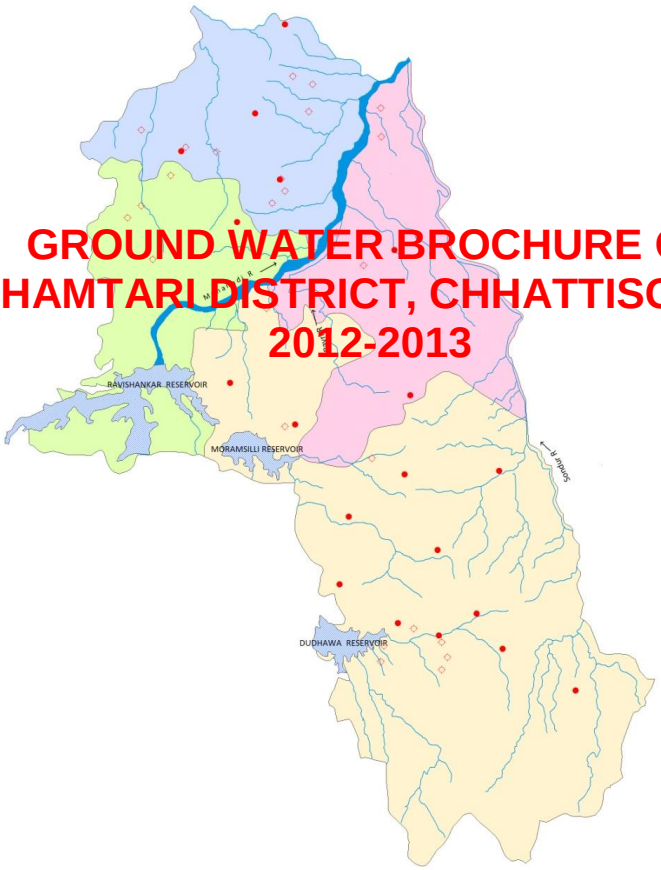
For official use

GOVERNMENT OF INDIA
MINISTY OF WATER RESOURCES
CENTRAL GROUND WATER BOARD



GROUND WATER BROCHURE OF DHAMTARI DISTRICT, CHHATTISGARH 2012-2013

Regional Director
North Central Chhattisgarh Region,
Reena Apartment, II[nd] Floor, NH-43,
Pachpedi Naka, Raipur-492001 (C.G.)

Ph. No. 0771-2413903, 2413689 **E-mail: rdnccr- cgwb@nic.in**

GROUND WATER BROCHURE OF DHAMTARI DISTRICT

DISTRICT AT A GLANCE

1.	**GENERAL INFORMATION**	
	i) Geographical area (Sq. km)	4082
	ii) Administrative Divisions	
	a) Number of Block	05 no.s
	b) Number of Villages	554 no.s
	iii) Population	
	2011 Census (provisional)	799199
	iv) Normal Annual Rainfall (IMD)	1302 mm
	v) Annual Rainfall (IMD, 2011)	1061 mm
2.	**GEOMORPHOLOGY**	
	i) Major Physiographic Units	Central Chhattisharh Plain and Part of Bastar Plateau
	ii) River Basin and Major Drainages	Mahanadi, Sondhur, Pairi and Kharun rivers
3.	**LAND USE (Sq. km)**	
	i) Forest Area	2126
	ii) Net Area Sown	1342
4.	**MAJOR SOIL TYPES**	Red gravelly, red sandy and red loamy (Alfisols), Dark grey black soil (Vertisols), Lateritic soil, Red and yellow soil (Ultisols)
5.	**AREA UNDER PRINCIPAL CROPS, in Sq. km (As on 2012)**	Rice: 1262 Pulses: 36.83 Wheat: 10.62

6. IRRIGATION (GROSS) BY DIFFERENT SOURCES (2012)

(Areas in Ha and Numbers of Structures)

i) Dug wells	350/ 1189
ii) Tube wells/Bore wells	37046/ 15972
iii) Canals	94398/ 11
iv) Ponds	236/22
v) Other sources	3034
vi) Net Irrigated Area	104656
vii) Gross Irrigated Area	135064

7. NUMBERS OF GROUND WATER MONITORING WELLS OF CGWB (As on 31.3.2012)

i) No of Dugwells	19
ii) No of Piezometers	11

8. PREDOMINANT GEOLOGICAL FORMATIONS

Archaeans: Dongargarh group (Granite and Granitic rocks)
Proterozoics: Arenaceous, calcarious & argillaceous rocks of Raipur Group, Chhattisgarh Super Group

9. HYDROGEOLOGY

i) Major Water Bearing Formation	Weathered & fractured granite, Fractured shale and sandstones, Cavernous Limestone
ii) Pre-monsoon Depth to Water Level During 2012 (mbgl)	1.72 to 10.92, Avg.: 6.84
iii) Post-monsoon Depth to Water Level During 2012 (mbgl)	0.71 to 5.29, Avg.: 2.78

10. GROUND WATER EXPLORATION BY CGWB (As on 31.3.2012)

i) No of Wells Drilled	EW: 64, OW: 17, PZ: 11 Total: 92
ii) Depth Range (m)	17 to 300
iii) Discharge (litres per second)	0.1 to 16

iv) Transmissivity (m^2/day)	2.51 to 335.96

11. GROUND WATER QUALITY

Type of Water	Water is potable and fit for irrigation purpose.

12. DYNAMIC GROUND WATER RESOURCES (As on March 2009)- in ham

i) Annual Available Ground Water Resources	36969.73
ii) Grass Annual Ground Water Draft	24915.31
iii) Stage of Ground Water Development (%)	67.39
iv) Available Ground Water Resources for future use	9253.8

13. AWARENESS AND TRAINING ACTIVITY

Mass Awareness Programmes Organised

i) Year 2006-07, Place: Dhamtari
ii) Year 2008-09, Place: Dhamtari
iii) Year 2010-11, Place: Dhamtari

Water Management Training Programmes Organised

i) Year 2007-08, Place: Dhamtari

14. EFFORTS OF ARTIFICIAL RECHARGE & RAIN WATER HARVESTING

i) Projects Completed by CGWB (No & Amount spent)	Nil

15. GROUND WATER CONTROL AND REGULATION

i) Number of Over Exploited Blocks (Stage of Development > 100%)	Nil
ii) Number of Critical Blocks (Stage of Development > 90%)	Nil
iii) Number of Blocks Notified	Nil

16. MAJOR GROUND WATER PROBLEMS AND ISSUES: Nil

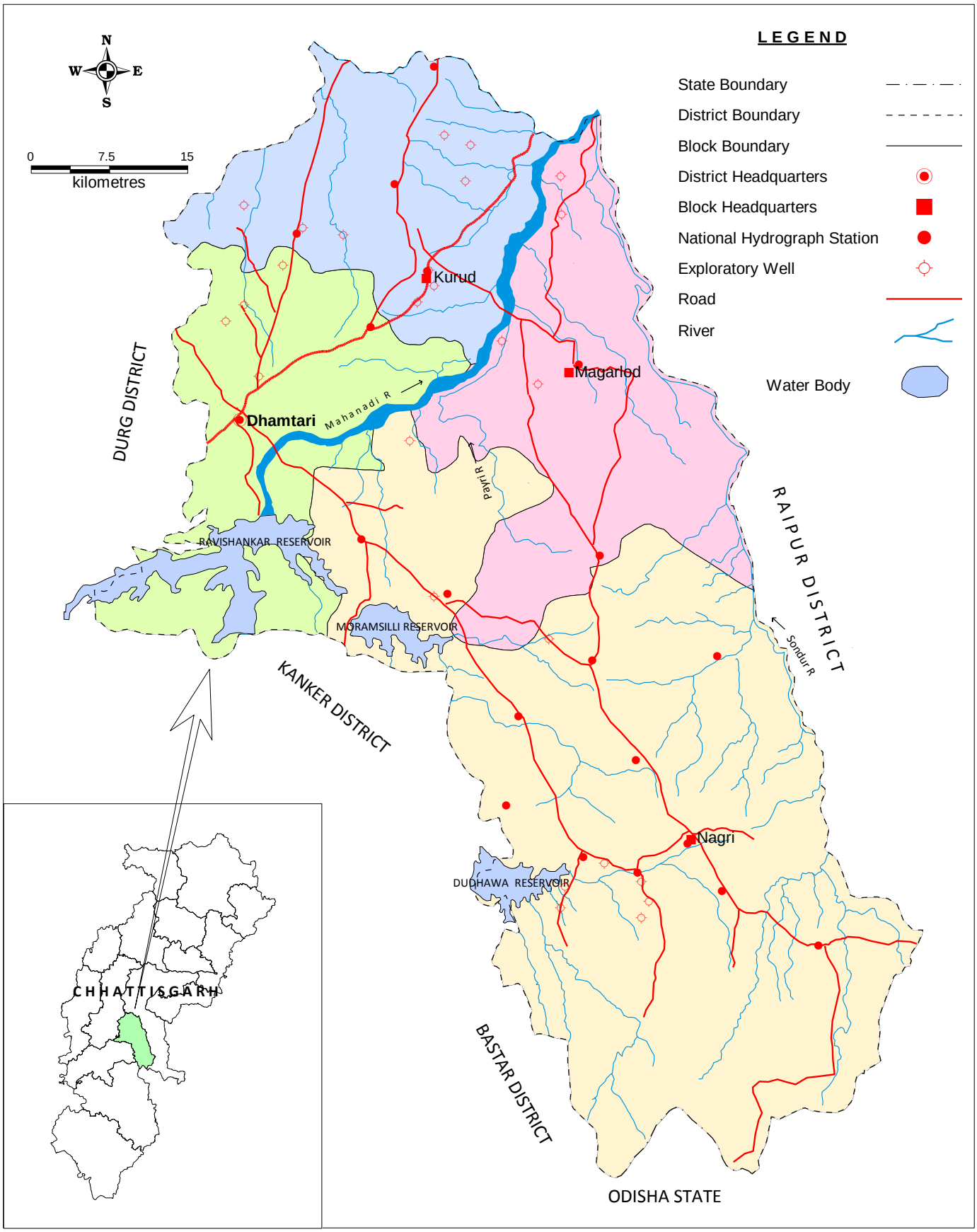
1.0INTRODUCTION

Dhamtari district is situated in the fertile plains of Chhattisgarh Region. It is located in the southern part of the Chhattisgarh state and is bounded by East longitudes 81°24'43" & 82°10'29" and by North latitudes 20°02'45" & 21°01'33" falling in the Survey of India topo-sheets nos 64G, 64H and 64L. It covers an area of 4082 sq.km. Dhamtari town is the district headquarters of the district. The District is surrounded by District Raipur in North & East, District Durg in North-West, Kanker as well as Bastar in South-West and part of Odisha state in the South (**Fig-1**). For the convenience of administration, the district is divided into 3 no. of tehsils, 4 no. of Community Development blocks and 554 no. of revenue villages. The block head quarters are Dhamtari, Kurud, Magarlod and Nagri. The district is known mainly for its rice production and forest produce. The district is well connected by all weathered roads.

The Dhamtari town which is the district headquarters, is covered by Municipal Corporation. According to the 2001 census the total population of the district is 706591, out of which rural population is 613007 (86.75%) and remaining is urban population of 93584 (13.25 %). As per 2011 provisional census figure, the population of the district is 799199. The decadal growth of population is 13.10%.

Mahanadi is the principal river of this district. Its tributaries are Pairy, Sondur and Kharun rivers. The fertility of lands of Dhamtari district can be attributed to the presence of these rivers. Mahanadi originating in the hills of Sihava flows in the direction of north east throughout its length in the district. River Kharun forms part of western boundary of Dhamtari district with Durg district. The tributaries for Sondhur are Sita Nala, Kajal Nala, Bindra Nala and Sukha Nala whereas Sefari, Ama Nala, Pawai and Bagbura Nala directly join with River Mahanadi. The drainage pattern is typically dendritic and is controlled by initial slope. The drainage density is very high in the hilly areas of south and southeast indicating that the infiltration is low. A major irrigation project, named Mahanadi Reservoir Complex Project is constructed on River Mahanadi, 10 kms away from the district headquarter, Dhamtari. The main reservoir, named as Ravishankar Sagar, is spread over an area of 86.52 sq.kms and the gross catchment area of the reservoir is 3700 sq.kms. The live storage capacity of the reservoir is 905 mcm and it caters the irrigation requirement of the district. A well distributed canal network is spread in Dhamtari, Kurud and parts of Magarlod blocks of the district. The major source of irrigation in the district is through canals. Ravishankar Sagar dam irrigates almost 57000 Hectare of land and also acts as a main supply unit of safe drinking water resource for state capital Raipur as well as supply to Bhilai Steel Plant.

Fig. 1: Index Map of Dhamtari District



Around 212554 hectares (52.07%) of the total area is covered by forest. The rest of the land is very fertile and is mostly used for the agriculture purposes with surface irrigation facilities. The net area sown during the year 2012 is around 33% of the total geographical area. Paddy is the main crop (126200 ha) followed by wheat (1062 ha) and then by pulses (3683 ha).

The net sown area in the district in the year 2012 is 134175 hectares. By all the sources the net irrigated area is 104656 ha & gross irrigated area is 135064 ha. The contribution of ground water for irrigation comes to nearly 16.45% of the net irrigated area and 27.68% of the gross irrigated area in the district.

1.0 RAINFALL AND CLIMATE

Dhamtari is endowed with high rainfall. Areas of chronic shortfall are few and localized. The district receives its rainfall mainly from the south-west monsoon which usually sets in the third/fourth week of June and spread over a period from late June to early October with heaviest shower in the months of July and August. The annual average (2004-11) rainfall in the district is 1084mm with 55-65 rainy days and the rainfall is 1061 mm in the year 2011.

Dhamtari district has a sub-tropical wet and dry climate; temperatures remain moderate throughout the year, except from March to June, which can be extremely hot. The highest temperature goes up to 46^{o}C and observed in the months of May and June. Winters last from November to January and are mild and the lowest falls up to 10 °C and observed in the months of December and January. The relative humidity varies from 86 % in rainy season to 30-35 % during winter.

2.0 GEOMORPHOLOGY & SOIL TYPES

Geomorphologically the district is having matured type of land forms and can be broadly divided into two prominent geomorphic units. These are

1. Chhattisgarh plains in the northern part of the district.
2. Bastar plateau in the southern part of the district.

The northern part of the district represents Chhattisgarh plains, with an elevation ranging between 290 and 320 m amsl .The Mahanadi River flows from southwest to northeast direction and divides the plains into two halves. The southern half of the district is predominantly a part of Bastar plateau. This is characterized by hilly tracks and intermediate plateau, flanked by high mounds and hillocks rising to an altitude of 700 meters. The elevation of this region ranges from 400 to700 meters. The slope is towards northeast and northwest thus forming a NNW-SSE trending major surface divide in this region. The main Geomorphological features and landforms developed in the district are Pediplains, Pediments, Residual hills, Structural hills and Flood Plains.

As per the US soil taxonomy three soil types namely Alfisols, Vertisol and Ultisol have been found in the district. The soil orders in US soil taxonomy and their Indian equivalents, which are found in the district, are:

Sl. No.	US soil taxonomy	Indian equivalents
1	Vertisol	Deep black soil
		Light to dark grey soil
2	Ultisol	Lateritic soil
		Red and yellow soil
3	Alfisols	Yellowish to reddish

Vertisols:

They are characterised by a high content of expanding and shrinking clay known as montmorillonite that forms deep cracks in certain seasons. The indian equivalent of Vertisols which are available in the district are deep and medium black & light to dark grey soils. These soils cover maximum parts of Dhamtari and Kurud blocks. These soils are produced through long continued weathering and disintegration of limestone and shales and due to its moderate moisture retention capacity and fertility, suitable for taking double crops.

Ultisols:

The word "Ultisol" is derived from *"ultimate"*, because Ultisols were seen as the ultimate product of continuous weathering of minerals in a humid temperate climate. This is a highly weathered and leached acid soil with high levels of clay below the top layer. They are characterized by a humus-rich surface horizon (the uppermost layer) and by a layer of clay that has migrated below the surface horizon. The indian equivalent of Ultisols which are available in the district are Lateritic soil and covers mostly northeastern & northwestern parts of the district.

Alfisols

About 54% of the district area, mostly in central and southern parts, is covered by yellowish to reddish Alfisols, locally known as 'Dorsa'. These soils are derived from weathering of crystallines and metamorphic rocks.

3.0 GEOLOGY & HYDROGEOLOGY

The district is underlain mainly by three distinct geological formations ranging in age from Achaean to recent. The crystalline basement, occupy major parts of the

district, comprising of granite and granitic rocks belonging to Dongargarh group, severally intruded by the quartz veins and basic dykes. The rocks of Chhattisgarh Super group are unconformably overlying the basement crystalline and are represented by the sandstone, limestone and shale sequence occupying the north central and central part of the district. A thin layer of alluvium / laterite belonging to the Quaternary age occur along the flood planes of major rivers and its tributaries.

The ground water mainly occurs in phreatic (water table) conditions and at places under semi-confined conditions. In granites the weathered thickness varies from 18 to 40 m. and the weathered and fractured formation constitutes the aquifers. Invariably the fractures are limited to a depth of 18 to 170 m. In sedimentary formations the weathered thickness varies from 9 to 33 meters where as the fractured and cavernous formation constitute the aquifers. Invariably the fractures/caverns are limited to a depth of 102-106 m. The hydrogeological map prepared for the district is presented in **Fig.5.**

There are 30 no. of permanent observation wells (National Hydrograph Network Stations); out of which 19 nos are dug wells and 11 no.s are piezometers. These are established in the district to monitor the water levels four times a year and water quality once in a year. The pre-monsoon ground water level in the district **(Fig 2)** varies from 1.72 to 10.92 mbgl with an average value of 6.84 mbgl and the post-monsoon water level **(Fig 3)** varies from 0.71 to 5.29 mbgl with an average of 2.78 mbgl. The water level trend (for 10 years) for pre-monsoon and post-monsoon period have been analyzed and show significant change. The long term water level trend in pre-monsoon period shows significant fall (0.10 to 0.20m/year) in 6.6% of the wells in the district. The water level trend in post-monsoon period shows significant fall in 13.3% of the wells in the district.

Hard rock areas in the district have been proved to be potential aquifers. Under ground water exploration programme Central Ground Water Board has drilled 81 bore wells. These wells in the depth range of 22 to 300 m have yielded 0.5 to 16 lps. The yield of the wells drillied by CGWB in Chhattigarh formation varies from 0.8 to 16 Ips. The transmissivity of these formations ranges from 2.51 to 335.96 m^2/day. Nearly 30% of the exploratory wells drilled by the department yielded less than 1 Ips. About 20% wells recorded yield in the range of 1 to 3 Ips and 10% in the range of 1-5 Ips whereas in the remaining 40 % it was more than 5 Ips.

Fig. 2: Pre-monsoon (May 2012) Depth to Water Level in Dhamtari District

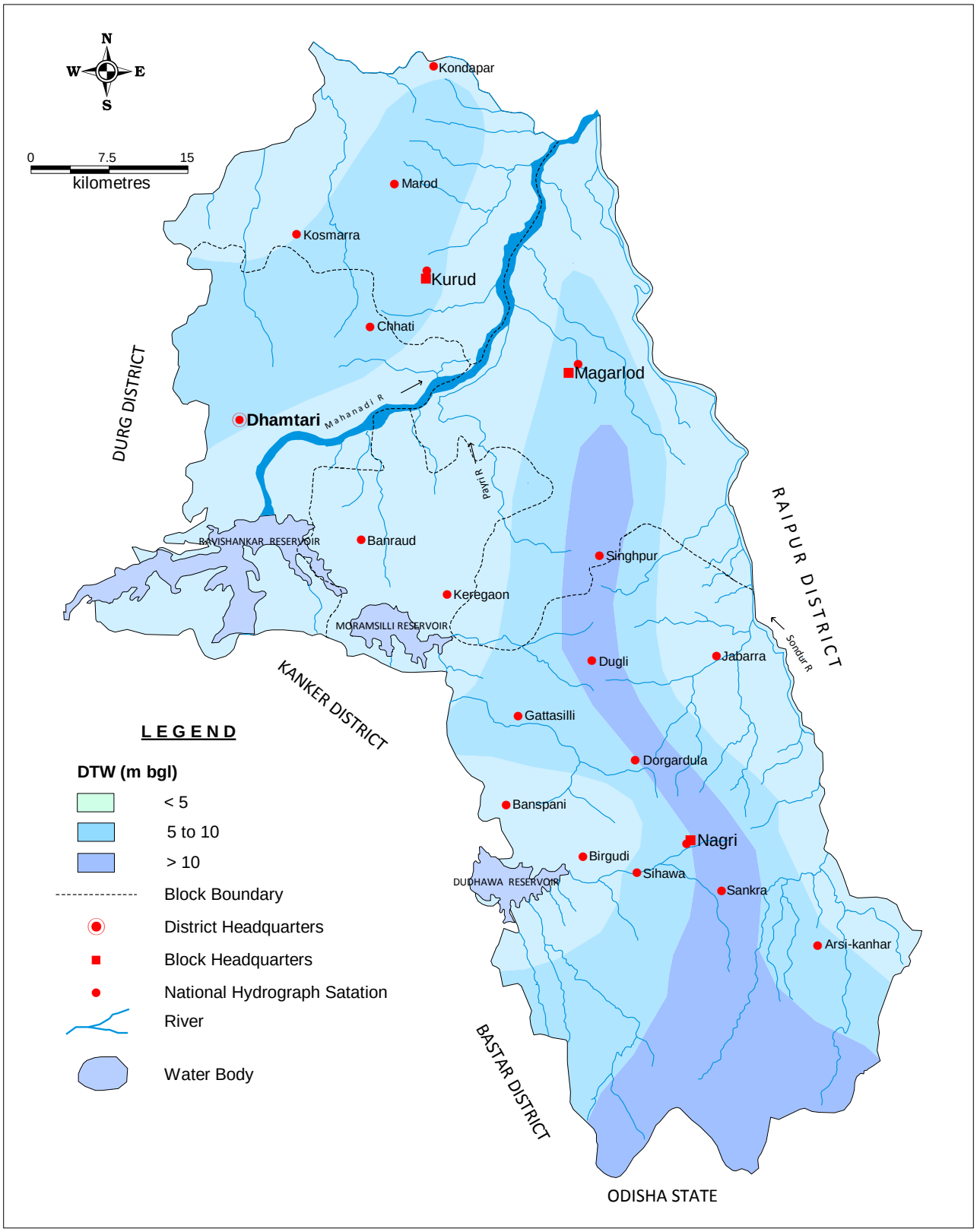
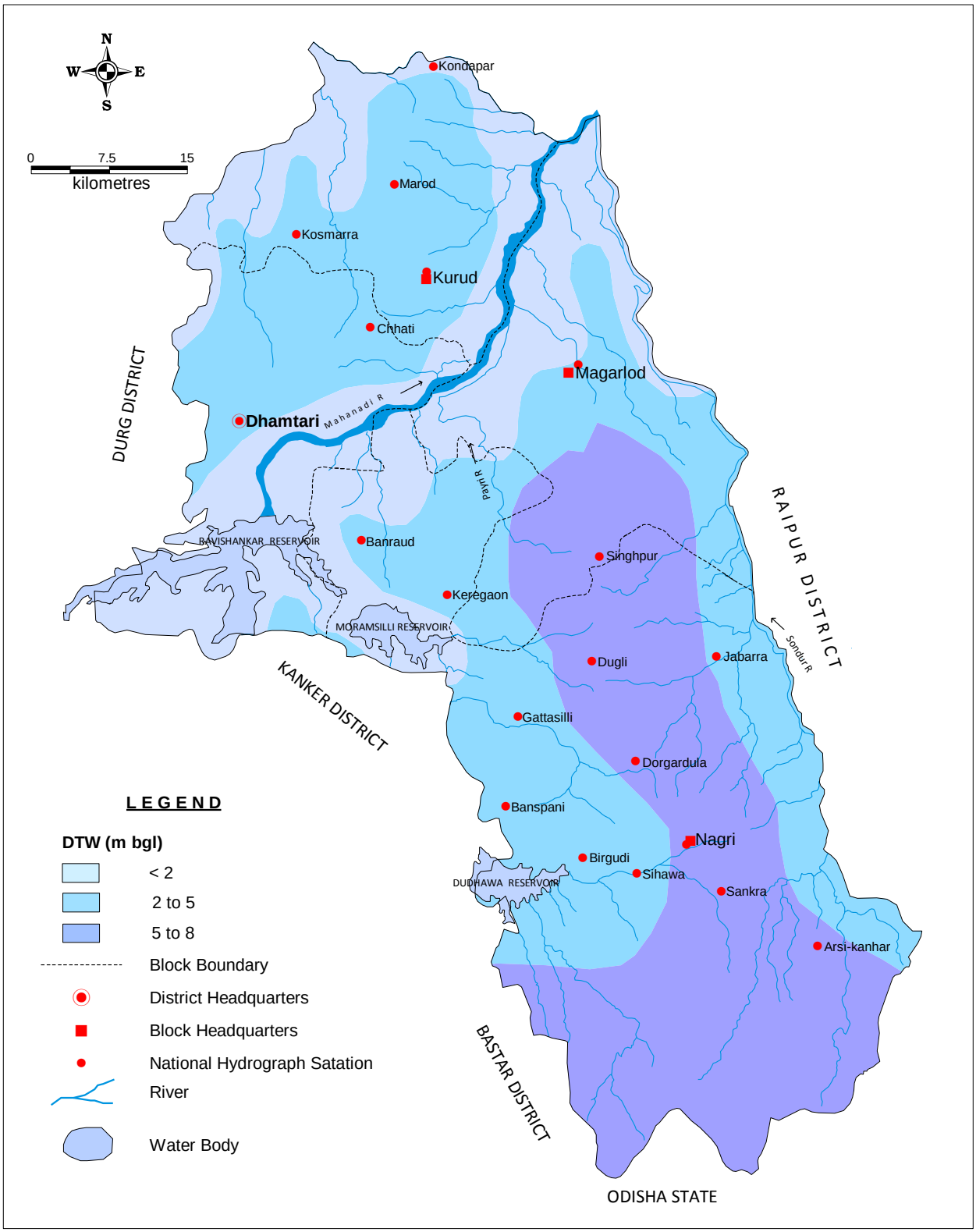


Fig. 3: Post-monsoon (Nov 2012) Depth to Water Level in Dhamtari District



4.0 GROUND WATER RESOURCES

Estimation of Ground Water Resources has been carried out based on the methodology recommended by the Groundwater Estimation Committee (GEC'97). A ground water resource of the entire state has been computed by CGWB (CGWB, NCCR, 2010) for the year 2008-2009. Salient features of the estimation of ground water resources are described below. The present computations pertain to the ground water year 2008-09. The resources have been computed block wise. Areas having slope more than 20 % were excluded from recharge computations. Ground water recharge and draft were computed separately for command and non-command areas.

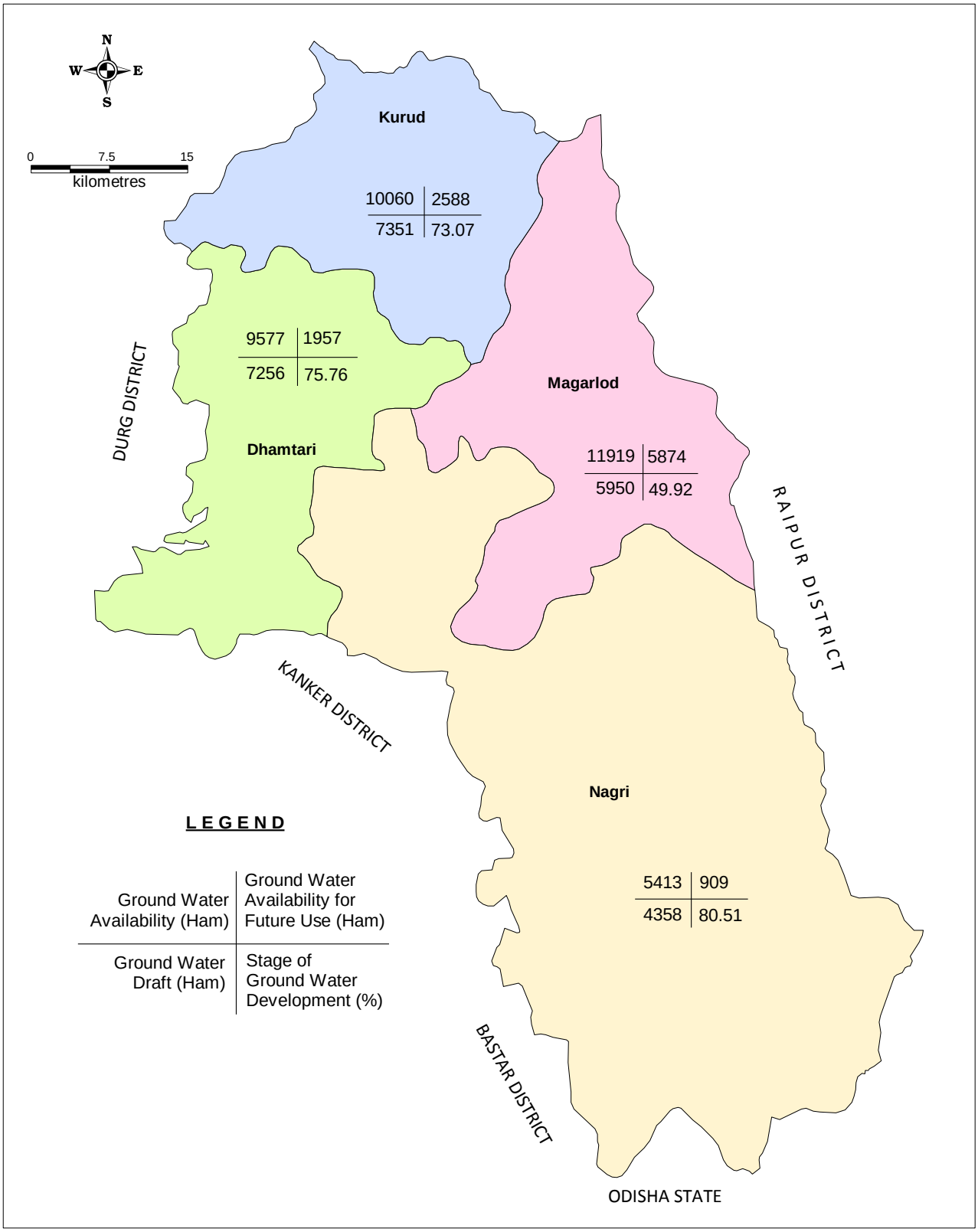
Annual replenishable resource and net ground water availability of the district have been estimated to be 38915 ha m and 36969 ham respectively. Gross ground water draft for all uses in the district is 24915 ham. Average stage of ground water development in the district is 67.39%. Stages of development in the blocks vary from 49.92% in Magarlod to 80.51% in Nagri block. Three out of 4 blocks in the district have been categorised as 'semi-critical'. These are Dhamtari, Kurud and Nagari block. The remaining Magarlod block has been categorised as 'safe'. The stage of ground water development is 80.51% in Nagari, 75.76% in Dhamtari and 73.07% in Kurud block.

5.0 STATUS OF GROUND WATER DEVELOPMENT

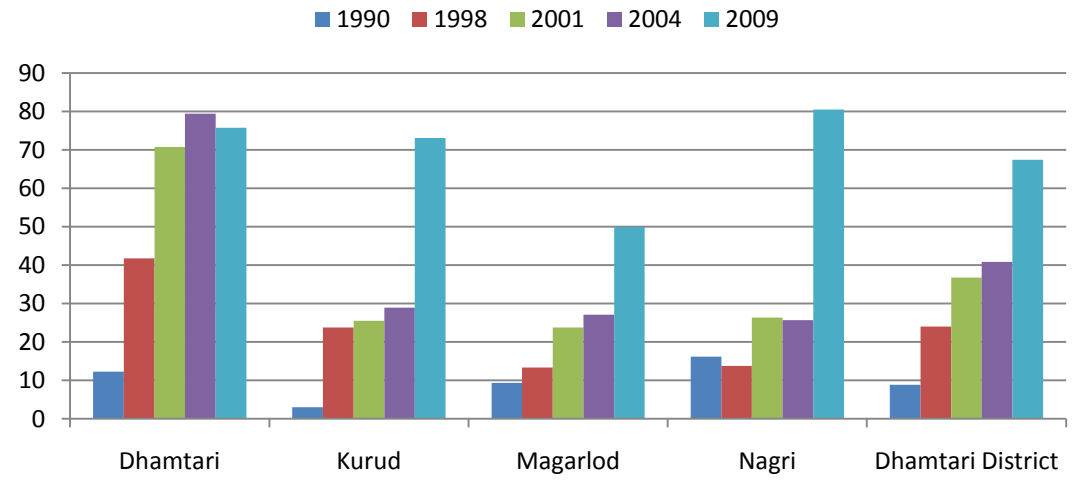
Average stage of ground water development in the district is 67.39%. Stages of development in the blocks vary from 49.92% in Magarlod to 80.51% in Nagari block. Three out of 4 blocks in the district have been categorised as 'semi-critical'. These are Dhamtari, Kurud and Nagari block. The remaining Magarlod block has been categorised as 'safe'. The stage of ground water development is 80.51% in Nagari, 75.76% in .Dhamtari and 73.07% in Kurud block. Potential deeper aquifers exist in the district. Central Ground Water Board has drilled 29 bore wells under the ground water exploration programme. These wells in the depth range of 45 to 150m have yielded 0.5 to 16 lps.

The ground water development in the district is being done by dug wells and borewells. The dug well depth varies from 5 to 20 m and the diameter varies from 2 to 3.5 m. The bore wells drilled by public for different purposes in the area are 60 to 90 m deep with diameter of 100 to 150 mm. Diesel or electric operated pumps of 0.25 to 1 HP or traditional teda is used to lift the water from dug wells for the irrigation purposes. The electrical pump or rope and bucket are used to lift the water for domestic purpose. Submersible electrical pumps of 3 to 5 HP are used for irrigation purpose in case of bore wells in the area. The bore wells in granitic terrain can irrigate an area of 0.5 to 1.5 ha for paddy crops.

Fig. 4: Ground Water Resource Map of Dhamtari District



Ground water is the main source of drinking in the district covering 554 no. of revenue villages. In all 15972 no. of tube wells and 1189 no. of dug wells exist in the district (2011-12). Together they irrigate around 37396 ha. The contribution of ground water for irrigation comes to nearly 16.45% of the net irrigated area and 27.68% of the gross irrigated area in the district. The contribution of ground water for irrigation comes to nearly 27.87% of the net sown area. The use of ground water for irrigation purpose in non-command area is maximum. The ground water development in the district is mainly for domestic and irrigation purposes. The stage of ground water development in the district is of the order of 67.39%. The ground water development is maximum in Nagari block. The gross and net irrigated area by the ground water resources is 37396 ha and 17216 ha respectively. The stage of ground water development of blocks of Dhamtari district in different assessment years is given in following figure.



7.0 GROUND WATER QUALITY

The ground water quality of the samples collected from the National Hydrograph Network Stations (NHNS) has been taken into consideration for assessing the general quality of ground water in the phreatic zone. The average concentration of different parameters analysed for samples collected during the month of May from the year 2000 to 2008 from the NHNS were taken into consideration for the purpose. No quality problem was reported from the district. All the analysed parameters, in all stations fall well within safe limits for drinking as well as irrigation purpose as prescribed by the BIS. The pH value ranges from 6.7 to 8.6 and is within the prescribed limit by BIS. The Electrical Conductivity (EC) value ranges from 66 to 1430 micro siemens/cm (**Fig. 5**). All of the samples have EC value well within the range. The northern part of the district has marginally higher value of EC. The Cl^- varies from 4 mg/l to 220mg/l. The Ca^{+2} values vary from 8 mg/l to 126 mg/l and Mg^{+2} values vary from 2.45 mg/l to 50 mg/l. Almost all the values of the analysed parameters fall under the safe category for both drinking and irrigation purpose. The

overall composition of ground water indicates that it is moderately alkaline and predominantly $CaHC0_3$ type (Calcium bicarbonate type).

8.0 GROUND WATER MANAGEMENT STRATEGY

The ground water in the district is developed mainly for irrigation and domestic needs. The agricultural sector is consuming most of the ground water and since 94% of the net sown area is under paddy, ground water is being used at present mainly to grow paddy. Paddy needs flood irrigation with high crop water requirement. Change in cropping pattern in the district and further efficient use of ground water resource can enhance the productivity as well as area of irrigation.

One out of four blocks in the district have been categorised as 'semi-critical'. i.e Dhamtari blocks. The remaining Kurud ,Nagari and Magarlod block has been categorised as 'safe'. Dhamtari blocks require a proper management of surface and ground water resources. The alluvium covered hard rock areas of the district need suitable techniques to construct ground water abstraction structures so as to increase the yield and sustainability of the structures.

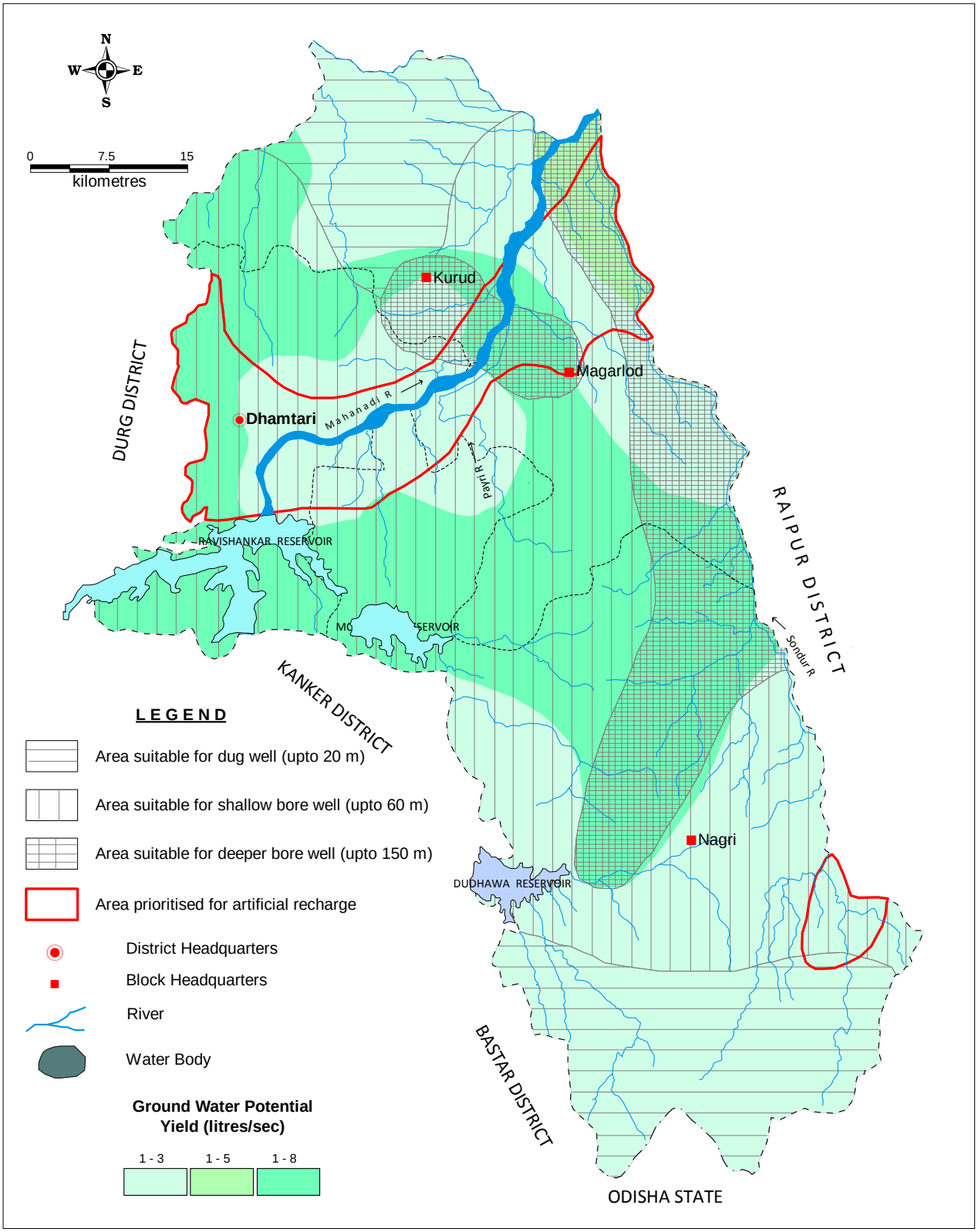
9.0 GROUND WATER RELATED ISSUES & PROBLEMS

Ground water level in the district was monitored in both dug wells and piezometers. As can be seen from the depth to water level map during pre-monsoon period, the water level is found to be deepest in southern parts of the district in and around Sankra. Similarly during post-monsoon period deeper water level is observed in south-eastern & southern parts of the district in and around Singhpur, Jabbara, Birgudi, Sihawa, sankra and Arsi-kanhar area. The deeper water level is occurring in areas where the ground water is being exploited heavily by construction of bore wells for irrigation purpose. Such irrigation bore wells are found in large numbers in the northern and south eastern parts of the district.

10.0 WATER CONSERVATION & ARTIFICIAL RECHARGE

Long term water level trend analysis of the national hydrograph monitoring stations shows a decline of water level in the range of 10 to 20 cm/yr in an area of 644 sq. km. in the district. These areas have been identified for construction of suitable artificial recharge structures for augmenting ground water resources. Decadal average post monsoon depth to water level is considered to estimate the sub surface available storage space for accommodating the recharge water. The decadal post monsoon average depth to water level is predominantly in the range of

Fig. 6: Ground Water Development Potential and Artificial Recharge Prospects in Dhamtari District



6 to 9 m below ground level. A total 2049 mcm volume of unsaturated zone was estimated to be available for recharge.

The suitable artificial recharge structures in the area are gully plugs, gabion structures, percolation tanks, nala bunds in the runoff zones and recharge shafts, gravity head wells in downstream areas. There are two Urban Areas in Dhamtari district, where the roof top rain water harvesting can be adopted for augmenting the ground water resources (**Fig. 6**).

11.0 AWARENESS & TRAINING ACTIVITY

11.1 Mass Awareness Programme (MAP) & Water Management Training Programme (WMTP) by CGWB

So far only one training programs on ground water conservation and artificial recharge has been organized during 2007-08,by Central Ground Water board at district Head Quarter, Dhamtari. Representatives from PHED, State Ground Water Survey dept. and Forest department, NGO's and ground water professionals were trained during this program .

Three mass awareness programme and one water management training programmes were conducted in the district. The details of the programmes are as follows.

Sl. No.	Year	Programme	Venue
1	2007-08	WMTP	Dhamtari
2	2006-07	MAP	Raipur
3	2008-09	MAP	Raipur
4	2010-11	MAP	Raipur

12.0 AREAS NOTIFIED BY CGWA/SGWA

Three of the blocks in the district are categorized as semi-critical from ground water abstraction point of view and none of these blocks of the district has been notified by the CGWA/SGWA for regulation of ground water.

REFERENCE:

1. Ingle V. K.; CGWB, NCCR, Raipur; Ground Water Brochure of Dhamtari District (2008-09); Unpublished Report.

2. CGWB, NCCR, Raipur; Dynamic Ground Water Resource of Chhattisgarh (As on March 2009); Unpublished Report.

3. CGWB, NCCR, Raipur; Dynamic Ground Water Resource of Chhattisgarh (As on March 2004); Unpublished Report.

4. CGWB, NCCR, Raipur; Hydroheology of Chhattisgarh-State Report, 2006; Unpublished Report.

5. CGWB, NCCR, Raipur; Ground Water Exploration of Chhattisgarh-State Report, 2011; Unpublished Report.

6. CGWB, NCCR, Raipur; Master Plan for Artificial Recharge in Chhattsigarh State, 2010, Unpublished Report.

7. Commissioner, Land Records, Chhattisgarh; Agriculture Statistical Tables, 2012, Unpublished Report.

8. http://www.imd.gov.in/section/hydro/distrainfall/chhattisgarh.html

ACKNOWLEDGEMENT

The author is grateful to **Shri Sushil Gupta ,** Chairman, Central Ground Water Board for giving this opportunity for preparation of the 'Ground Water Brochure of Dhamtari district, Chhattisgarh'. The author is thankful to **Shri K. C. Naik,** Regional Director, Central Ground Water Board, NCCR, Raipur for his guidance and constant encouragement for the preparation of this brochure. The author is also thankful to **Shri S. K. Verma,** Sr. Hydrogeologist (Scientist 'C') for his valuable comments and guidance. The help rendered by **Shri V K Ingle** Scientist 'B', (RGNGWT&RI, Raipur) in preparing the brochure is duly acknowledged. The author is also thankful to **Shri B. K. Sahoo,** Sr. Hydrogeologist (Scientist 'C ', RGNGWT&RI, Raipur) for his valuable guidance and help in preparation of the brochure.

Mausumi Sahoo

Scientist 'B'

Fig. 5: Hydrogeological Map of Dhamtari District

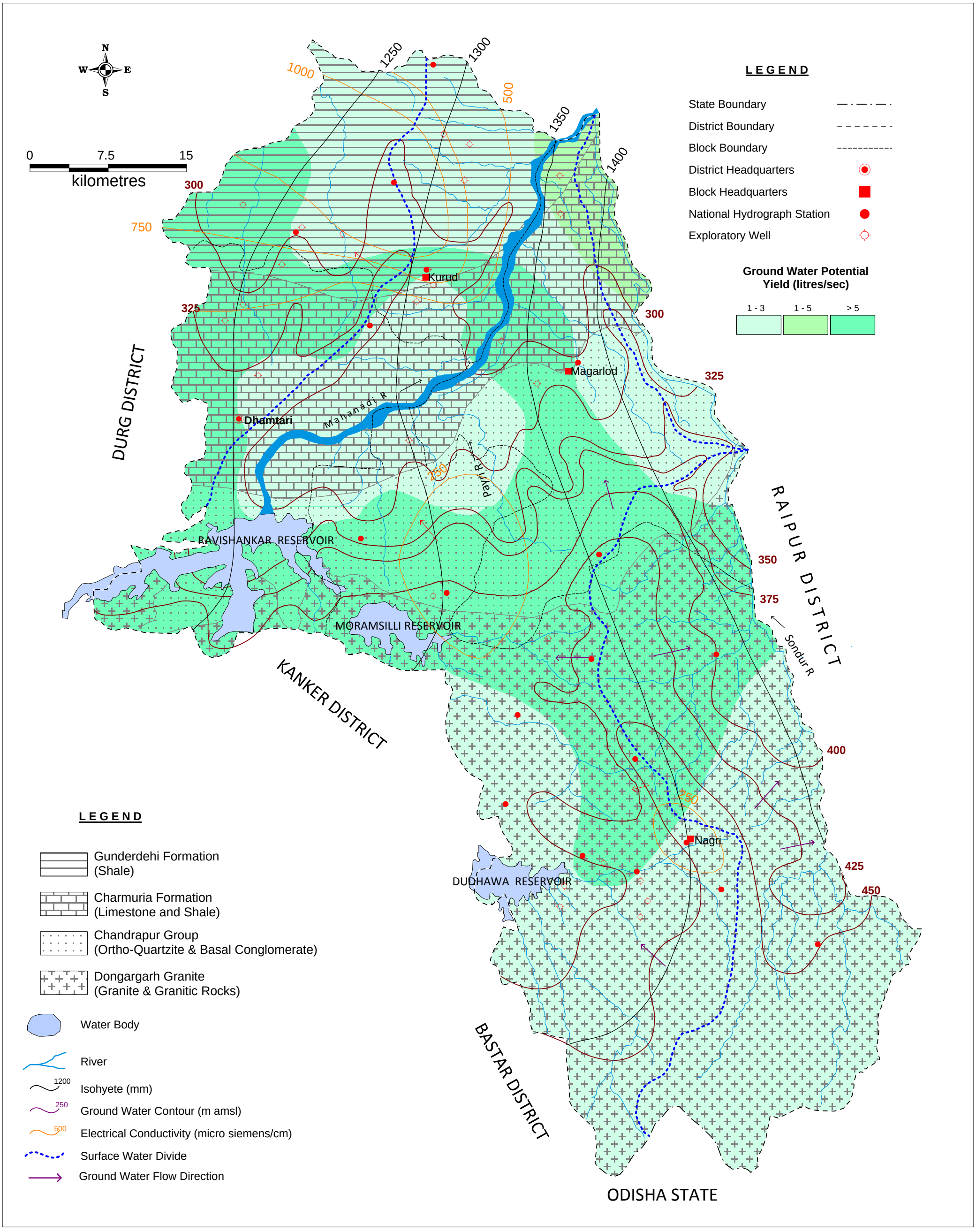


Fig. 6: Ground Water Development Potential and Artificial Recharge Prospects in Dhamtari District