



**GOVT. OF INDIA
MINISTRY OF WATER RESOURCES
CENTRAL GROUND WATER BOARD**

**GROUND WATER BROCHURE
SURGUJA DISTRICT, CHHATTISGARH
2012-13**



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GROUND WATER BROCHURE OF SURGUJA ,CHHATTISGARH

By
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AT A GLANCE

I. General

- | | |
|------------------------------------|---|
| 1. Location | : Located in the extreme north-western corner of the State.
: Long (East): 82°30"10" and 84°04"13"
: Lat (North): 22°38"30" and 24°06"13" |
| 2. Geographical area | : 16034.4 sq.km. |
| 3. Community Development blocks | : 19 no.s |
| 4. Villages | : 1758 no.s |
| 5. Population | : 2361329 As per Census 2011) |
| 6. Average annual rainfall | : 1300 mm |
| 7. Major physiographic unit | : Northern Hilly Region, |
| 8. River Basins and major drainage | : Ganga Basin(covers 82% area)
Major rivers: Kanhar and Rehar
Mahanadi Basin(covers 18% area)
Major rivers :Jhink and Mand |
| 8. Forest area | : Nearly 45.35 % of geographical area |

II. Major Soils

- | | |
|----------------|-----------------------------|
| 1. Alfisols | : Red gravelly/sandy |
| 2. Inceptisols | : Shallow black |
| 3. Ultisols | : Red and yellow, lateritic |

III. Principal crops

- | | |
|--------------|-------------------------|
| Crop seasons | : Two (Kharif and Rabi) |
| 1. Rice | : 311000 ha |
| 2. Pulses | : 15000 ha |
| 3. Gram | : 20000 ha |
| 4. Wheat | : 20000 ha |

IV. Irrigation(2010)

- | | |
|-------------------------|------------------------|
| 1. Net sown area | : 480000 ha |
| 2. Gross irrigated area | : 39000 ha |
| a) Net irrigated are | : 37000 ha |
| a) By dug wells | : 55806 no.s (5849 ha) |
| b) By tube wells | : 938 no.s (1821 ha) |
| c) By tanks/ponds | : 1761 no.s (7529 ha) |
| d) By canals | : 22 no.s (4398 ha) |
| e) By other sources | : 4982 nos 10096 ha |

V. Geology

: Deccan Trap:(Dykes, Sills & Basalt flows)
: Gondwana Supergroup:(Sandstone Shale, clay, siltstone coal seam)
: Chhota Nagpur Complex :
(Granite gneiss, Quartzite & Calc-Silicate rocks)

VI. Hydrogeology

Water bearing formations

: Major formations are porous & fractured Sandstones, Granite gneisses, vesicular Basalts etc.

VII. Ground water monitoring (by CGWB)

- | | |
|-------------------------------|-----------|
| 1. No. of monitoring stations | : 93 no.s |
| a) Dug wells | : 73 no.s |
| b) Piezometers | : 20 no.s |

VIII. Ground water exploration (by CGWB)

- | | |
|-------------------------------|------------------------------------|
| 1. Total no. of wells drilled | : 106 no.s |
| a) Exploratory wells | : 67 no.s |
| b) Observation wells | : 24 no.s |
| c) Piezometers | : 15 no.s |
| 2. Depth range | : 60 to 320 mbgl |
| 3. Discharge | : 0.45 to 12 lps |
| 4. Transmissivity | : 11.0 to 159 m ² /day |
| 5. Storativity | : 0.007 to 2.25 x 10 ⁻⁶ |

IX. Ground water quality : potable

X. Ground water resources (As on March 2009)

- | | |
|--------------------------------------|-----------------|
| 1. Annual available resources | : 156932.37 ham |
| 2. Ground water draft | : 40166.28ham |
| 3. Stage of ground water development | : 25.59% |

XI. Ground water control and regulation: Nil (No critical/ notified/ Overexploited area)

XII. Major ground water problems and issues : Nil

GROUND WATER BROCHURE OF SURGUJA, CHHATTISGARH

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1.0 INTRODUCTION:

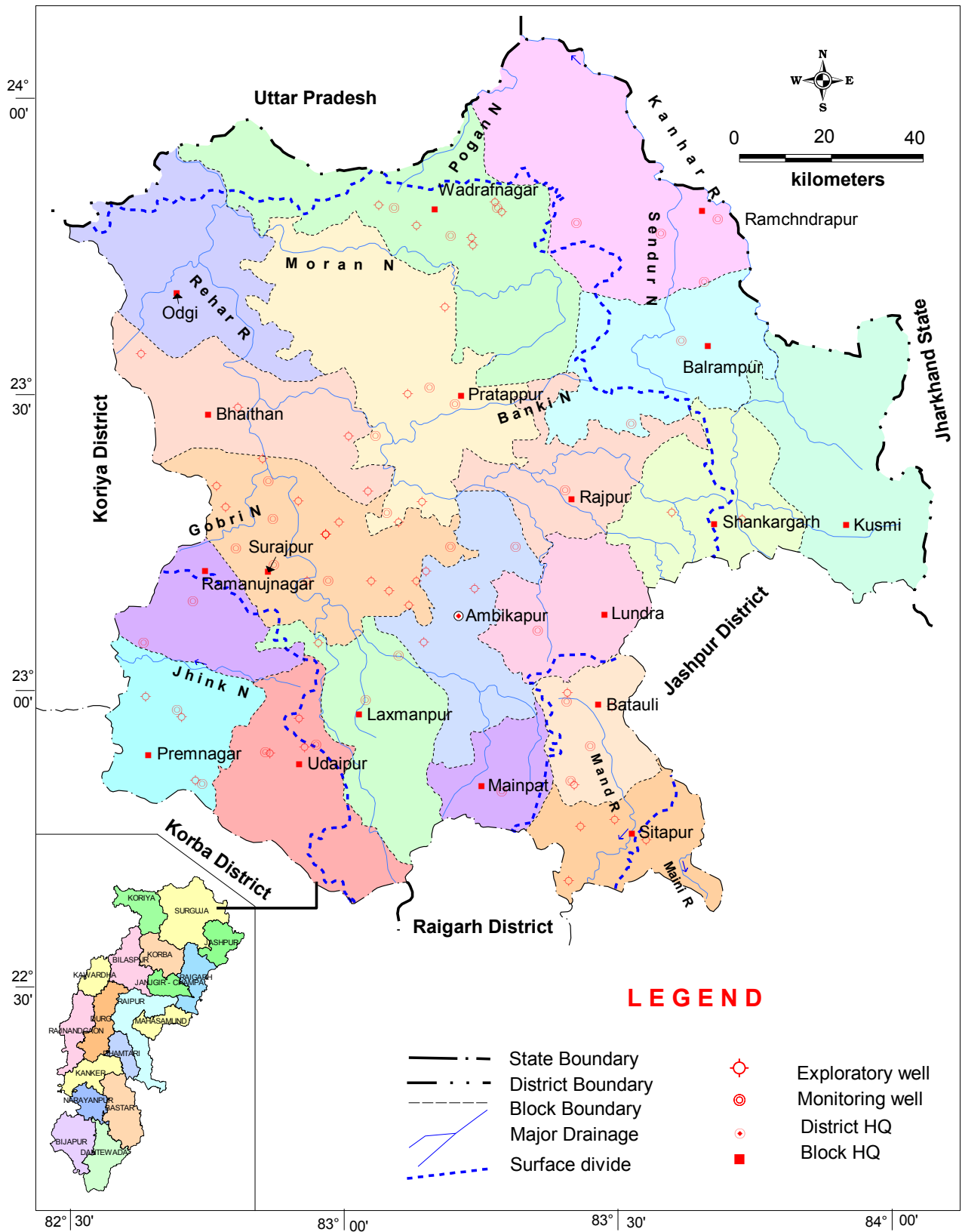
The Surguja District covers an area of 16034.4 sq.km. It consists of 1758 no. of villages. For administrative convenience these villages are grouped into 19 no. of community development blocks. Ambikapur is the district headquarters. The block headquarters are Ambikapur, Lakhanpur Udaipur, Rajpur, Lundra, Sitapur, Batauli, Mainpat, Surajpur, Premnagar, Ramanujnagar, Bhaiyathan, Odagi, Wadrafnagar, Pratappur, Ramchandrapur, Balrampur, Kusami and Shankargarh. Nearly 45.35 % of the total geographical area of the District is covered by forest. The District is known for its forest product and coal mining. **Fig 1** shows the location of the area along with drainage, block headquarters, Network Hydrograph Stations and location of exploratory wells established and drilled by Central Ground Water Board in the District respectively.

Physiographically the District is a part of Northern Hills and characterized by undulating topography with high hills, dissected plateaus, steep slopes and scarps. The Basaltic terrain is characterized by highly undulating topography with steep hills and plateau tops. The plateaus and ridges in the area are of 600 m amsl. The maximum elevation observed for hilly areas is 1025 m amsl and is at the central part of the District namely the Devgarh peak. The lowest elevation is 380 m amsl and is along the Banas river, which is on the northwestern part of the District. The District can be broadly divided into two major river basins. The Ganga basin and the Mahanadi basin. The Ganga basin covers 82 % of the area however the remaining area is drained by the Mahanadi basin. The Hasdeo, Gej and Mian flow towards South and their valleys occupy small areas in the south and southeastern parts of the District. The northward flowing rivers join the Sone and ultimately drain into the Ganga river, while south ward flowing rivers drain into the Mahanadi river. The drainage pattern in the District is dendritic to sub-dendritic and the drainage density is high in central and southern parts.

The agricultural activities in Surguja District are still dependent on the vagaries of monsoon. Surface and ground water irrigation aims at making good of the deficiency of crop requirements caused by poor rainfall in Kharif season and also for increasing the double cropped area. The main sources of irrigation in the District are lift irrigation schemes with canals, wells and surface water tanks.

There is no major irrigation/project in the District, and all existing (completed) and ongoing schemes belong to medium and minor categories. Ground water irrigation also plays an important role in agricultural activities and an area of about 7770 ha. is irrigated by ground water irrigation by means of bore well/dug well. in the District and thus constitutes 21.0% of the total area irrigated. The average annual rainfall received is 1300 m.m. The rainfall increases from North West towards the southeast and ranges

Fig 1 Index map of the Surguja district.



from 1344.4 mm at Ramanjagar to 1657.6 m.m. at Ambikapur. About 87% of the annual rainfall is received during June to September, July and August are the months of maximum precipitation, some rainfall is received in June, mostly in the form of thunder showers and during the cold season in association with passing western disturbances. There are on an average 73 rainy days in a year in the District. This number varies from 64 at Ramanjagar to 78 at Ambikapur . The heaviest rainfall in 24 years recorded at any station in the District was 341.6 m.m at Ambikapur on 27.6.1948. The annual temperature varies from 10°C in winter to 40°C in summer. The relative humidity varies from 75% in rainy season to 30-40% during winter.

The soils in the District are having wide variations. In all three types of soils exist in the District and are mostly insitu in nature. Most of the area is covered by Red gravelly/ sandy Alfisols. It occurs over the Suprabarakars (Mahadeva/ Suprapanchet/ Parsora formation) in the area. The Shallow black Inceptisols are present over the Panchet and the Barakar formations. The Red and yellow Ultisols rich in iron oxide occur on the Upper Pali and the Mahadeva/ Suprapanchet/ Parsora formations.

2.0 GEOLOGY

2.1 Basement crystalline: The Archean rocks mainly comprising of gneisses, granite, schist and quartzite occupying the northern portion of the District The porphyritic gneiss is pink in coloured and contains phynocrysts in the area. The gneisses exhibit banded structure. The granite of the area comprise of quartz, felspar and biotite. The weathering of these rocks shows biotite altering to chlorite. It is observed that the weathering of these rocks varies to a depth range of 5 to 30 mbgl.

So far a total of 37 no.of exploratory wells have been drilled in this group of rocks. The depth of bore wells drilled in this rock types varies from 106-151 mbgl. The casing length inserted varies from 8.6 to 24.35 m, which also represents the weathered thickness in this formation. Generally the weathered zone is immediately followed by fractures. Within a depth range of 9 to 146 m, only 2-4 fracture zones were encountered. The discharge varies from 0.62 to 3 lps and the maximum drawdown was 30.06 m. The static water level is varying between 2.53 mbgl and 10 mbgl

2.2 Gondwana Super Group:

i) Talchirs: Talchir rock formations unconformably overlies the metamorphics and granites rocks , comprises boulder bed, sandstone , shale and tillite. The sandstone is fine grained, yellow and pale olive in colour white shale's are yellow or olive green and well laminated. Good out- crops of Talchirs are found at Bishrampur and Ramgopala Coal fields. The unevenness of the basement causes variation in thickness of Talchirs formation and occurrence of inliers also. Excellent sections of Talchirs strata are exposed along the course of Mahan and Banki rivers. Conglomerate, feldspathic and gritty sandstone and shales with thin seams of coal belonging to Karharari formation lie conformably on the Talchirs. Shale and sandstone contain plant fossils which are best exposed in the Ramgopala Bishrampur coal field and garuamuda nala, 1.6 km north west of Ganeshpur 24° 25': 83°12'). Talchir formation is formed poor yielding aquifer.

ii) Barakars: The formation comprises sandstone which are bedded massive, highly feldspathic and interbedded with shales and coal seams. The Barakars are also found at places and to rest directly over the Archaeans. The rocks cover a large area in the District in Ramgopala and Bishrampur Coal field south west of Bulga near Chandra. The formation also covers large areas around Songara ($23^{\circ}17''$: $83^{\circ}6''$), Markadand ($23^{\circ}22''$: $83^{\circ}18''$), Barthi ($23^{\circ}40''$: $83^{\circ}14''$), Giddi ($23^{\circ}47''$: $83^{\circ}34''$) etc. A few outliers of hard bedded sandstones overlie the Barakars comprising hard gritty arkosic sandstone and pebbles of quartzitic these formation are known as supra Baraker formation are exposed in Ramgarh hill (975 mts. amsl). Exploratory drilling has brought out the fact that the lower unit of Barakar and suprabarakar formations is more productive, potential aquifer encountered below 150 mbgl.

iii) Kamthi: the Kamthi formation comprises feldspathic sandstone with ferruginous and argillaceous matter and has great thickness in Karanjia Pahar (820 mts amsl). Because of the similarity in lithology it is difficult to separate the Kamthis from the Supra Barakars of Barakars. The Kamthis are also found on the western and North -western part of Mainpat. Kamthi formations are more productive aquifer.

iv) Raniganj: This formation occurs over a small area near Bapatia ($23^{\circ}37''$: $83^{\circ}2''$) Narola ($23^{\circ}39''$: $83^{\circ}9''$) and Thurkunda ($23^{\circ}50''$: $83^{\circ}22''$) of felspar and biotite. Biotite gneiss hornblende gneiss, Aegean gneiss are mostly exposed

v) Mahadeva: Highly ferruginous and reddish brown and yellowish, hard and compact medium grained, bedded sandstone is the characteristic of this formation. This formation is exposed at Jobepahar 692 m). Mahadevas extends over large areas in Surajpur tehsil. The formation is exposed around Chatonda ($23^{\circ}46''$: $82^{\circ}08''$). Ramgarh ($23^{\circ}40''$: $30^{\circ}31''$), Wadraf Nagar ($23^{\circ}45''$: $83^{\circ}13''$) etc. A large area is covered by Gondwanas formation in the District around Surajpur, Ramanujganj and Ambikapur tehsils. Minerals in the gondwanas supergroup are clay, coal, iron ore and others etc. The Depth of exploratory wells varies from 80.45 to 413.50 mbgl with discharge in the range of 0.3 lps to 10 lps. More than 80% of the zones encountered are of granular formation i.e. sandstone which is arenaceous in nature

Shale bands varying in thickness from less than a meter to about 30 meters are also encountered in the boreholes. Clay horizons ranging in thickness upto 117.0 meters are also encountered at places. Coal seams of less than two meters to as much as 26 meters in thickness are also encountered, Geological map of the district is presented in fig.5

2.3 Infratrappeans:

Lametas: Unconformably overlying gondwanas are the sedimentary rocks of Lameta formation which include medium grained sandstone, ferruginous- shale and cherts. These rocks are exposed at an altitude of 835 mamsl in Mahesh Pahar and Anil (911.29 m.amsl) and occur on the fringes of Deccan Traps especially at Mainpat, Samripat and Jamirapat plateaus.

2.4 Deccan Traps:

The Deccan Traps are younger than lametas (infratrappeans) and at places directly overlie the Archaean granite gneisses. These comprise layered basaltic lava flows, which are known as Deccan Trap, due to their step like structure. These basalts are melanocratic, dense hard, medium grained composed of feldspar augite hornblende, quartz, etc. These rocks occur near and at Jaranpat, Jamurapat, Lahsunpat and hillocks south of Rehra ($23^{\circ}16''$: $83^{\circ}48''$). Basic intrusives or dykes of dolerite, etc are seen exposed at a number of places in Gondwana formation. They are exposed near Bonga and Mahewa area. A 115 metres to 136 m thick basic sill popularly known as Korea sill occurs in Sonhat, Jhilmilli coal basins. The lower parts of the flows are sandstones form prominent hill ranges viz Bijlimana Pahar (583 mt). Barpahar (549 m) generally massive, hard and compact in nature. The upper part of each flow is vesicular and comprises rounded to oval shaped vesicles, which are generally filled with zeolites, calcites or quartz.

Pleistocene to Recent Formations: Laterites of Pleistocene and Recent age occur over large areas of this District as capping on formations like Gondwana, Traps, Lametas and Archaean. They are seen in high areas of Mainpat, Jaranpat, Lahsumpat, Jainira-pat etc. They are mostly ferruginous in nature (at places aluminous) and due to concentration of aluminous material deposits of Bauxite are formed at localised places. Thickness of laterite over archaean is upto 30 meters around Askala ($23^{\circ}40''$: $83^{\circ}23''$), Bargidih etc. Alluvium as patches occur along river course at a number of places comprising gravels, sands, calc-tufa, and fine silty deposits with layers of pebbles derived from the neighbouring rocks. At places the alluvium is 25 to 30 meters thick.

3.0 HYDROGEOLOGY

3.1 Aquifer System:

Ground water in the district occurs under phreatic, semi confined and confined conditions. It is controlled by the local topography, drainage, lithology and disposition of structural features like fractures and joints. Similarly medium to coarse-grained sandstone forms good aquifers in which movement of ground water is controlled by inter-granular porosity. Basic dykes, and sills traversing the basement crystalline and gondwana formations also play significant role in sub-surface movement of groundwater. As such the aquifer system in the district constitutes two type aquifers.

3.2 Aquifer Parameters and Well Design:

The aquifer parameters and the hydrogeological properties of the different lithological formations in the district are described as follows. The hydrogeology of the area is shown in **Fig.5**.

(a) Achaean: The Achaean group of rocks are exposed in the eastern part of the district and also as minor patches in south central parts over an area of about total 7150 Sq.km. Ground water generally occurs under phreatic conditions in the weathered,

jointed and fractured zones, ranging thickness from 10-40 meters. Archaeans exposed in large parts of Ambikapur, Semri and Ramanujganj blocks are hard and compact and poorly permeable rocks. Gneisses and granodiorites are susceptible to weathering and have weathered, jointed and fractured zones extending about 15 to 25 mbgl. The phyllites and schists are moderately permeable and the occurrence of groundwater in them is dependent on the intensity of fractures and development of weathered zone. Impervious bands of siliceous phyllites with vertical foliation at places acts as sub-surface barrier for ground water movements. Sites having such disposition are suitable for ground water development on its upstream side.

(b) Gondwans : Gondwanas rock occur about 7650 Sq.km area of the district and comprise thick beds of sandstone, shale's, clays and coal seams. Sandstones having felsdpathic composition and medium to coarse grained, it is then porous and permeable and forms good aquifers. Sandstone having siliceous matrix behave like impervious hard rocks. Shales are fine grained, compact and though porous lack in permeability and so do not form good aquifers.

Among Gondwana formation the Barakar and Suprabarakar sandstones are the most important water bearing formations. They occupy about 4600-sqkm areas in the district and occur in western half in central, northern and southern parts of the district. These sandstones are medium to coarse-grained felsdpathic and highly porous and permeable. The intergranular pore spaces, joints and fractures control ground water movement in them. Shale beds behave as confining layers and help to form different aquifer systems. The ground water occurs under phreatic, semi confined and confined conditions. Talchir sandstone which is very fine- grained and compact yield comparatively less ground water.

Ground water is extracted by dug wells and tubewells for domestic and irrigation purposes. Shallow dug wells in the depth range 5-20 mbgl tapping Barakar sandstones can give a yield range of 25 to 15 m³/day. The depth to water level in these wells ranges from 4 to 16 mbgl.

A number of tubewells have been constructed in Barakar sandstone formation upto the depths ranging from 75 to 320 mbgl. The yield of these tubewells ranges from 16-25 m³ per hour.

(c) Lameta Formation: The infratrappeans, which uncoformably overlie Gondwanas and Archaeans, are represented by medium grained sandstone and limestone. The formation occurs over small area in widely separated patches. The rocks have low arenaceous and more calcareous in nature. Sandstones are hard and compact and well jointed and fractured and hence act as good aquifers with solution cavities in limestone. Groundwater generally occurs under water table condition and dug wells tapping lametas in areas of lower elevations yield upto 5 m³/ hr discharge.

(d) Deccan Traps: Deccan trap basalts occur in patches in northern and southern parts over about 304 Sq.km area. Ground water occurs in weathered zone, joints and fracture and vesicular zones under both phreatic and semi-confined conditions. Semi confined conditions are observed in interflow zones at shallow depths, whereas confined

conditions are observed in the interflow zones at deeper depth. The bottom of each flow is massive, hard and compact in nature and the overlying vesicular basalt comprise rounded to oval shaped vesicles which are filled in by secondary minerals like quartz, calcite and zeolites. Thickness of vesicular horizon is limited. It is observed that ground water in Deccan Traps occur in

- (i). Weathered loose morrum like material in upper weathered zone.
- (ii). Weathered ambygadaliodal basalts in each flow.
- (iii). Exfoliated weathered zones covered by flows with columnar joints.
- (iv). Fractured massive basalt, dykes etc.

The shallow aquifers are tapped by open wells of depth range of 8 to 25 mbgl. in which depth to water level range from 1.5 to 21.0 mbgl. The yield of shallow dug wells ranges from 20 to 100 m³/day, while those wells located in topographic lows near the confluences of streams or at intersection of fractures often yields from 50 to 150 m³/day.

The borewells tapping interflow zones between 60 to 100 mbgl have piezometric head ranges from 15 to 25 mbgl. The yield of shallow/ deep boreholes depends on the thickness of vesicular and jointed horizons and it's inter connection with the overlying recharge zone and ranges from 5-to 35 m³/per hour.

(e) Alluvium and Laterite : The soft unconsolidated and semi consolidated sediments comprising gravel, sand, silt and clay occur in proximity of the drainage channels which include the major and minor rivers and streams. The thickness of alluvium ranges from 20 to 30 meters.

Laterites capping on the top of Deccan trap and basement crystalline are seen in plateau areas. The capping are porous, permeable and thickness ranges from 1-5 meters. Laterite forms good and high yielding aquifers in low-lying areas. The depth of dug wells range from 5 to 21 mbgl. The yield of shallow dugwells in laterite varies from 40 to 60-m³/ day. The depth of tube wells ranges from 60 to 100 m and their yield varies from 30 to 70 m³/day.

C.G.W.B. has drilled 67 exploratory boreholes and constructed tubewells for determining hydrogeological behaviour of different litho units of Gondwans formation. The PHED State Department has drilled about 5000 bore- wells in the entire district, which are fitted with hand pumps for water supply. Tubewells of 50 to 300 m depth (CGWB and PHED) show that ground water in Gondwanas occur under semi confined to confined conditions. Gondwana formation comprises alternate layers of sandstone beds and shale and clay beds sequence with coal seams, forming multiple aquifer system. Shale beds form confining layers. The thickness of individual aquifers may vary from few meters to as much as 28 meters. The recharge to the deep aquifers takes place from leakage of phreatic aquifers or through interconnected aquifer system. The discharges from the multiple aquifers in the Gondwana formation range from 10-50 m³/hr.

3.3 Depth to Water Level:

Water levels of representative dugwells (NHS) are being monitored in the district. The distribution of these NHS in district is given in **fig 1**. The depth of these dugwells varies from 7 to 22 mbgl and their diameter varies from 1.8 m to 4.94 m. The frequency of monitoring of water level is four times in a year i.e. January, May, August and November. The depth to water level in Pre-monsoon has been monitored during May-12 for the area. Pre-monsoon DTW map of phreatic aquifer (**fig 2**) show maximum area falls under 5-10 mbgl followed by 3-5 mbgl, 0-3mbgl. Water level > 10 mbgl, has been observed in few wells and are distributed in isolated manner in Mainpur, Sitapur, Premnagar and Surajpur blocks. The post monsoon levels of dug wells were collected during November 12. Post monsoon DTW map of phreatic aquifer (**Fig 3**) shows that during this period maximum area falls under 3-5 mbgl followed by 0-3 mbgl and >5 mbgl.

3.4. Water Level Fluctuation:

Magnitude of water level fluctuations between pre and post monsoon periods is shown that fluctuation of water level was recorded in Kamleshwarpur (18.0 m), which is located at surface water divide between Mahanadi and Ganga basin in Deccan trap formation. Lowest fluctuation value was of 0.9 m. recorded at Laxmanpur which is situated in Barakar formation.

3.5 Long term Trend Analysis of Water Level :

The CGWB is maintaining water level data since 1976, to study the changes in resources and trend of rise or fall in water levels of phreatic aquifer. Average water level fluctuation in the existing network of hydrograph stations for a period of 10 years from 2003 – 2012 were considered in this report. The long-term average water table fluctuation (2003 – 2012) in the district. The data shows that there is a fall in water level except in the north western and south eastern parts of the district in Ganga and mahanadi basins respectively, number of dug wells have gone dry due to over development in the area, where a rise in water level was observed in some isolated patches. In Surguja district a general rise in water level from 0 to 2 m. and at places upto 4m, was recorded in Ganga basin.

4.0 GROUND WATER EXPLORATION

Ground Water exploration in Surguja District was first taken up during 1988-89 by deploying DR/WBCO-31 rig which was continued during 95-96. The drilling sites were identified on the basis of earlier systematic studies, preliminary hydrogeological investigations and surface geophysical surveys carried out for delineating the orientation of fracture zones, depth of weathered mantle and ground water movement in hard rocks. The pinpointing of the sites for drilling was finalized keeping in view the requirement of the state authorities. The drilling was done with the target depth of 350 m. Density of one borehole per 250 sq.km (Gondwana formation) has been contemplated. till March 1996, a total of 30 Exploratory bore wells (Tube wells) and 15 observations wells were drilled in Gondwana formation in Surguja District.

Surguja District, like some other District of Chhattisgarh, experienced a moderate drought situation in the year 2000 because of poor monsoon which was less than 27% of the normal rainfall. The Central Government under the scheme of “Assistance to Drought Affected States” drew a contingency plan for drought proofing by construction of Sanctuary wells that could be used during the period of drought as crisis management measure, mainly for drinking needs. 20 numbers of exploratory borewells were drilled through outsourcing in 2001-2002 for providing drinking water to the rural population of Surguja District under the 'accelerated exploration drilling programme' during AAP 2001- 2002.

For determination of a aquifer parameters of deeper aquifer system of the hard rock Central Ground Water Board again took up exploratory drilling programme under F.S.P. 2008-09 and 2009-10 and 17 exploratory wells and 12 observation wells have been constructed.

So far 106 bore wells (67 exploratory wells, 24 observation wells under exploratory drilling programme and 15 piezometers under „Hydrology Project”) have been drilled in Surguja District (**Fig-1**). The status of borewells drilled in each block of the District is shown in **Table 1**. Based on the information collected during exploration a potential map has been prepared for the District. (**Fig 6**).

Table-1 The status of borewells drilled in each block of the District				
S.No	Block	Gondwana fm	Basement crystalline	Total
1	Ambikapur	3	3	6
2	Lakhanpur	2	3	5
3	Udaipur	2	2	4
4	Ramchandrapur		2	2
5	Balrampur		2	2
6	Kushmi			
7	Shankargarh		2	2
8	Surajpur	10	4	14
9	Odgi		2	2
10	Bhaiyathan	1	1	2
11	Ramanujnagar	1		1
12	Premnagar			
13	Sitapur		3	3
14	Batauli		6	6
15	Mainpat			
16	Pratappur	5		5
17	Lundra		3	3
18	Wadraf Nagar	6		6
19	Rajpur		4	4
	Total	30	37	67

4.1 Salient features of exploratory drilling

The status of exploratory borewells drilled in each formation and their depth range, zone encountered and discharge variation is tabulated in **Table 2** and is discussed below in detail.

Formation	No of Bore wells drilled	Depth Range (m.bgl)	Casing pipe lowered in m	Discharge in Ips	Draw down m	Transmissivity m2/day	Specific Capacity lpm/m
Gondwana fm	30	56.75 – 228.62	9.32 – 50.75	2.68 - 18	5.97 – 26.55	8.5 - 396	17.40 – 134.24
Basement Granite	37	152 – 300.62	6 – 16.5	0.5 – 2.1		0.4 – 5	-

The Geology of the District and yield potential is shown in **Figure.5** .

5.0 GROUND WATER RESOURCE

The ground water resources for Surguja District has been estimated based on the GEC“1997 methodology as on March year 2009. The estimates indicate that the annual replenishable ground water resource for the District is **165191.96** ham. The net annual ground water availability is **156932.37** ham. The gross annual draft has been estimated as **40166.28** ham and out of which, the draft for irrigation is **35282.58 ham** and for domestic purpose is **4883.7 ham**.Ground water resources given in table 3

Assessment Unit / Block	Total Annual Recharge in Ham	Net Ground Water Availability in Ham	Existing Gross Ground Water Draft for Irrigation in Ham	Existing Gross Ground Water Draft for Domestic & Industrial Water Supply in Ham	Existing Gross Ground Water Draft for All Uses in Ham	Allocation For Domestic & Industrial Water Supply in Ham	Net Ground Water Availability for Future Irrigation Development in Ham	Stage of Ground Water Development in %
Ambikapur	9203.21	8743.05	3056.1	457.18	3513.28	574.09	5112.86	40.18
Balrampur	10758.93	10220.99	971.7	229	1200.7	322.44	8926.85	11.75
Batouli	7274.37	6910.65	934	149.45	1083.45	196.99	5779.66	15.68
Bhaiyathan	5149.57	4892.09	2913.78	293.7	3207.48	392.21	1586.1	65.56
Kusmi	9229.08	8767.63	857.8	230.34	1088.14	297.21	7612.62	12.41

Lakhanpur	5673.09	5389.43	1515.8	252.43	1768.23	344.77	3528.86	32.81
Lundra	10199.18	9689.22	1127.6	254.44	1382.04	345.18	8216.44	14.26
Mainpot	2840.58	2698.55	675.13	166.49	841.62	229.75	1793.67	31.19
Odgi	14509.34	13783.87	1509.88	179.6	1689.48	247.94	12026.05	12.26
Pratappur	8311.63	7896.05	2858.5	319.81	3178.31	467.82	4569.73	40.25
Prem Nagar	10063.47	9560.3	1719	135.28	1854.28	189.37	7651.93	19.4
Rajpur	6591.54	6261.97	1583.34	226.97	1810.31	318.31	4360.32	28.91
Ramanuj Nagar	9382.64	8913.5	2898.27	259.48	3157.75	355.33	5659.9	35.43
Ramanujgang	12032.94	11431.29	1196.41	336.25	1532.66	529.34	9705.54	13.41
Shankargarh	5871.03	5577.48	1072.8	151.38	1224.18	194.28	4310.4	21.95
Sitapur	5345.9	5078.61	1245.9	287.78	1533.68	671.77	3160.94	30.2
Surajpur	10450.81	9928.27	4681.1	443.62	5124.72	655	4592.17	51.62
Udaipur	9373.62	8904.94	1995.9	169.28	2165.18	237.85	6671.19	24.31
Wadrafanagar	12931.03	12284.48	2469.57	341.22	2810.79	501.56	9313.35	22.88
District	165191.96	156932.37	35282.58	4883.7	40166.28	7071.21	114578.58	25.59

6.0 GROUND WATER DEVELOPMENT

The ground water development in the District is being done by dug wells and bore wells. The dug well depth varies from 5 to 14 m and the diameter varies from 1 to 4 m. The bore wells drilled in the area are 60 to 75 m deep with diameter of 100 to 150 mm. Diesel or electric operated pumps of 1 to 5 HP or traditional teda is used to lift the water from dug wells for irrigation purposes. The electric 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 the area can irrigate an area of 0.5 to 1.5 ha for paddy.

Ground water is the main source of drinking in the District. In all 4817 no. of bore wells and 2960 no. of dug wells exist in the District (2012). Together they irrigate around 8296 ha. The contribution of ground water for irrigation comes to nearly 22 % in the District. The use of ground water in non-command area is maximum.

The stage of ground water development estimated for Bhaiyathan block is maximum (**65.56%**) and for Balrampur block is Minimum **11.75 %**. The overall stage of development in the District is **25.59 %**. The District as well as all the blocks fall within the Safe category. The block wise stage of ground water development in the District is depicted in **Fig 4**. The yield potential and the recommended suitable abstraction structures for the area are shown in **Fig 6**.

Fig 2. Pre-monsoon (May 2012) Depth to Water Level

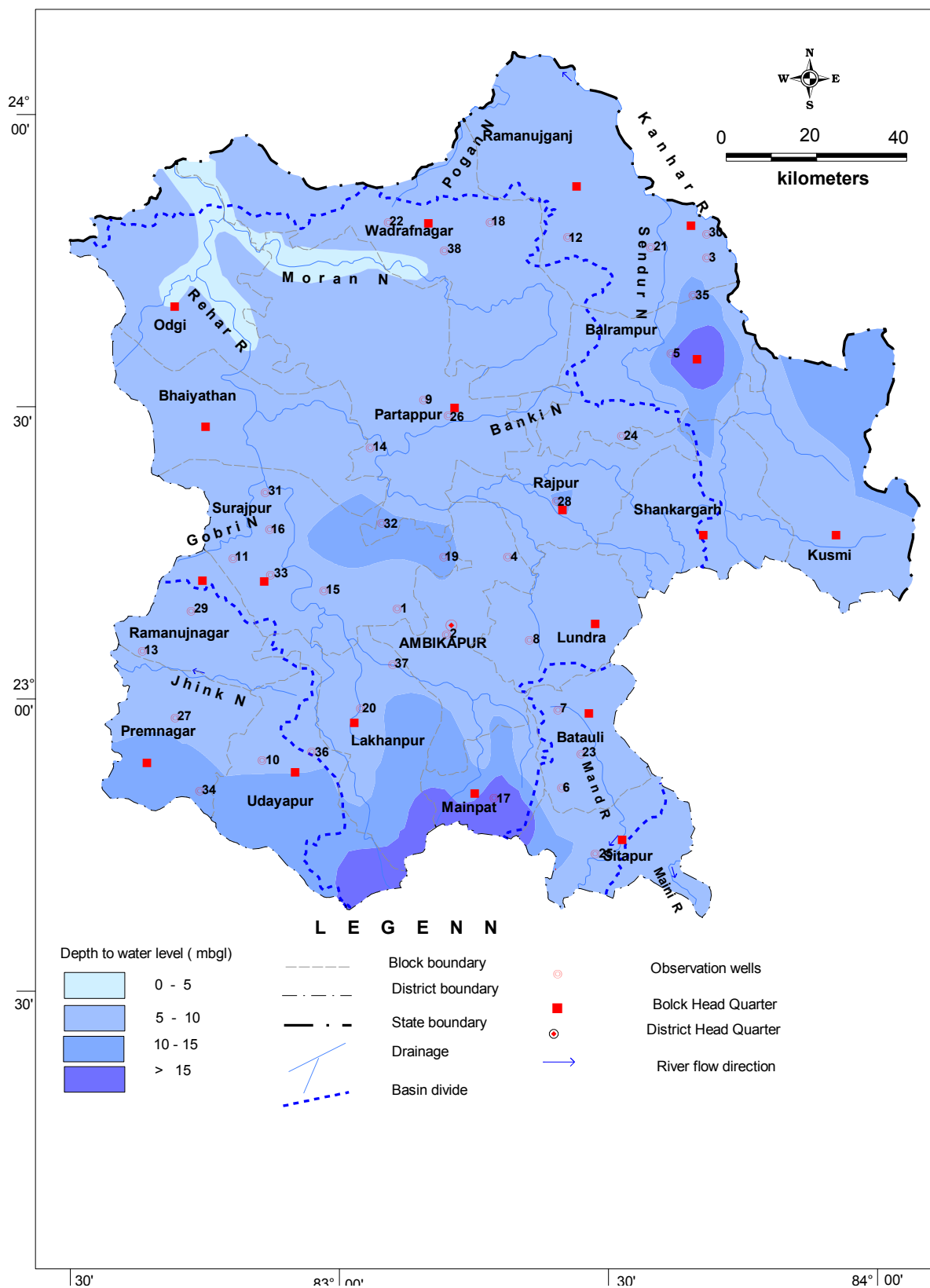


Fig 3 Post-monsoon (Nov 2012) Depth to Water Level

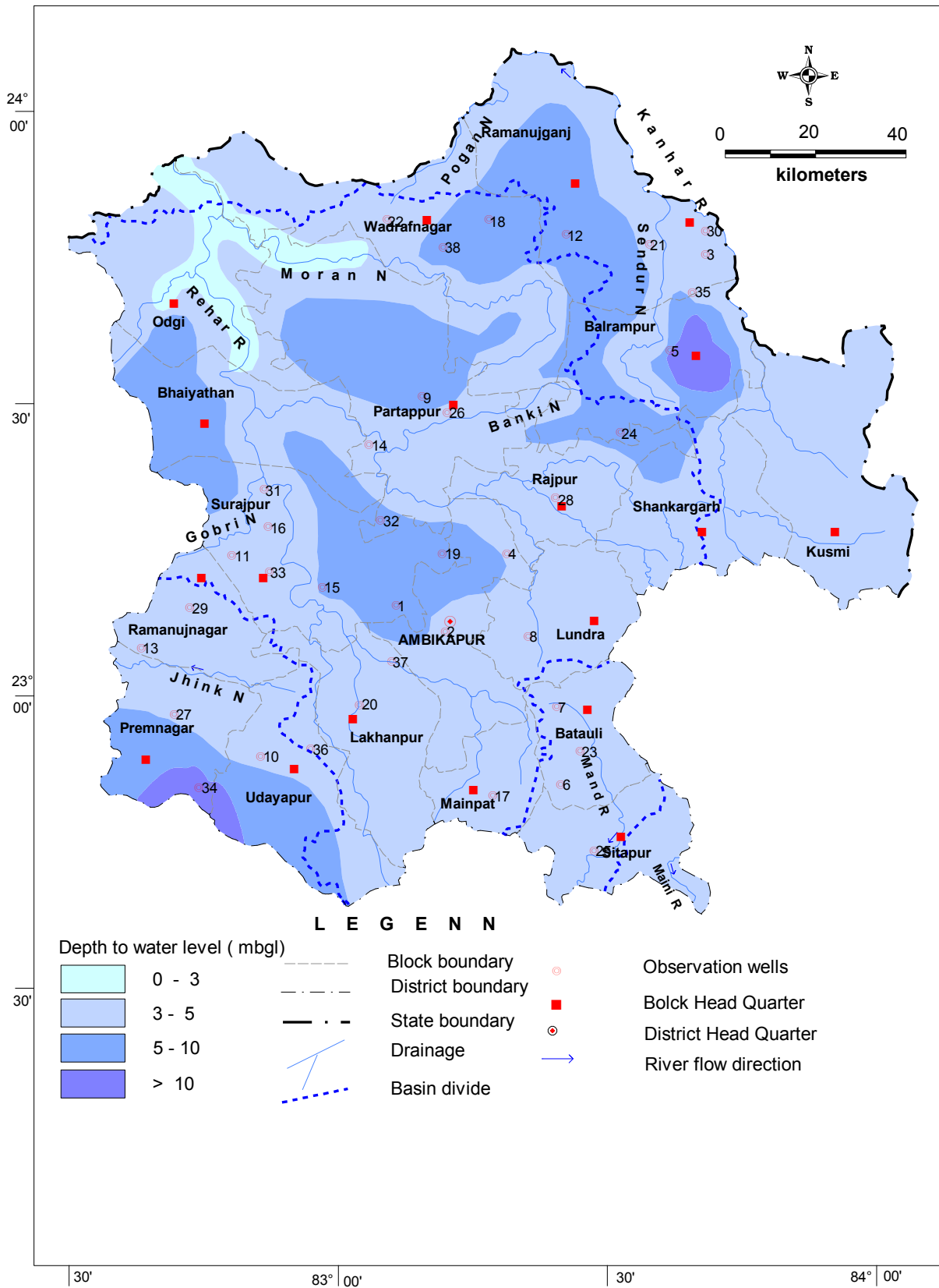
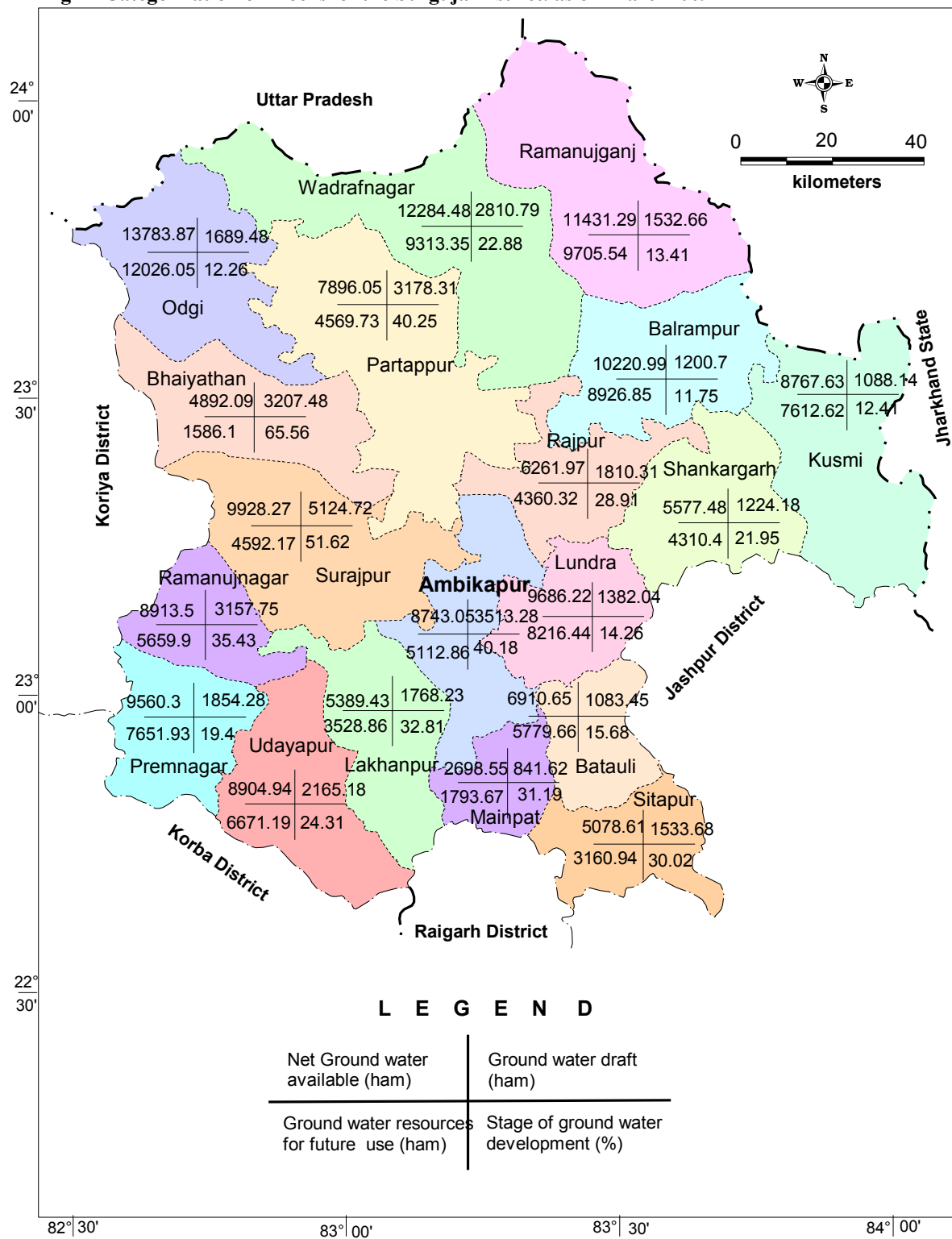


Fig 4 Categorization of Blocks of the Surguja District. as on March 2009



7.0 . GROUND WATER QUALITY

The water samples collected from NHNS during the month of May"2012 (Pre-monsoon) were analysed to determine the quality of ground water in the District. The analysis shows that the concentration of the major ions are within limit as per BIS Standards and the ground water in the District is suitable for all purposes.

The plot of Piper Trilinear Diagram and US Salinity Diagram indicates that the ground water in the District is suitable for drinking, irrigation and all other purposes. The EC values ranges between 75 to 1200 micro siemens/cm at 25°C and the pH values ranges between 7.7 to 8.2. The overall composition of ground water indicates that it is moderately alkaline and predominantly CaHCO₃ type (calcium bicarbonate).

8.0 GROUND WATER MANAGEMENT STRATEGY

There exists a wide scope for ground water development in the District. The available ground water resources for the District are of order of **114578.58** ham and the ground water draft is **40166.28** ham. The stage of ground water development is only 25.59 %.

It is estimated that with the available ground water resources a total of 48330 no.s of bore wells and 24165 no.s of dug wells can be constructed in the District. By adapting suitable developmental strategies, the less developed blocks like Shankargarh, Ramanujnagar and Ramchndrapur can be further developed by way of increased irrigation. The ground Water development plan is given in Fig 6.

The northwestern part of Wadrafnager block Premnagar and part of Lakhanpur block can be developed by constructing deep tube wells of average depth around 250m.

9.0 CONCLUSIONS AND RECOMMENDATIONS

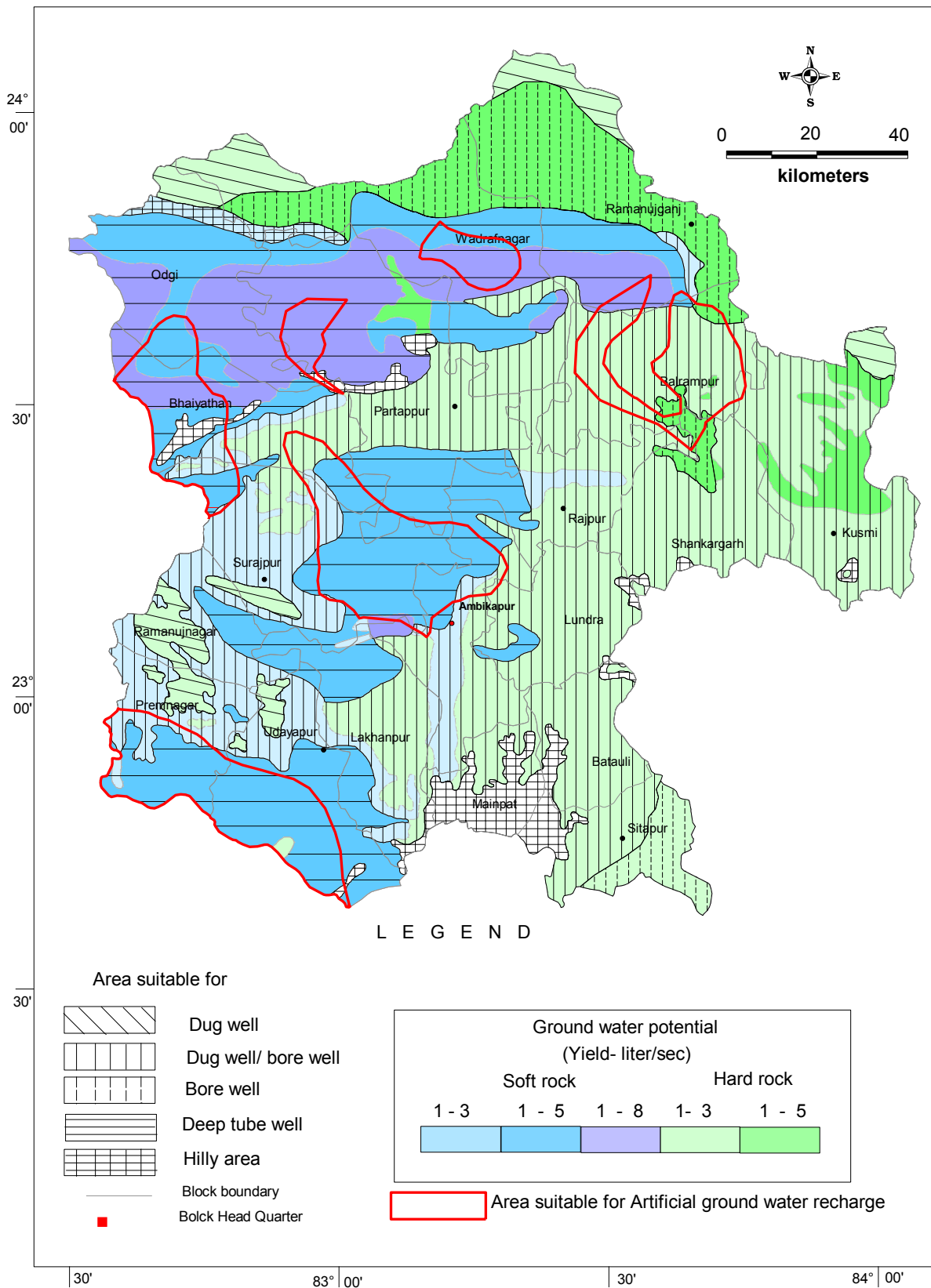
9.1 Conclusions:

Surguja is the largest district of Chhattisgarh State and is located in the northern part. It occupies parts of Ganga and Mahanadi river basins. Eastern half of the district have flat topped table lands of 800 mamsl. The Central parts have in general flat topography and the western part is hilly terrain. Elevation ranges from 424 mamsl (Ramanujanj to 1180 mamsl (Lahsum) with the average of 609 m.amsl.

Main rivers are Kanhar, Rehar, Hasdo, Mand and Maini rivers. The soils are mainly of two types Lateritic and Sandy soils. The Climate is hot dry in summer and well distributed rain fall during the monsoon season. The average annual rainfall is 1365 mm. There are a total of 70 medium schemes which were completed till 2006, have storage capacity of about 71.44 mcm out of which 41903 hectares area is irrigated annually. Further there are 191 medium irrigated schemes are under construction stage

Geologically the area is underlain by granites, gneisses, schists, phyllites and pegmatites and covers an area of about 7151 sq.km. Gondwanas comprising

Fig 6 Ground Water Development,Potential and Artificial Recharge Prospects



sandstone, coal seams, shale cover 7600 Sq.kms where as inftatrappeans, Deccan lava flows; laterite and alluvium occupy the remaining area. A basic sill of 115 to 136 meters thickness known as Korea sill occurs in Sonhat- Jhilmillia area.

Ground Water occurs under water table, semi confined and confined conditions in alluvium/laterite, Deccan trap basalts and Gondwana sandstone. The artesian conditions are common in Gondwana sediments in the western parts of the district. The ground water flow in phreatic aquifer is controlled by surface topography as flow lines indicate the movement of ground water towards river basins Fig.5. The depth to water ranges from 6 to 12 meters and water level fluctuation range is 0.25 to 12.0 metres for the year 2008. The important aquifers in the district are :-Weathered, jointed and fractured portions of Archaean formation with a moderate yield of 5-15 m³/hr and weathered mantle of sandstone and solution cavities in limestone of Lametas with yield of 5-15 m³/hr. Weathered/fractured basalt, interflow contacts and the contact with the underlying granite gneiss and or Lametas with general yields of about 5-10 m³/hr. The Shallow tubewells drilled by P.H.E.D. shows that hydraulic conductivity of jointed/ fractured and weathered zones in Archean, Gondwana and Deccan trap formation ranges from 0.2 to 40 m²/day. The depth of the aquifers varies from few meters to 70 mbgl. The C.G.W.B. exploration data for Gondwanas shows that discharge of the tubewells range from 5 m³ to 30 m³ per hour and the depth of tubewells from 76 to 27 meters.bgl. Ground water occurs under semi confined and confined due to alternate shale, sandstone sequence. The depth of shallow dugwells ranges from 8 to 25 meters in the district.

The ground water quality as a whole is generally good and suitable for domestic, irrigation and industrial uses.

The ground water resources for Surguja district has been estimated based on the GEC"1997 methodology and were projected to the year 2009. The estimates indicate that the annual replenishable ground water resource for the district is 1651.91 mcm. The net annual ground water availability is 1569.32 mcm. The gross annual draft has been estimated as 401.66 mcm and out of which, the draft for irrigation is 352.82 mcm and for domestic purpose is 48.83 mcm. The ground water development in the district is being done by dug wells and bore wells. The dug well depth varies from 5 to 14 m. The bore wells drilled in the area are 60 to 75 m deep with diameter of 100 to 150 mm. 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 the area can irrigate an area of 0.5 to 1.5 ha for paddy.

Ground water is the main source of drinking in the district. In all 938 no. of bore wells and 55806 no. of dug wells exist in the district (2005-06). Together they irrigate around 7670 ha. The contribution of ground water for irrigation comes to nearly 20.05 % in the district. The use of ground water in non-command area is maximum. The stage of ground water development estimated for Surajpur block is height (65.56%) and for Balrampur block is Minimum 11.75%,. The overall stage of development in the district is 25.59 %. The district as well as all the blocks falls within the Safe category.

9.2 Recommendations:

Following recommendations are made for the scientific management of ground water resources and development of utilisable ground water resources. The ground water development should be taken up by construction of suitable structures and in areas as per feasibility recommended in Fig.6.

Area recommended for deep aquifer: An area covered with Barakar and Suprabarakar having low potential shallow aquifer are required to explore deep sited potential aquifer for ground water development. However, suitable sites for drilling should be selected by hydrogeological survey and land sat imagery..

Area recommended for exploration by shallow tube well: An area covered with lower Barakar sandstone in which thickness of aquifers is quite large and have good hydraulic conductivity. Tube wells of about 10 to 15 cm diameter and depth of 150 to 200 m.bgl are recommended. The tube wells constructed are expected to have yields of 5 to 20 m³/hr.

Area recommended for dug wells and borewells : An area covered with basement crystalline rocks are suitable for construction of large diameter dug well ,The area is generally plain and low lying which is fractured zone constitute shallow aquifer diameter dugwells (3 to 5 meters) and 15 meters in depth is recommended. In areas particularly in basaltic terrain where vesicular, jointed and fractured zones are present, dugwells of lesser diameter (3 to 5 meters) can be constructed.

Area recommended for „Conjunctive use development: In the command area of Kunwarpur and other medium irrigation projects, conjunctive use of surface and ground water is recommended to increase the additional irrigation potential in the higher reaches of the area and also to promote efficiency of irrigation project and prevent water logging.

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Dr O.N. Tiwari
Scientist 'D'

Fig 5

HYDROGEOLOGICAL MAP OF THE SURGUJA DISTRICT.

