived from granites, laterites and schists. These soils are shallow to medium in depth and the color changes with depth from red at the surface and red and yellow mottles at depth. The soils are suitable for coffee, cardamom, areca, paddy and sugarcane crops.

In the eastern taluks, the soils are red sandy type, which are derived from granite, gneisses and schists. These are shallow, loamy to sandy loamy in texture and are intermixed with coarse gravel and pebbles and are well-drained but poor in moisture retaining capacity. These soils are suitable for crops like paddy, sugarcane, coconut, potato and vegetables under irrigated conditions and ragi, millets, groundnuts and cotton under rain fed conditions. In parts of Arsikere taluk, black soils are also seen locally.

## 4.0 Groundwater scenario

### 4.1 Hydrogeology

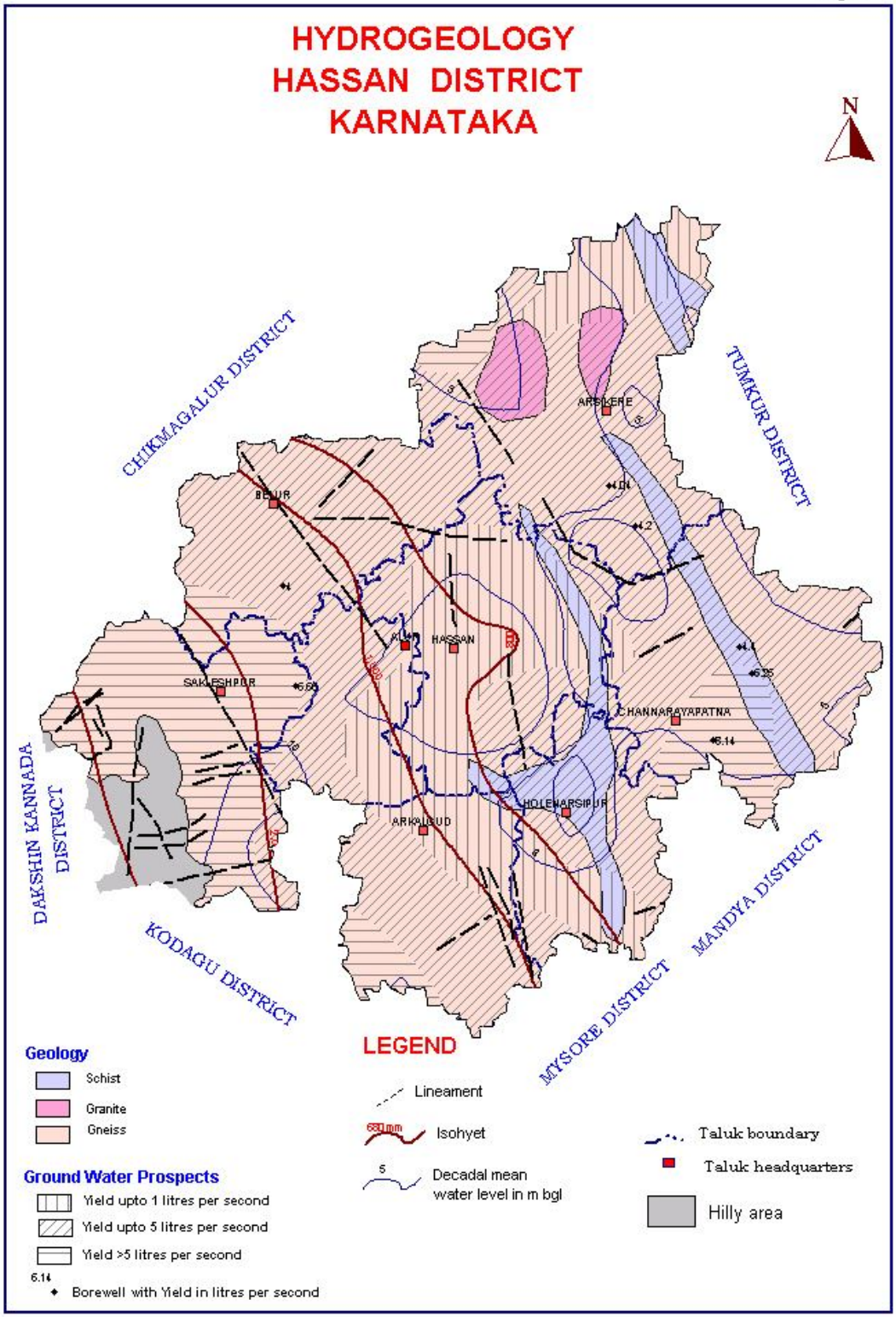
Weathered and fractured gneiss, granite and schist are the major water bearing formations. Alluvial formation of limited thickness and aerial extent is found along the courses of major rivers. Groundwater occurs under phreatic (water table) conditions in weathered zones of gneiss, schist and granite and under semi-confined to confined conditions in joints and fractures of these rocks at deeper levels. Weathered and fractured gneiss is the predominant aquifer found in the district followed by schistose and granitic aquifers, which occur as isolated patches in a few taluks (Figure3).

The depth to water level during pre-monsoon (May-2011) ranges from 0.79 mbgl (Gorur) to 12.00mbgl (Hanumanthapura). The pre-monsoon depth to water level is shown in **Figure. 4**. During post-monsoon (Nov-2011) it ranges from 1.39 mbgl (Gorur) to 8.32 mbgl (Hanumanthapura). The post-monsoon depth to water level is shown in **Figure 5**. The seasonal fluctuation data reveals that 84% of the wells show rise while 16% of the wells show a fall in water level. The rise in water level ranges from 0.003 m to 1.876m while, the fall ranges from 0.090m to .540m.

The trend in water level fluctuation for pre monsoon as well as post monsoon period are quite significant. The rising trend in pre monsoon generally

indicates the reduction of draft, due to increased dependence on surface water supply. While, a falling trend in pre monsoon indicates the reverse. The rising trend in post monsoon indicates effective watershed treatment or high incidence of rainfall, while the falling trend in post monsoon throw light on high level of urbanization by reducing the natural infiltration rates by way of concrete

Fig-3



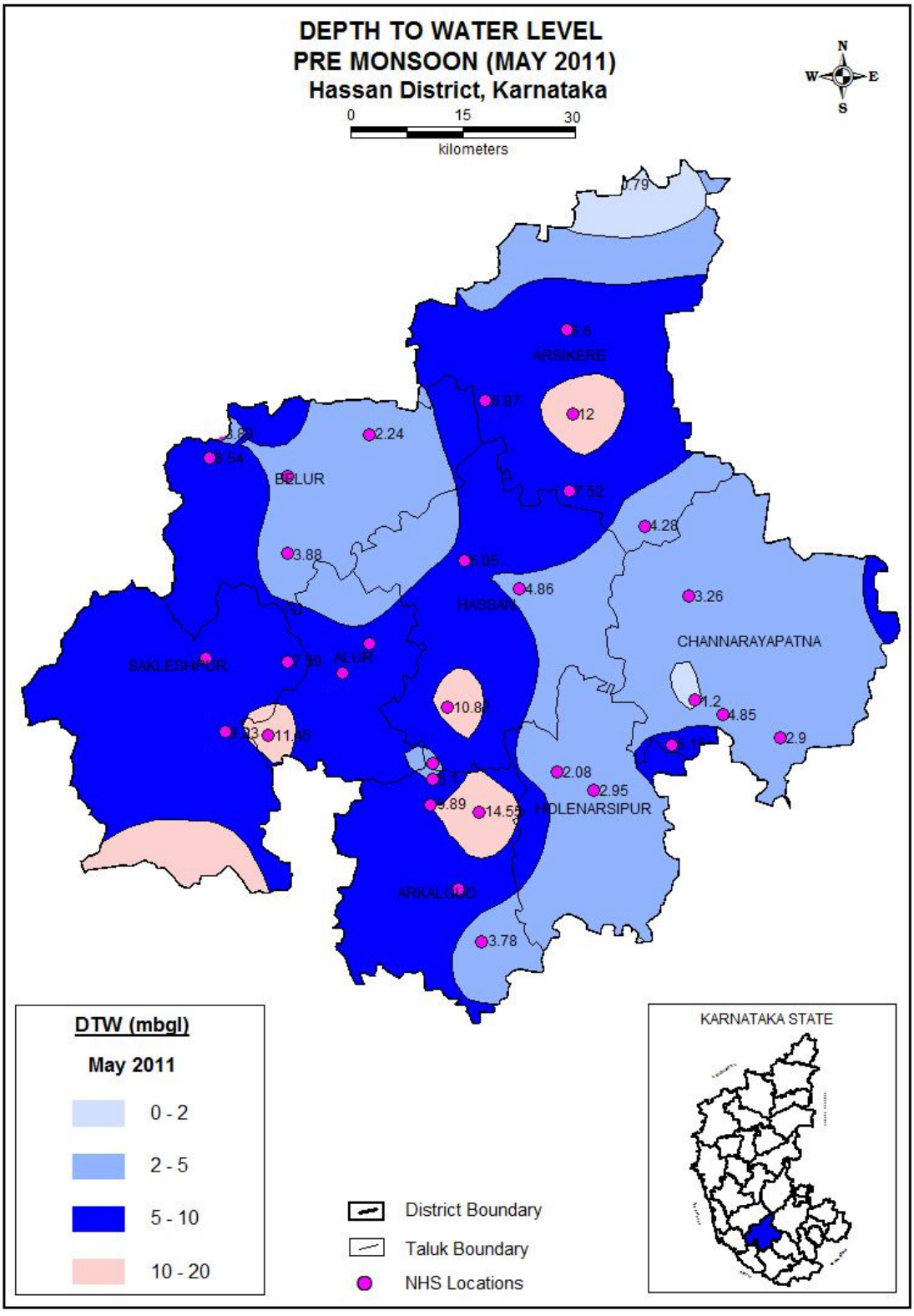

DEPTH TO WATER LEVEL
PRE MONSOON (MAY 2011)
Hassan District, Karnataka
0
15
30
kilometers
N
W
E
S
ARSIKERE
BELUR
HASSAN
CHANNARAYAPATNA
SAKLESHPUR
ALUR
HOLENARSIPUR
12
2.24
4.28
3.88
4.86
3.26
10.8
4.85
2.9
2.08
2.95
14.55
3.78
DTW (mbgl)
May 2011
0 - 2
2 - 5
5 - 10
10 - 20
District Boundary
Taluk Boundary
NHS Locations
KARNATAKA STATE

Fig: 4

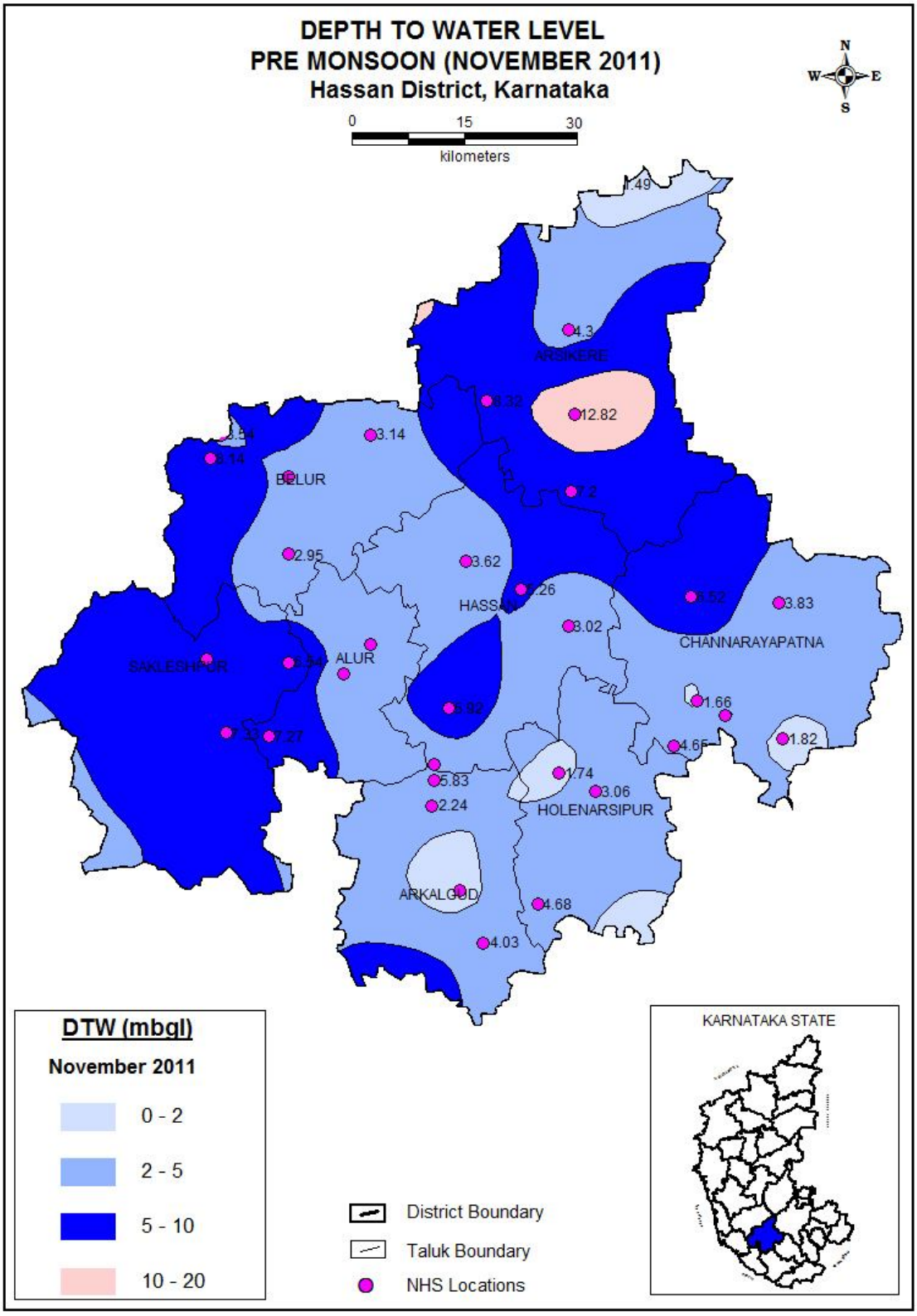

DEPTH TO WATER LEVEL
PRE MONSOON (NOVEMBER 2011)
Hassan District, Karnataka
0
15
30
kilometers
N
W
E
S
7.49
4.3
ARSIKERE
8.32
12.82
3.14
BELUR
2.95
3.62
HASSAN
7.26
3.52
3.83
8.02
CHANNARAYAPATNA
SAKLESHPUR
ALUR
1.66
1.82
4.65
5.83
1.74
3.06
2.24
HOLENARSIPUR
ARKALGUD
4.68
4.03
DTW (mbgl)
November 2011
0 - 2
2 - 5
5 - 10
10 - 20
District Boundary
Taluk Boundary
NHS Locations
KARNATAKA STATE

**Fig: 5**

pavements, lined water channels, reduced areas of natural tanks and other water impounding structures etc. Analysis of the long-term water level trend in the last 10 years (2002-2011) reveals that 10% of the wells show a fall in water level ranging from 0.090m to 0.540m, whereas, the remaining wells (90%) show a rise in the range of 0.003m to 0.1.876 m. This means, more than three-fourth of the wells indicate a rise in water level in the district**. Fig.6 and Fig. 7**

Specific Yield of predominant unconfined aquifers ranges from 1.5 to 2.5% and Transmissivity of aquifers ranges from 2 to 63 $m^2$/day. The taluk wise hydrogeological details are given below:

**i. Alur taluk**

Groundwater occurs under phreatic condition in weathered zone of gneiss and under semi-confined to confined conditions in joints and fractures at deeper level. The depth of weathered zone (shallow aquifer) ranges from less than 10m to 25 m. The depth to water level varied from 3.53 mbgl to 10.50 mbgl (**Figure 4**) during pre-monsoon (May-11) and from 1.45 mbgl to 7.26 mbgl (**Figure 5**) during post-monsoon season (Nov-11). Average seasonal fluctuation between pre-monsoon and post-monsoon is 3.31m. The long-term water level trend (2002-2011) shows a rise of 0.31m/year. Permeability in the shallow zone is less than 10m/day. Specific Capacity of dugwells ranges from10.08 to 154.08 $m^3$/day/m. Potential deep aquifers occur below 25m to 100m (explored depth 266m) in the form of joints and fractures. The yield of borewells (CGWB exploratory wells) ranges from less than 1 lps to 2 lps.

**ii. Arkalgud taluk**

Groundwater occurs under phreatic condition in weathered zone of gneiss and under semi-confined to confined conditions in joints and fractures at deeper level. The depth of weathered zone (shallow aquifer) ranges from 10m to more than 20 m. The depth to water level ranges from 1.81 mbgl to 10.56 mbgl during pre-monsoon (May-11) and from 1.38 mbgl to 5.75 mbgl during post-monsoon season (Nov-11). Average seasonal fluctuation between pre-monsoon and post-monsoon is 4 m. The long-term water level trend (2002-2011) shows a rise of 0.54m/year. Permeability in the shallow zone is less than 10m/day. Specific Capacity of dugwells ranges from 3.92 to 102.24 $m^3$/day/m. Potential deep aquifers occur between 25m and 100m (explored depth 196m) in the form of joints, fissures and fractures. The average yield of borewells (CGWB exploratory wells) is 2.0lps. Transmissivity ranges from 16 to 22 $m^2$ /day.

**iii. Arsikere taluk**

Groundwater occurs under phreatic condition in weathered zone of gneiss, granite and schist and under semi-confined to confined conditions in joints and fractures of these formations at deeper level. Of these, gneiss is the most predominant aquifer covering major part of the taluk. The depth of weathered zone (shallow aquifer) ranges from less than 10m to 20 m. The depth to water level ranges from 5.0 mbgl to 6.0 mbgl during pre-monsoon (May-11) and from 2.55 mbgl to 10.95 mbgl during post-monsoon season (Nov-11). Average seasonal fluctuation between pre-monsoon and post-monsoon is

2.45 m. However, in some areas, fall in water level during post-monsoon season is also observed. The long-term water level trend (2002-2011)shows a rise of 0.17m/year to 0.55m/year at some places and a fall of 0.08m/year in higher ground water development areas. Specific Capacity of dugwells ranges from 11 to 117 $m^3$/day/m. Permeability in the shallow zone varies from less than 10m/day to 20 m/day. Potential deep aquifers occur below 25m to 90m (explored depth 90 m) in the form of joints, fissures and fractures. The yield of borewells (CGWB exploratory wells) varies from 2 lps to 10.5 lps. Transmissivity ranges from 17 to 50 $m^2$ /day.

**iv. Belur taluk**

Groundwater occurs under phreatic condition in weathered zone of gneiss, and under semi-confined to confined conditions in joints and fractures of the formation at deeper level. The depth of weathered zone (shallow aquifer) ranges from less than 10m to 42 m. The depth to water level ranges from 5.36 mbgl to 12.34 mbgl during pre-monsoon (May-06) and from 2.37 mbgl to 7.04 mbgl during post-monsoon season (Nov-06). Average seasonal fluctuation between pre-monsoon and post-monsoon is 2.48 m. The long-term water level trend (1996-2005) shows a rise of 0.14m/year to 0.31m/year. Permeability in the shallow zone varies from, is less than 10m/day to 20 m/day. Specific Capacity of dugwells ranges from 4.6 to 123 $m^3$/day/m. Potential deep aquifers occur below 25m to 180m (explored depth 235 m) in the form of joints, fissures and fractures. The yield of borewells (CGWB exploratory wells) varies from 1 lps to 4 lps. Transmissivity ranges from 3 to 21 $m^2$ /day.

**v. Channarayapatna taluk**

Groundwater occurs under phreatic condition in weathered zone of gneiss and schist and under semi-confined to confined conditions in joints and fractures of these formations at deeper level. Of these, gneiss is the predominant one covering major part of the taluk. The depth of weathered zone (shallow aquifer) ranges from less than 10m to 15 m. The depth to water level ranges from 3.58 mbgl to 6.25 mbgl during pre-monsoon (May-011) and from 4.56 mbgl to 6.41 mbgl during post-monsoon season (Nov-11). Average seasonal fluctuation between pre-monsoon and post-monsoon is 0.95 m. However, in some areas, fall in water level during post-monsoon season is also observed. The long-term water level trend (2002-2011) shows a fall of 0.11m/year to 0.15m/year. Permeability in the shallow zone varies from is less than 10m/day to more than 20 m/day. Specific Capacity of dugwells ranges from 15 to 164 $m^3$/day/m. Potential deep aquifers occur below 25m to 90m (explored depth 90 m) in the form of joints, fissures and fractures. The yield of borewells (CGWB exploratory wells) varies from less than 1 lps to 8 lps. Transmissivity ranges from 27 to 63 $m^2$ /day.

**vi. Hassan taluk**

Groundwater occurs under phreatic condition in weathered zone of gneiss and schist and under semi-confined to confined conditions in joints and fractures of these formations at deeper level. Of these, gneiss is the predominant one covering major part of the taluk. The depth of weathered zone (shallow aquifer) ranges from 10m to 20 m. The depth to water level

ranges from 1.55 mbgl to 21.67 mbgl during pre-monsoon (May-11) and from 0.98 mbgl to 19.42 mbgl during post-monsoon season (Nov-11). Average seasonal fluctuation between pre-monsoon and post-monsoon is 2.35 m. The long-term water level trend (2002-2011) shows a rise in the range of 0.10 m/year to 0.33 m/year at some places and a fall of 0.14m/year in higher ground water development areas. Permeability in the shallow zone varies from less than 10m/day to more than 20 m/day. Specific Capacity of dugwells ranges from 3 to 417 $m^3$/day/m. Potential deep aquifers occur below 25m to 85m (explored depth 85 m) in the form of joints, fissures and fractures. The yield of borewells (CGWB exploratory wells) varies from less than 1lps to 2.4 lps. Transmissivity ranges from 5 to 10 $m^2$ /day.

**vii. Holenarsipur taluk**

Groundwater occurs under phreatic conditions in weathered zone of gneiss and schist and under semi-confined to confined conditions in joints and fractures of these formations at deeper level. The depth of weathered zone (shallow aquifer) ranges from less than 10m to 20 m. The depth to water level ranges from 1.38mbgl to 5.75 mbgl during pre-monsoon (May-11) and from 1.18 mbgl to 3.54 mbgl during post-monsoon season (Nov-11). Average seasonal fluctuation between pre-monsoon and post-monsoon is 1.20 m. The long-term water level trend (2002-2011) shows a rise of 0.018m/year at some parts and a fall of 0.071m/year in higher ground water development areas. Specific Capacity of dugwells ranges from 10 to 268 $m^3$/day/m. Permeability in the shallow zone varies from, is less than 10m/day to more than 20 m/day. Potential deep aquifers occur between 25m and 53m (explored depth 53 m) in the form of joints, fissures and fractures. The average yield of borewells (CGWB exploratory wells) is 2.4 lps. Transmissivity ranges from 10 to 46 $m^2$ /day.

**viii. Sakleshpur taluk**

Groundwater occurs under phreatic condition in weathered zone of gneiss and under semi-confined to confined conditions in joints and fractures at deeper level. The depth of weathered zone (shallow aquifer) ranges from less than 10m to more than 20 m. The depth to water level ranges from 8.64 mbgl to 13.00 mbgl during pre-monsoon (May-11) and from 3.60 mbgl to 5.36 mbgl during post-monsoon season (Nov-11). Average annual fluctuation is 4.6m.The long-term water level trend (2002-2011) shows a rise of 0.31m/year. Permeability in the shallow zone is less than 10m/day. Potential deep aquifers occur below 25m to 100m (explored depth 196m) in the form of joints and fractures. The average yield of borewells (CGWB exploratory wells) is 2.0 lps.

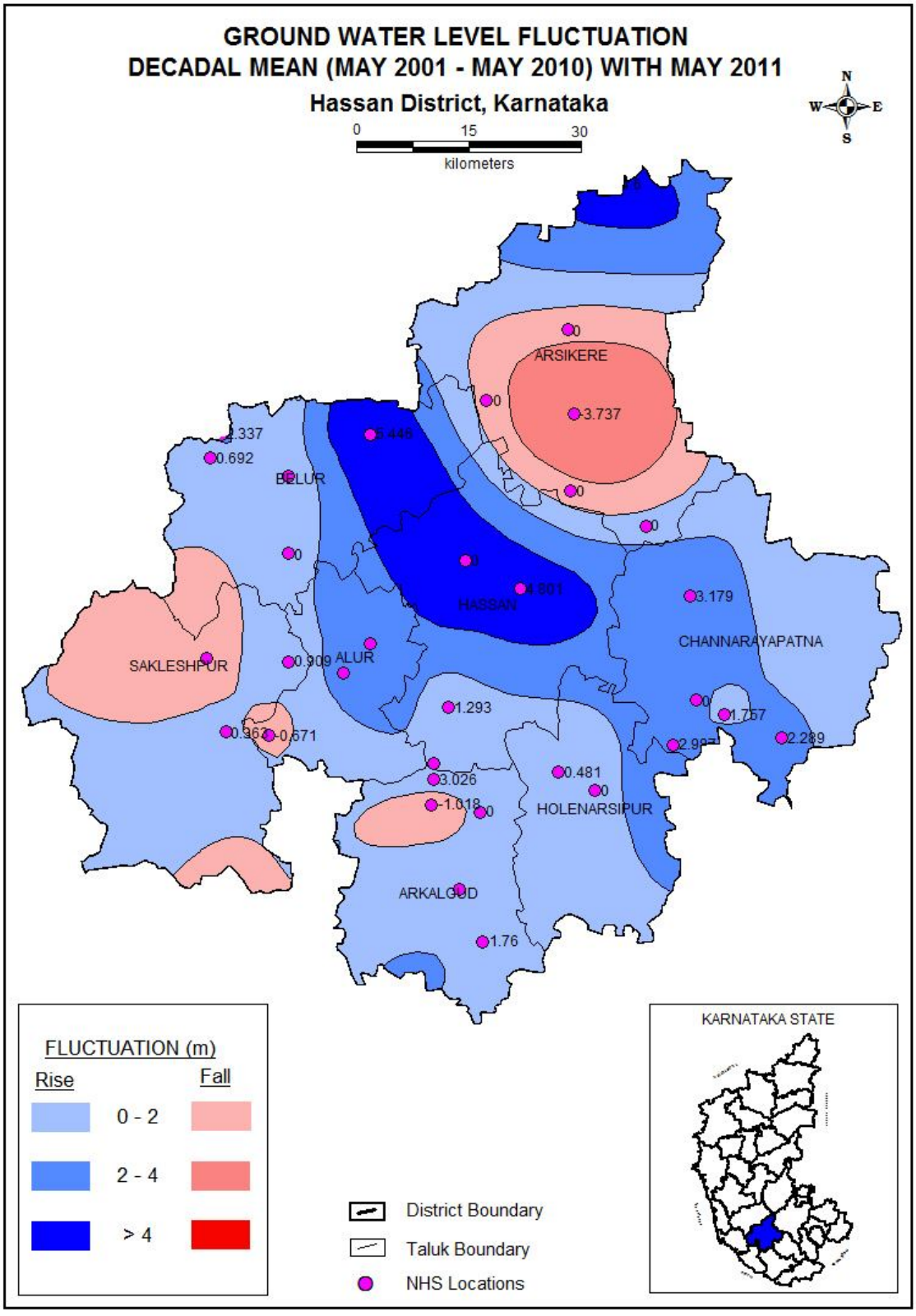

GROUND WATER LEVEL FLUCTUATION
DECADAL MEAN (MAY 2001 - MAY 2010) WITH MAY 2011
Hassan District, Karnataka
0
15
30
kilometers
N
W
E
S
ARSIKERE
3.737
BELUR
0.692
HASSAN
1.801
3.179
CHANNARAYAPATNA
SAKLESHPUR
0.909
ALUR
1.293
1.757
2.289
0.962
0.671
3.026
0.481
HOLENARSIPUR
ARKALGUD
1.76
FLUCTUATION (m)
Rise
Fall
0 - 2
2 - 4
> 4
District Boundary
Taluk Boundary
NHS Locations
KARNATAKA STATE

**Fig. 6**

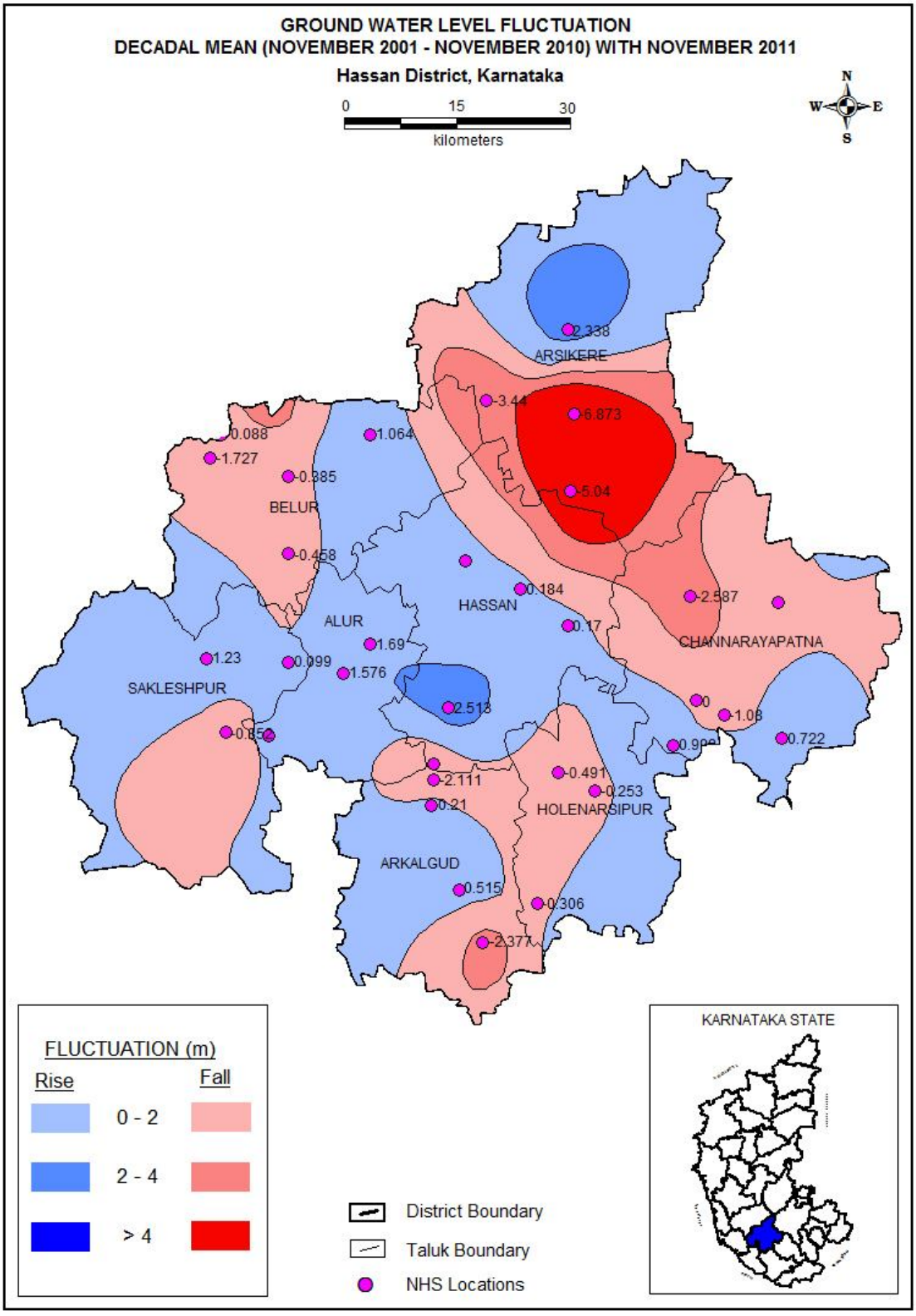

GROUND WATER LEVEL FLUCTUATION
DECADAL MEAN (NOVEMBER 2001 - NOVEMBER 2010) WITH NOVEMBER 2011
Hassan District, Karnataka
0
15
30
kilometers
N
W
E
S
2.338
ARSIKERE
-3.44
6.873
0.088
1.064
-1.727
-0.385
-5.04
BELUR
-0.458
0.184
HASSAN
-2.587
ALUR
0.17
1.69
CHANNARAYAPATNA
1.23
0.099
1.576
SAKLESHPUR
2.513
0
-1.08
0.722
-0.111
-0.491
-2.111
-0.253
0.21
HOLENARSIPUR
ARKALGUD
0.515
-0.306
-2.377
FLUCTUATION (m)
Rise
Fall
0 - 2
2 - 4
> 4
District Boundary
Taluk Boundary
NHS Locations
KARNATAKA STATE

**Fig: 7**

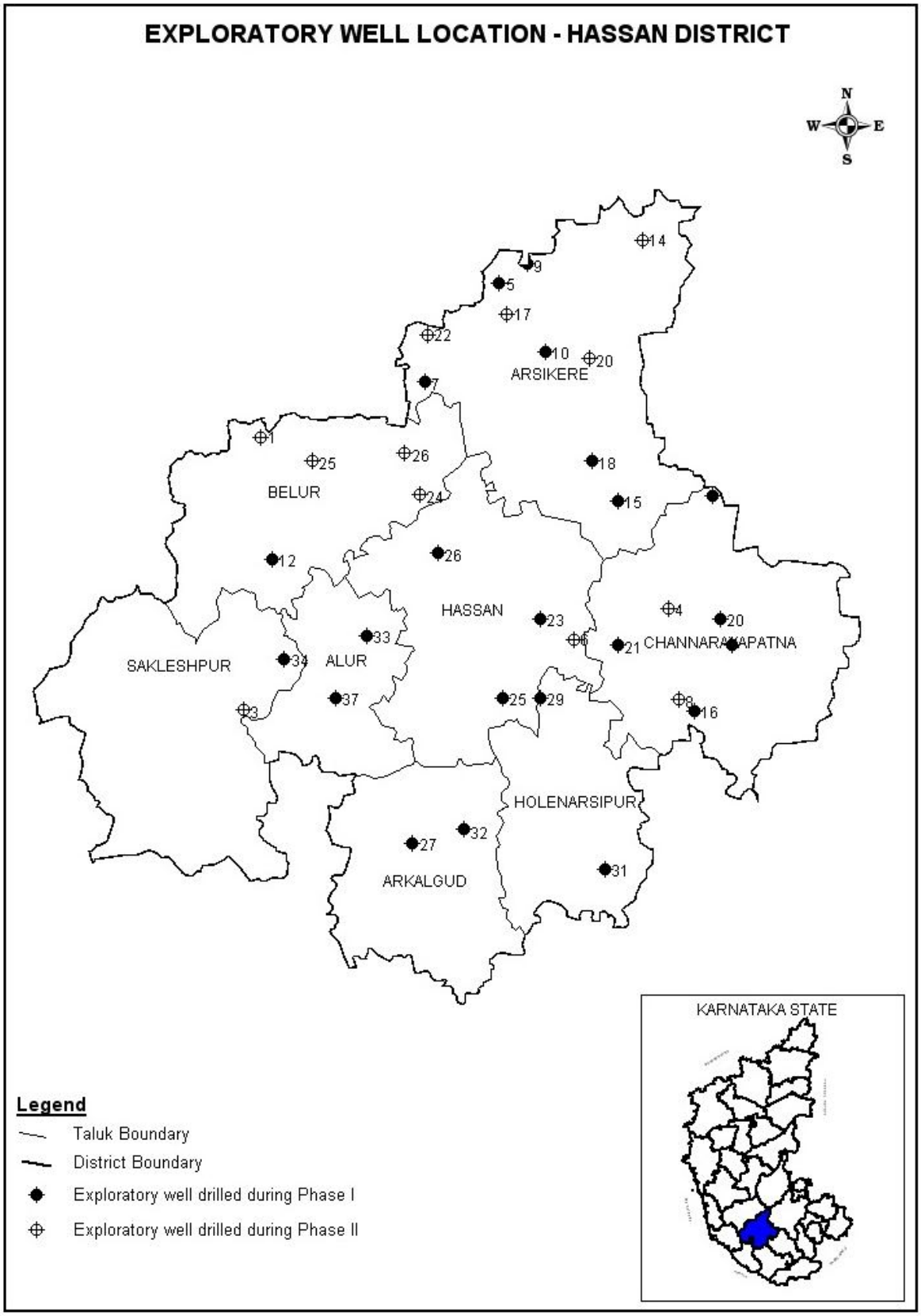

EXPLORATORY WELL LOCATION - HASSAN DISTRICT
N
W
E
S
14
9
5
17
22
10
20
ARSIKERE
7
1
25
26
18
BELUR
24
15
12
26
HASSAN
4
20
23
33
6
21
CHANNARAYAPATNA
SAKLESHPUR
34
ALUR
37
25
29
8
16
3
HOLENARSIPUR
32
27
31
ARKALGUD
KARNATAKA STATE
Legend
Taluk Boundary
District Boundary
Exploratory well drilled during Phase I
Exploratory well drilled during Phase II

**Fig.8**

## 4.2 Groundwater resources

**(I) Groundwater Assessment**

As per the Ground Water Resource Estimation Studies GEC 2009 based on (GEM-1997), the annual ground water availability is 830.97mcm and the balance resource availability for industrial and domestic purposes is 68.78 mcm. Further, the net groundwater availability for future irrigation development is 89401 ham. The taluk wise groundwater resource (as on March2009) is given in Table 3.

**(II)Details of OE /Critical / Semi-Critical / Safe areas:**

The resource estimation has been done by keeping taluk as administrative unit. In each taluk, depending upon the degree of groundwater development, different parts are falling in various categories of ground water development, which has been given in the Table 3. From the table it is seen that, least ground water development has taken place in Alur( 14%) and Sakleshpur taluks( 53%) with the entire areas falling under 'SAFE' category. Highest development has been reported in Arsikere, followed by C.R.Patna, Hassan, Belur ,Holenarsipur and Arkalgud. In these taluks 75%, 60%, 50%,40%, 40% and 10% of the areas are falling in OVER-EXPLOITED category respectively. The categorization is shown in Figure. 9.

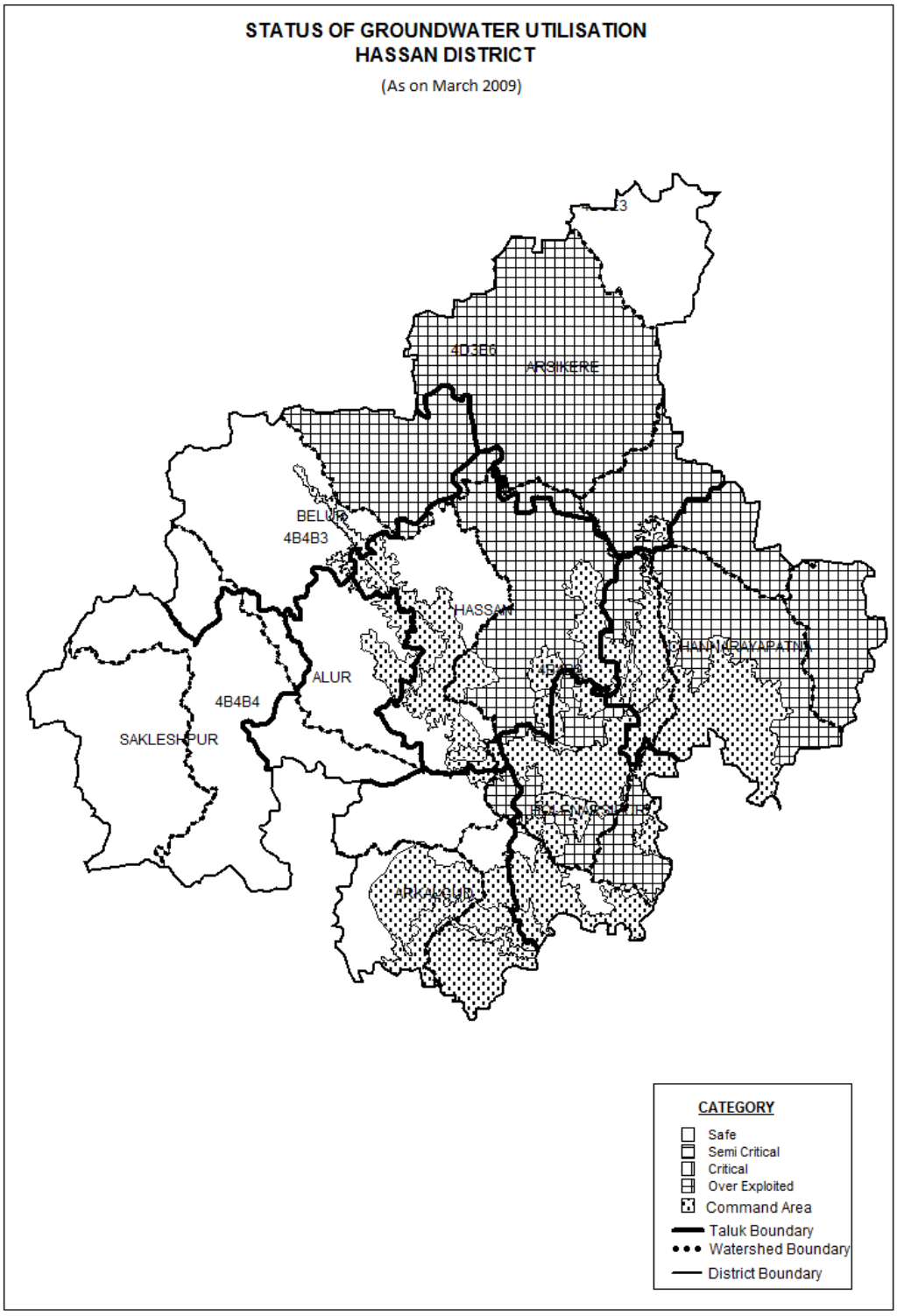

STATUS OF GROUNDWATER UTILISATION
HASSAN DISTRICT
(As on March 2009)
4D3E6
ARSIKERE
BELUR
4B4B3
HASSAN
ALUR
4B4B4
SAKLESHPUR
CHANNARAYAPATNA
CATEGORY
Safe
Semi Critical
Critical
Over Exploited
Command Area
Taluk Boundary
Watershed Boundary
District Boundary

**Figure .9**

**Table 3. Talkwise groundwater resource (as on March 2009) Hassan 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 | BALANCE GROUND WATER IRRIGATION POTENTIAL AVAILABLE | STAGE OF DEVELOPMENT AS ON MARCH 2009 | SAFE AREA | SEMI-CRITICAL AREA | CRITICAL AREA | OVER-EXPLOITED AREA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | mcm | mcm | mcm | mcm | mcm | mcm | Ha | (%) | (%) | (%) | (%) | (%) |
| **ALUR** | 63.34 | 7.03 | 1.96 | 8.99 | 2.45 | 54.31 | 630.67 | 14 | **100** | - | - | - |
| **ARKALGUD** | 69.49 | 14.66 | 7.43 | 18.48 | 10.31 | 25.66 | 3505.08 | 35 | **96** | - | - | **10** |
| **ARSIKERE** | 101.23 | 96.46 | 6.16 | 88.88 | 8.58 | 11.02 | 1254.66 | 102 | **20** | | - | **75** |
| **BELUR** | 66.29 | 28.18 | 5.76 | 34.96 | 7.96 | 10.00 | 1127.15 | 49 | **65** | - | - | **40** |
| **C.R. PATNA** | 128.68 | 79.71 | 6.14 | 85.84 | 8.60 | 39.45 | 4527.12 | 93 | **20** | - | - | **60** |
| **HASSAN** | 250.35 | 112.99 | 8.23 | 49.34 | 11.44 | 12.92 | 1441.14 | 28 | **43** | | - | **50** |
| **HOLENARSIPUR** | 97.06 | 43.72 | 5.69 | 42.32 | 8.04 | 21.19 | 2310.67 | 49 | **27** | - | - | **40** |
| **SAKLESHPUR** | 54.53 | 14.95 | 12.99 | 36.26 | 17.80 | 31.44 | 4096.88 | 53 | **100** | - | - | - |

## 4.3 Groundwater quality (Irrigation and drinking point of view.)

Quality of groundwater in the district, in general is good and potable. It is suitable for domestic and irrigation purposes. Water samples from NH Stations were analysed to decipher the shallow aquifer water quality and samples from exploratory borewells represent water quality of deeper aquifers in the district. All the important parameters like EC, pH, TDS and fluoride levels, both in the shallow and the deep aquifers are, in general, within the permissible limits prescribed for drinking water standards. Only nitrate and chloride are found in higher concentrations at a few places.

The **shallow zone** groundwater is Calcium-Magnesium Bicarbonate type and suitable for all purposes. At the following places the nitrate and chloride concentrations are in excess of permissible limits. Nilavagilu (Alur taluk), Harnahalli, Javagallu and Kanakatte (Arsikere taluk), Halebeedu (Belur taluk),Bragur, Hiresave and Jambur (Channarayapatna taluk),Kattaya and Shantigrama (Hassan taluk).The combination of these two ions in excess of permissible limits indicates the pollution from point source in these villages. Only nitrate is in above permissible concentration at Ballupet (Sakleshpur taluk), Bychanahalli and Vadrahalli (Arkalgud taluk), and Gorur (Hassan taluk), which indicates the non-point source of pollution and is due to the use of nitrogenous fertilizers in the surrounding area The Sodium Adsorption Ratio **(SAR)** ranges between 0.02 and 6.63, which is in 'Excellent' class (being less than 10).

The **deep zone** ground water is Calcium-Magnesium Bicarbonate and Chloride type and suitable for all uses. Excess nitrate and chloride are noticed at Javagallu and D.M.Kurki (Arsikere taluk), which is due to point source pollution and reached the deep aquifer from shallow zone due to pumping. Only nitrate is in above permissible concentration at A.M.G.Halli (Arkalgud taluk), Shanegere, Mudodi and Banavara (Arsikere taluk), Y.Cross (Channarayapatna taluk) and Kandli (Hassan taluk), which is due to the excess use of nitrogenous fertilizers in the surrounding area. Excess fluoride of 1.63 mg/litre is observed at Banavara (Arsikere taluk) alone. The Sodium Adsorption Ratio **(SAR)** ranges between 0.66 and 3.13, which is in 'Excellent' class (being less than 10). (**Figure 10)**
Groundwater being a dynamic resource is prone to deterioration in quality. The vulnerability is high in certain areas while in other areas it is comparatively stable. Vulnerable areas from quality point of view are presented in **Figure 13**.

Fig-7

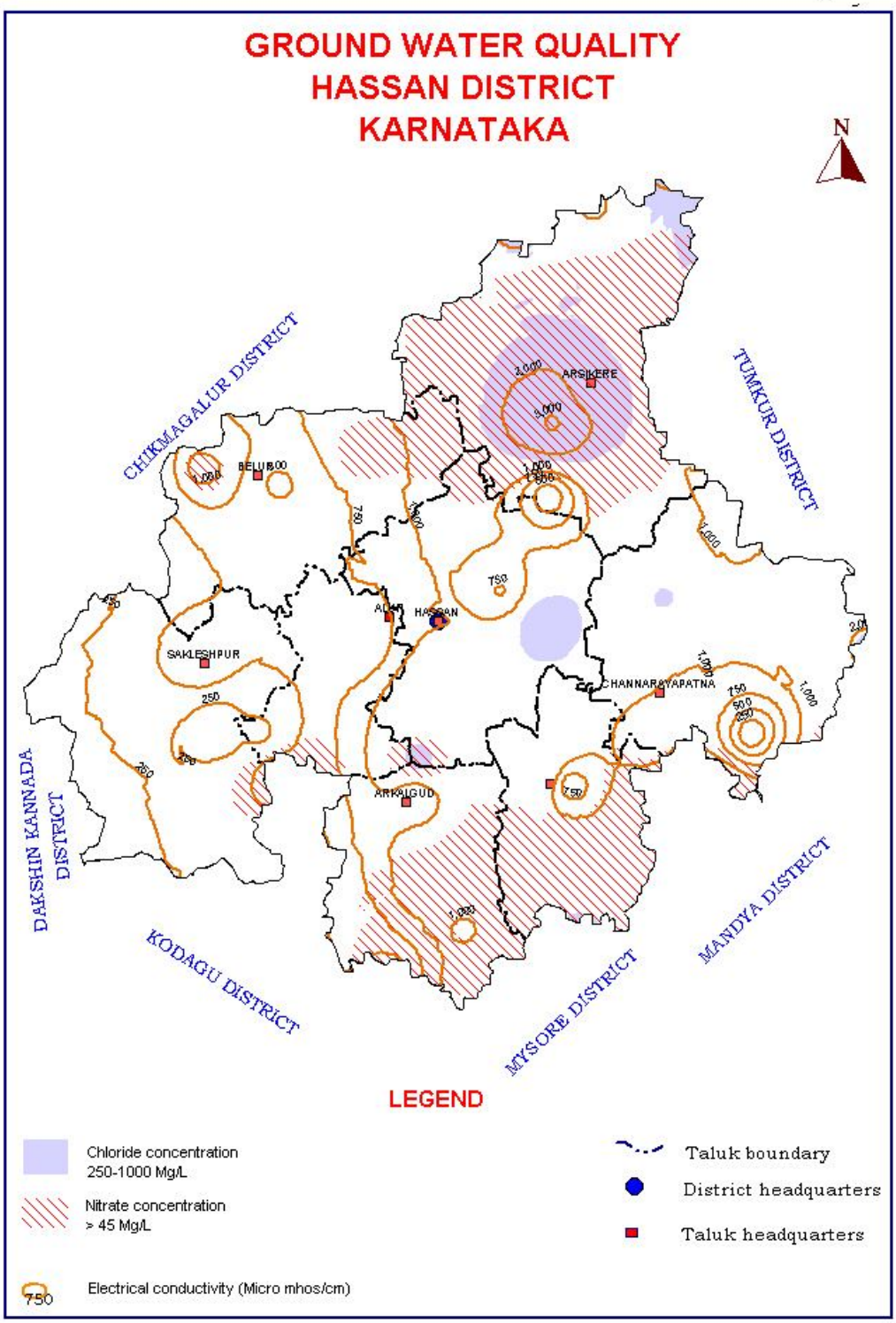

GROUND WATER QUALITY
HASSAN DISTRICT
KARNATAKA
N
CHIKMAGALUR DISTRICT
TUMKUR DISTRICT
DAKSHIN KANNADA DISTRICT
KODAGU DISTRICT
MYSORE DISTRICT
MANDYA DISTRICT
ARSIKERE
BELUR
HASSAN
SAKLESHPUR
CHANNARAYAPATNA
ARKALGUD
LEGEND
Chloride concentration 250-1000 Mg/L
Nitrate concentration > 45 Mg/L
Electrical conductivity (Micro mhos/cm)
750
Taluk boundary
District headquarters
Taluk headquarters

**Fig:10**

## 4.4 Status of Groundwater development

The ground water development in the district varies from 14% (Alur taluk) to102% (Arsikere taluk). More than half of the district area (60%) falls under '**safe**' category, and the remaining 40% is '**over-exploited'** (**Figure 9**). When considered taluk wise, the entire Sakleshpura and Alur taluk and major parts of Arkalgud, Belur ,Holenarsipura taluks and small parts of Arsikere and C.R.Patna Hassan taluks are in 'safe' category. Major parts of Arsikere, C.R.Patna, Holenarsipura and Hassan and Belur taluks fall under 'over-exploited' category. Net groundwater draft for irrigation , domestic and industrial and all purposes are furnished in Table.3.From the above discussion it is observed that, the western higher rainfall area has a lower groundwater development than the eastern plain, lesser rainfall area.

### 4. 4.1 Drinking water supply

Bore wells are the major source of drinking water supply in the district.

### 4.4 .2 Irrigation water supply

Ground water is the major source of water supply for irrigation in the district. ground water irrigates 80% of the total irrigation. Between the dug wells and bore wells dug wells irrigate only 2% where as bore wells irrigate 98% showing the predominant role of bore wells in irrigation in the district.

## 5.0 Groundwater management strategy

Hassan is basically agriculture-dominated district, where it is the main occupation of the rural population, which constitutes 82.3% of the total population (2001 census). As per the data available ( IV$^{th}$MI Census) ), total irrigated area constitutes 20.5% of the net sown area. The contributions of surface water, groundwater and other sources in irrigated agriculture in the district are 48%, 45% and 7% respectively. It is apparent that groundwater is playing equally vital role in agriculture sector apart from being the main source of drinking water in major part of the district. Hence, its judicious use and sustainable management is all the more important. Water-economy irrigation practices like adoption of drip and sprinkler irrigation methods should be popularized. Efforts should be oriented towards conservation and augmentation of groundwater. In canal command areas, conjunctive use approach can be adopted. In deeper ground water areas of maidan area, artificial recharge measures like percolation tanks and check dams are to be implemented to augment the groundwater resource. In the hilly areas (Malnad region) watershed treatment techniques can help in augmenting the groundwater resources. Point recharge structures would help in recharging deeper depleted fractures and fissures so as to have a sustainable yield from borewells. Technical management of groundwater should be kept in mind while extending institutional finance to farmers and awareness should be created in different user communities.

Government of India sanctioned "National project for Repair, Renovation and Restoration (RRR) of water bodies which are directly linked to agriculture. The main objective is to restore and augment storage capacity of water bodies and

also to recover and extend their lost irrigation potential. The RRR scheme is operational in Hassan district.
Central Ground Water Board had rendered technical guidance for implementation of the scheme on artificial recharge to ground water through dug wells in OE/semicriical taluks of Hassan district(2007-10)

## 5.1 Groundwater development

**40%** of the district is OE, having > 100% stage of development. **10%** of Arkalgud Taluk, **75%** of Arsikere taluk, **40%** of Belur; **60%** of CR patna, 50% of Hassan and **40%** of Holenarsipur are falling under Over Exploited category Remaining **60%** is safe category areas ( Alur, Sakhleshpur, 100% safe).
Further development in the over-exploited areas of Hassan, Holenarsipur, Channarayapatna and Arsikere taluks should be restricted. In semi-critical areas of Arsikere and Belur taluks further development of groundwater should be done with all cautions. As groundwater level in general is declining, deepening of dug wells, conversion of dugwells into dug-cum-borewells is needed. The shallow zone ground water can be developed for irrigation through dug wells in topographic low areas and dug-cum-borewells in valley slope areas having comparatively deeper water levels. Optimum depth of dug well is 10-12 m having a diameter of 6-7m.The optimum depth of dug-cum borewell is 15-20 m having a diameter of 6-7 m in dug part and 100mm in lower borewell part to a depth of100m. A minimum spacing of 75 to 100m between dugwells is recommended. The recommended optimum discharge of dugwells is 4lps for the prevailing cropping pattern for a pumping of 4 to 5 hrs and 3 H.P. pump is needed. The recommended command of each well is 1.2 hectare. Borewells are possible in all topographic conditions and pinpointing of site, depth, yield prospects etc, should be ascertained by suitable investigations. The minimum distance of 150 m between two borewells is necessary to avoid mutual interference.

## 5.2 Water Conservation and Artificial Recharge.

Fast, unchecked and indiscriminate withdrawal of groundwater through different abstraction structures has resulted in the decline of ground water level. Further, deforestation and conversion of grass-covered land for other activities has reduced the natural groundwater recharge area. Hence, most part of the rain leaves the area as run-off causing floods and heavy soil erosion. By constructing suitable structures the contact time of this flowing water with the land can be increased and some part of which, will percolate down to recharge the groundwater.

Rain Water Harvesting would be a remedy in areas where there is ground water quality problem due to high nitrate, chloride and fluoride concentrations. By studying the nature of geological formations, slope of the land, depth of weathering, depth to water level and availability of land and water source for these artificial recharge structures, different types of artificial structures are recommended and shown in the map. The plain lands in eastern parts of the district covering Arsikere, Channarayapatna, Holenarsipur, Hassan, Arkalgud and parts of Alur and Belur are suitable for construction of Percolation tanks,

Nalla bunds and point recharge structures like recharging through existing borewells/dugwells and recharge pits. The moderate to high sloping, undulating terrain on the western parts of the district covering Sakleshpur taluk and the parts of Alur and Belur taluks are suitable for artificial recharge structures like gully plugs, gabian structures, cement plugs, nala bunds, contour bunds and contour trenches.

The selection of a suitable artificial recharge structure is site specific. So, scientific studies should be conducted while selecting the site for a specific type of structure. The year 2005 has received the highest rainfall in the last 10 years and hence; water levels in dugwells for the period are shallow even in high ground water development areas. However, artificial recharge structures are recommended in such areas considering the long-term water level trends. Feasibility of Artificial Recharge Structures is shown in **figure 11.** Feasible structures suggested are subsurface dams, percolation tanks, check dams and point recharge structures. except Hilly areas of Sakhleshpur and Safe category areas of Alur taluk, rest of the district are suitable for artificial recharge. However appropriate recharge structure may be finalised based on site specific conditions.

## 5.3 Unit area ground water 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 Hassan district the unit area annual recharge is grouped into three categories viz. in the range of 0.25- 0.50 in central part, Hassan District ; in the range of 0.10-0.15 in C.R.Patna and Holenarsipura and 0.025-0.10 in rest of the district **(Fig.12 )**

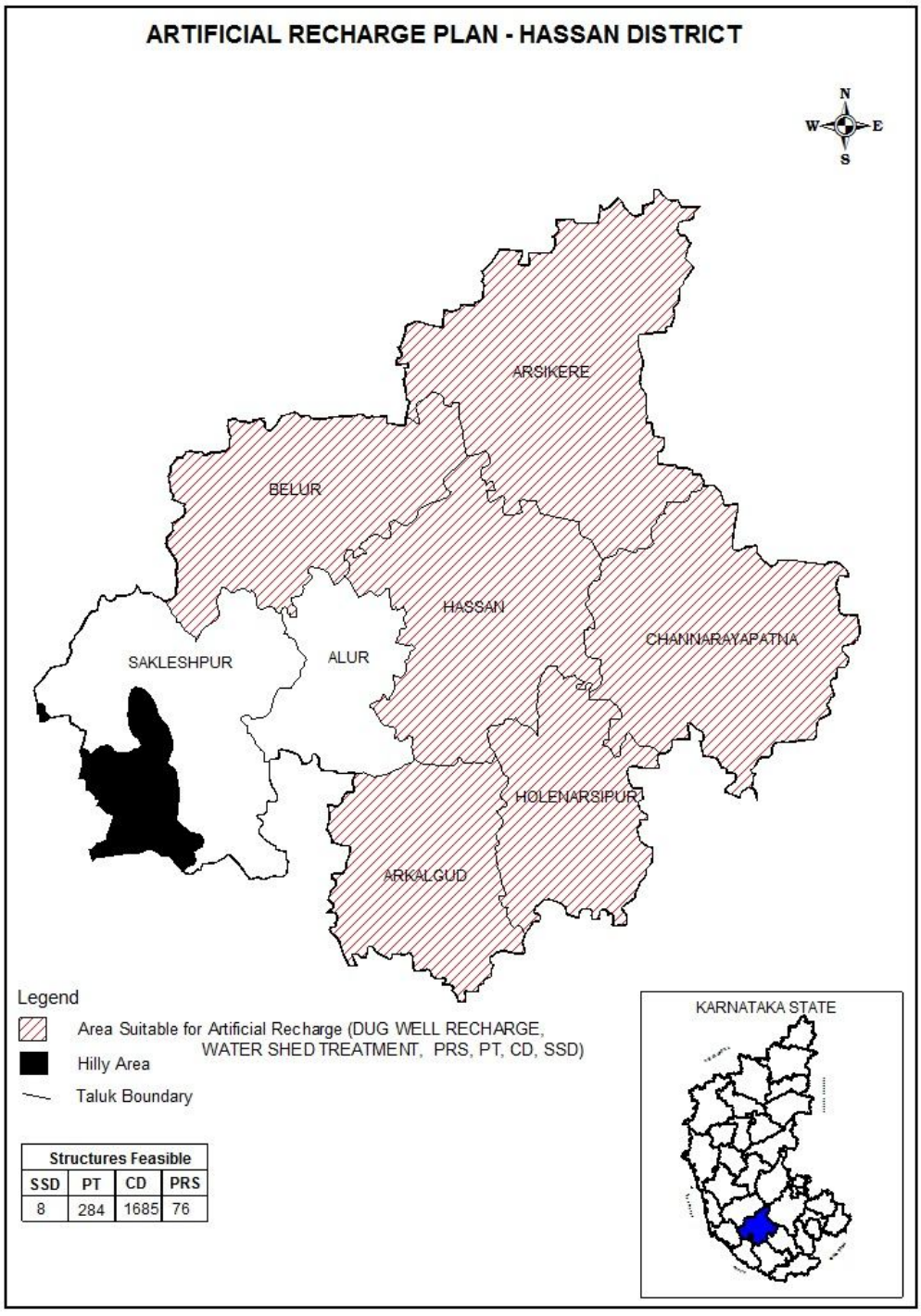

ARTIFICIAL RECHARGE PLAN - HASSAN DISTRICT
N
W
E
S
ARSIKERE
BELUR
HASSAN
CHANNARAYAPATNA
SAKLESHPUR
ALUR
HOLENARSIPUR
ARKALGUD
Legend
Area Suitable for Artificial Recharge (DUG WELL RECHARGE, WATER SHED TREATMENT, PRS, PT, CD, SSD)
Hilly Area
Taluk Boundary
Structures Feasible
SSD PT CD PRS
8 284 1685 76
KARNATAKA STATE

**Fig: 11**

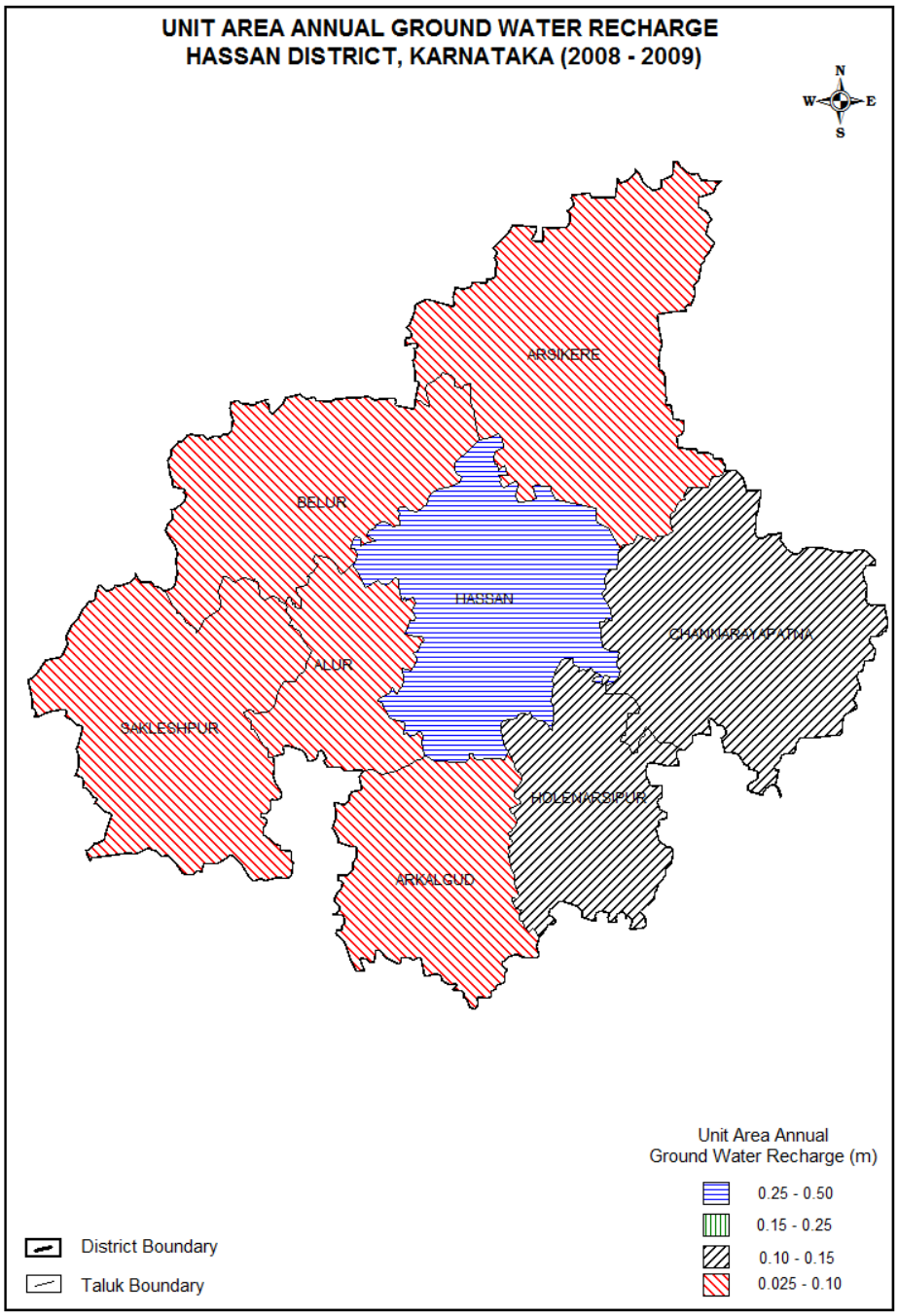

UNIT AREA ANNUAL GROUND WATER RECHARGE
HASSAN DISTRICT, KARNATAKA (2008 - 2009)
N
W
E
S
ARSIKERE
BELUR
HASSAN
CHANNARAYAPATNA
ALUR
SAKLESHPUR
HOLENARSIPUR
ARKALGUD
Unit Area Annual
Ground Water Recharge (m)
0.25 - 0.50
0.15 - 0.25
0.10 - 0.15
0.025 - 0.10
District Boundary
Taluk Boundary

Fig: 12

## 6.0 Groundwater related issues and problems.

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 of the district while in other areas it is comparatively stable. Based on it's susceptibility to various stress factors the district wise vulnerability map is prepared **( Fig.13 )** 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 Hassan district parts of the area groundwater is vulnerable due to more than one of the above parameters as represented in figure below**.( Fig.13)**

Presently decrease in the yield of borewells and depletion of ground water is the main cause of concern in the over-exploited taluks of the district. Over exploitation is witnessed in major parts of the taluks of C.R.Patna, Hassan and Holenarsipur followed by a lesser extent in Arsikere and Arkalgud. About 40% of the district, as elaborated above, is falling under 'Over-exploited' category, where, feasibility of further ground water development is very much restricted or nil.

Excess nitrate and chloride due to point source on a localized pattern is found in different parts of the district. Excess nitrate over restricted area in canal command area is noticed.

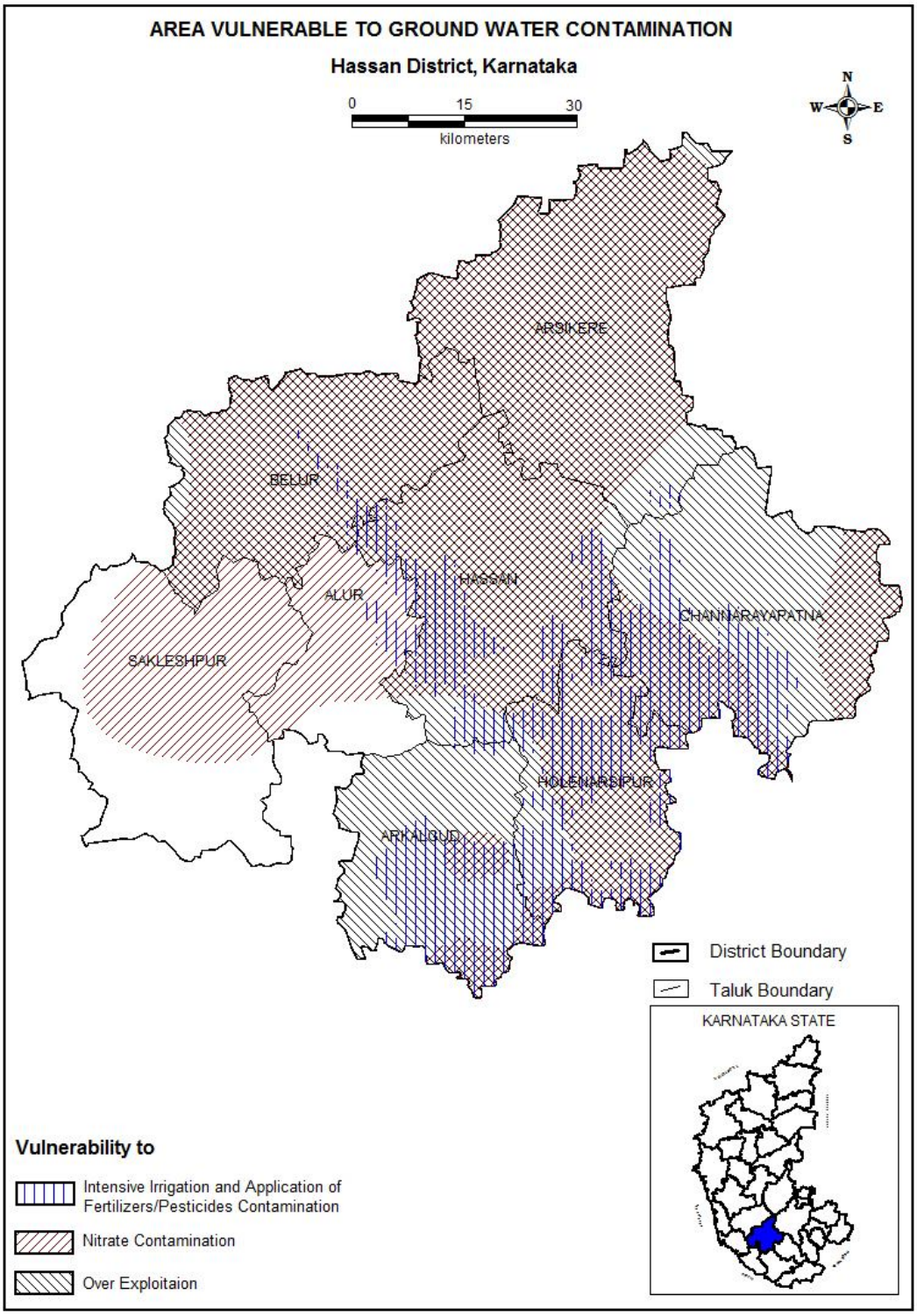

AREA VULNERABLE TO GROUND WATER CONTAMINATION
Hassan District, Karnataka
0
15
30
kilometers
N
W
E
S
ARSIKERE
BELUR
HASSAN
ALUR
CHANNARAYAPATNA
SAKLESHPUR
HOLENARSIPUR
ARKALGUD
District Boundary
Taluk Boundary
KARNATAKA STATE
Vulnerability to
Intensive Irrigation and Application of Fertilizers/Pesticides Contamination
Nitrate Contamination
Over Exploitaion

**Fig.13**

## 7.0 Awareness and Training Activity

## 7.1 Water Management Training Programme

- Water Management **Training Programme** was held at ZP office, Hassan during **16th and 17th December 2004**. Sri Jamadar, CEO, Hassan Zilla Panchayat presided over the function. Sri Ashwathnarayanagowda, IAS, Deputy Commissioner inaugurated the programme. Dr. Manjunath, Head of Civil Engineering Department, Malnad College of Engineering, Hassan was the Guest of Honour and released the training module. Sri C.S.Ramasesha, Regional Director, Central Ground Water Board, South Western Region, Bangalore welcomed the gathering. Thirty-five trainees from Zilla Panchayat and various state government departments attended the training programme. Officers of South Western Region presented lecture topics on the theme of water management. A field visit to the rooftop rainwater-harvesting site was arranged in Hassan town. Valedictory function was held on 17.12.2004 and certificates were distributed to trainees.
- As part of the nationwide programme of Central Ground Water Board of bringing awareness amongst the general public about the scientific management of ground water resources and under the implementation of Media Activities under IEC Scheme of the Ministry, a **Mass Awareness program** was organised at Government First Grade College, Jajur, Arasikere Taluk, Hassan District on **07.03.2009**. Sri Chennabasavaiah, Principal, Government First Grade College, Jajur was the chief guest and inaugurated the programme
- A Water Management **Training Programme (WMTP)** on Ground Water Management was organised during **04.03.2009 to 05.03.2009** at Zilla Panchayath Meeting Hall Hassan. This training programme was organised as a nation wide programme for officers of different departments attached to Zilla Panchayat, NGOs', Representatives from Farmers and Education Institutions etc., a total number of 31 trainees (including 3 women) attended the course.

## 7.2 Participation in Exhibition, Mela, Fair etc.

- Under the implementation of Media Activities under IEC Scheme of the Ministry, a Jalyatra was organised at Jajur on 7.3.2009. Jajur in Arasikere is a typical rural folk fore Panchayat in Arsikere taluk in Hassan district which is one of the 31 Hot-spot districts of the country where water literacy activities are important. The Jalyatra is targeted to bring awareness reference to ground water. Under this programme, a procession was arranged from Jajur Panchayat office to Govt. first grade college, Jajur covering a distance of about more than a kilometer. Public and farmers from Jajur village, students, women folk having water literacy caps with slogans "Save Water" participated in large numbers during the Jalyatra. Earlier to this, water conservation messages were conveyed with mobile public address system in the village limits. amongst the public particularly the students regarding water conservation with special

- An exhibition of live models on rainwater harvesting and artificial recharge to ground water was arranged during the three week long Mahamastakabhisheka mela in January 2006 at Shravanabelgola, in Hassan district. Posters, booklets and pamphlets on various aspects related to ground water were also exhibited and distributed to the public. The exhibition attracted a lot of people and has own the appreciation of VIPs and the general public.

## 8.0 Areas notified by CGWA/SGWA

No area is notified either by CGWA or SGWA.

## 9.0 Recommendations

After analyzing the present groundwater scenario in Hassan district, the following recommendations are made to develop ground water on sustainable basis in different parts of the district.

1. Dugwells, which are currently in use, may be further deepened to tap more saturated part of the phreatic aquifer and increase the yield. Wherever dugwells are more than 15 meter in depth, borewells of 100 to 150mm diameter to a depth of 50 m may be tried at the bottom to enhance the yield. Such measures will help in mitigating the irrigation water scarcity.
2. Pinpointing of sites for wells and borewells in feasible areas should be tried after taking technical guidance and scientific investigations. Otherwise, farmers have to suffer heavy financial burden in case of failures of wells.
3. In canal command areas of Arkalgud, Holenarsipur, Channarayapatna, Hassan, Belur taluks, conjunctive use of surface and groundwater should be practiced. Withdrawing more groundwater through dugwells and shallow borewells and transferring it to upland and tail end areas will solve water scarcity in such areas and reduces the waterlogging problem in the command area.
4. Water-economy methods like drip irrigation and sprinkler irrigation can be practiced in irrigated agriculture to save water.
5. Bimodal rainfall pattern in major parts of the district helps in growing short and long duration crops and also for adopting multiple cropping patterns as per the specific crop water requirement and available irrigation potential.

6. In situ rainwater harvesting in the villages, where ground water carries excess nitrate and fluoride contents, will offer a solution for drinking water problems.
7. Artificial recharge measures like check dams, percolation tanks, point recharge structures and Subsurface dykes should be implemented on extensive scale, especially in over-exploited areas like Arsikere, Hassan, Channarayapatna and Holenarsipur taluks. Suitable artificial recharge structures should be constructed in different terrains, which will arrest and store the run-off in rainy season, which will otherwise, go waste. This stored water will recharge groundwater and will help in arresting soil erosion and also flood control.

8. Rejuvenation of existing MI tanks by de-silting would enhance their storage and percolation capacities. RRR scheme is under implementation in Hassan District which involves water users association and NGOs in rejuvenation of tanks.
9. Institutional financial assistance should be provided to poor farmers for deepening of dugwells and for new borewells. Incentives should be given for those who are interested in implementing Rain Water Harvesting schemes. Construction of different Artificial Recharge Structures, which is generally not affordable to individuals, should be taken up by the government.