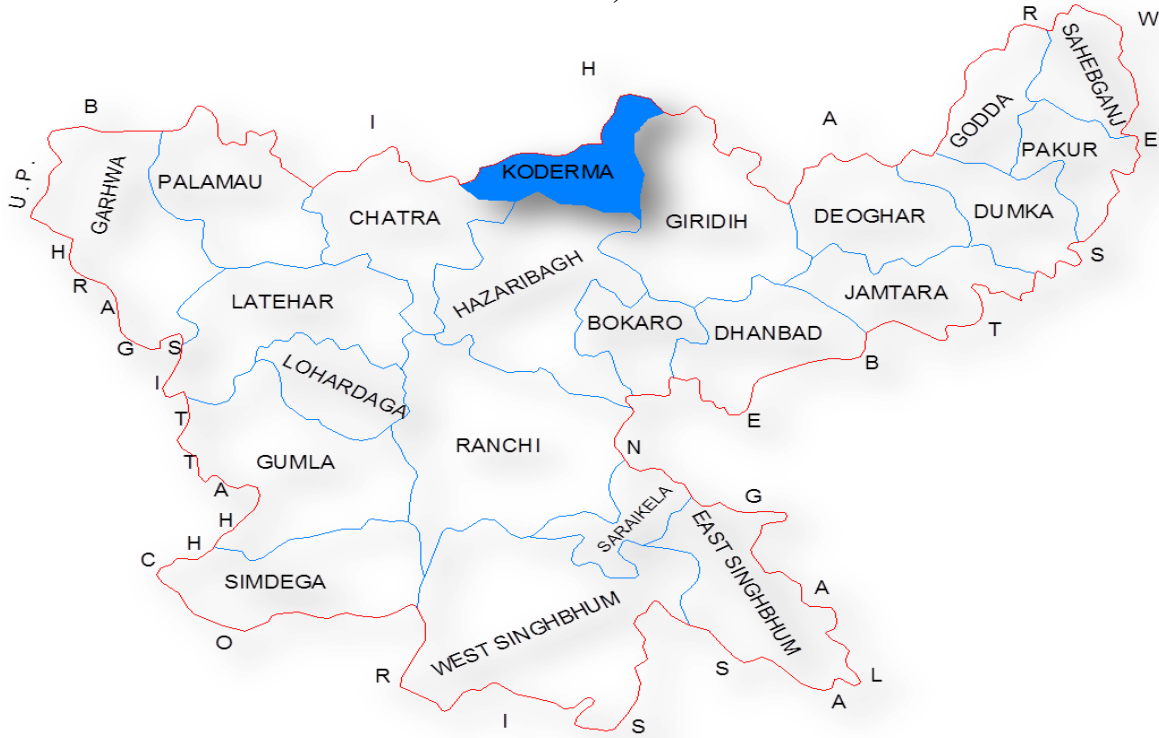




भूजल सूचना पुस्तिका
कोडरमा जिला, झारखंड
Ground Water Information Booklet
Koderma District, Jharkhand State



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Ministry of Water Resources
(Govt. of India)
State Unit Office,
Ranchi
Mid-Eastern Region
Patna

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Contents

Serial no.	Contents
1.0	Introduction
1.1	Administration
1.2	Drainage
1.3	Land use, Irrigation and Cropping pattern
1.4	Studies, activities carried out by C.G.W.B.
2.0	Climate
2.1	Rainfall
2.2	Temperature
3.0	Physiography and Drainage
4.0	Ground water scenario
4.1	Geology and Hydrogeology Aquifer systems Exploratory Drilling Well design Water levels (Pre-monsoon, post-monsoon)
4.2	Ground water Resources
4.3	Ground water quality
4.4	Status of ground water development
5.0	Ground water management strategy
6.0	Ground water related issues and problems
7.0	Awareness and training activity
8.0	Area notified by CGWA/SCGWA
9.0	Recommendations

List of Tables

Table 1	Geological succession of Koderma Mica Belt
Table 2	Exploratory wells drilled in Koderma district
Table 3	Block-wise Ground water Resources of Koderma district (2009)
Table 4	Range of chemical quality of Deeper aquifer in Koderma district
Table 5	Range of chemical quality of Shallow aquifer in Koderma district
Table 6	Block wise Results of Chemical Quality of Koderma district

List of Figures

Fig. 1	Administrative map of Koderma district
Fig 2	Drainage map of Koderma district
Fig. 3	Hydrogeological map of Koderma district
Fig.4	Depth to water level map (Pre-monsoon) of Koderma district
Fig. 5	Depth to water level map (Post-monsoon) of Koderma district
Fig.6	Block wise stage of ground water development of Koderma district (2009)

GROUND WATER INFORMATION BOOKLET OF KODERMA DISTRICT

1.0 INTRODUCTION

Koderma district spreads over an area of 1500 Sq.Km. It is the gateway district of Jharkhand. Koderma is known as Mica Capital of India. The Koderma district was carved out from Hazaribagh in April 1994. Ground water is an important natural asset of the country. Ground water is the lifeline of Jharkhand state. Koderma district lies in the northern part of the Jharkhand state and is bounded by the longitude $85^{\circ}26'01''$ and $85^{\circ}54'16''$ E and latitudes $24^{\circ}15'46''$ and $24^{\circ}40'18''$ N. Area is included in degree sheet 72H and survey of India toposheets (1:50,000 scale) no. 72H/6,7,10,11,13,14,15,16. The district has a total area of 1500 sq. km. consisting of five blocks, (Chandwara, Koderma, Jainagar, Markacho and Satgawan) 80 panchayats and 706 villages. It has a population of 7,16, 259 persons as per 2011 census.

1.2 LOCATION, EXTENT AND ACCESIBILITY

Nawada district of Bihar lies in north, Gaya district of Bihar in west, Giridih district of Jharkhand in East and Hazaribagh district of Jharkhand in south bound the district. The Koderma district is bounded by longitudes $85^{\circ} 26'01''$ and $85^{\circ} 54'16''$ (E) and latitudes $24^{\circ} 15'46''$ and $24^{\circ} 40'18''$ (N). Koderma town is situated at 155 Km north of Ranchi on NH-31 and is well connected by Rail. Koderma Railway station is on grand chord railway line connecting Calcutta and Delhi.

1.3 ADMINISTRATIVE DIVISION AND POPULATION

The district has got five administrative blocks namely satgawan, Koderma, Markacho, Jainagar and Chandwara. Chandawara block has been included recently by merging parts of Jainagar and parts of Chauparan blocks in 2005. The total population of the district is 7.16 lac out of which the rural population is 4.12 lac which is 82.73% of total population. The population density is 287 Persons/Sq.km.

(FIG- 1 Administrative map)

1.4 LAND USE PATTERN, AGRICULTURE, CROPPING PATTERN

Due to lateritic condition of the soil, deficiency in the rainfall and no major rivers, the land use pattern is different from the gangetic plain. Some irrigated area takes into account of Rabi, Kharif and oilseeds crops. But generally the area is best suited for vegetables, medicinal plants and floriculture due to natural drainage of water. Forest area covers about 41% of the total area, Barren and Uncultivable land is 11%, Land put to non agricultural use is 7 %, and current fallow is 15 % and 6% area comes under land other than current fallow. Net area sown is 13 %.

The agricultural production is mainly from pulses and corn. Total kharif irrigated area is 996 ha. And total kharif unirrigated area is 15262 ha. Rabi irrigated area is 2008 ha. and Rabi Unirrigated area is 756 ha. Garma irrigated area is 18.28 ha. Total cropped area is 18632.2 ha. Area sown more than once is 6099 ha .

Total irrigated Area in the district is 3186 ha. Irrigation is done mostly through dugwells, ponds, Borewells, minor irrigation and other sources. Irrigation done by dug well is 829.55 hectares. Irrigation by minor irrigation sources is 226.27 ha. Irrigation done by Ponds in the district are 612.39 ha. Irrigation done by bore wells in the district comes out to be 931.52 ha. Other sources of Irrigation contributes about 586.12 ha in the district. Total no. of dug wells in the district is 3866

1.4 Studies/Activities carried out by C.G.W.B.-- central ground water board has established one observation well under NHNS at the district headquarter Koderma to ascertain fluctuation and ground water quality. The board has also carried out exploratory drilling in different parts of the district and drilled about 5 no. of exploratory wells and one no. Of observation well to determine aquifer parameters, fractures encountered at different depths. Rainwater harvesting training programme was organized at Koderma mining Institute during the month of March 2005. In this training programme lectures were organized regarding ground water conservation and artificial recharge techniques.

2. CLIMATE AND RAINFALL

The calendar year may be divided into three main seasons in the district of Koderma. The winter season starts from November to February. The summer season is from March to May and the rainy season is from June to October. In winter early mornings and nights are cold. Night temperature falls down to 5⁰C or even lower. To the contrast summer is hot and unpleasant, the temperature rising up to 44⁰ C. The annual average rainfall is 1126 mm. Koderma region receives more rainfall and it gradually decrease in east direction.

Having humid and sub humid tropical monsoon type of climate characterize the climatic zone of Koderma. In normal year 40-60 mm of rain is received as pre monsoon shower that help farmer to start land preparation. About 80% of the rain is received during mid June to first week of October. Further, 100 mm of rain is received during October and November. Winter rain during December to February is very helpful for Rabi cultivation.

2.1 Rainfall—The average rainfall (10 years) in the district is 1125.1mm. Monthly average rainfall of the district is given below-

Month	Jan	Feb	March	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Rainfall (mm)	4.5	6	8	6.7	25.1	165.7	323.7	322.9	214.3	40	4.0	4.2

Temperature—The temperature of the district varies between mean minimum temperature of 10⁰C in winters and mean maximum temp. of 40⁰C in summer. Temperature varies between 4⁰c to 46⁰c in general.

3.0 PHYSIOGRAPHY & DRAINAGE

3.1 PHYSIOGRAPHY

Koderma district is the part of Chotanagpur plateau. The area exhibits undulating topography comprising hills, hillocks, mounds and plains. Valley fills with low to moderate frequency of lineaments, pediplains with moderate frequency of lineaments and pediplains are major geomorphological units of the district. Concentrations of lineaments are more in Chandwara, Koderma and Jainagar blocks and less in Satgawan and Markacho blocks of the district. Northern part of the district is occupied by Koderma Reserve forest. The highest peak is Debour Ghati (677 meter) that is the state boundary of Jharkhand and Bihar. Jainagar, Markacho blocks are covered by pediplain. Koderma block consists mostly of directed plateau (Hills / Valley). Upper part of Chandwara block consists of dissected plateau and lowest part by pediplain. Satgawan block is covered by pediplain in upper parts, ridges and valley in middle parts and erosional valley in lower parts.

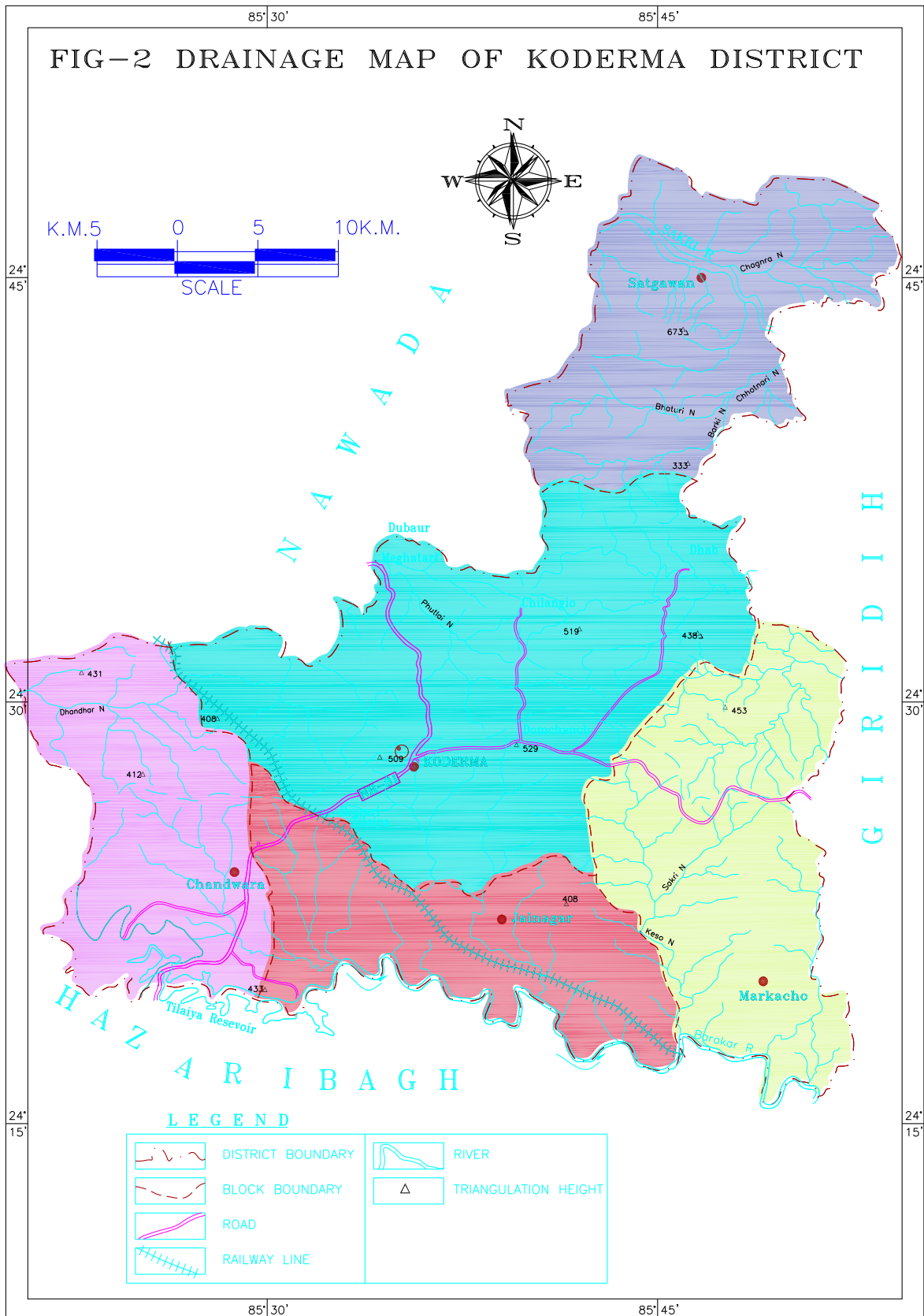
3.2 DRAINAGE

Mainly Barakar, Sakri River and their tributaries drain the district of Koderma. The flow of Barakar is from west to east and in the southern part of the district. The river Ponchkhara, Keso, Akto, Guro and Gukhana nadi flow from west to east and are the tributaries of Barakar river. Sakri River is the main river of northern part of the district that flows from Southeast to northwest part of the district. Ghagra and Chhotanari nadi are the tributaries of Sakri river. **The drainage map of the district is depicted in Fig –2**

3.3 SOILS

The whole Koderma district is divided into the following four types of soils depending upon lithology and physiography of the area.

1. Reddish yellow, yellow, grayish and yellow deep catenary soil.
2. Hill and forest soil of steep slopes and high-dissected regions.
3. Red yellow and light grey catenary soil
4. Pale yellow, Yellow and pinkish catenary soil on high micaceous schist.



4.0 GEOLOGY

The entire district is underlain by the rocks of wide variety of geological formation ranging in age from Archean to Recent. The main being Archean proterozoic, pemocarboniferous and recent.. Phyllite, Mica Schist, Granite gneiss and intrusive granite are the main geological formation of the district. Sporadic occurrence of Dolerite, Quartz pegmatite veins and Quartzites are also found. Few portion of Gondwana sediments are found in the block of Markacho and Jainagar. Thin deposits of alluvium are found along the course of rivers. The Geological succession of Koderma district is given below.

GEOLOGICAL SUCCESSION

The district is underlain by wide range of geological formations ranging in age from Archeans to Recent. Phyllite, Mica Schists, Granite gneiss and intrusive granites are the main geological formations of the district. Sporadic occurrence of Dolerite, Quartz, quartz pegmatite veins and quartzite are also found. Thin venner of thin alluvium are found near the course of rivers.

Table 1 Geological succession of Koderma mica belt (Mahadevan 2002)

Age	Rocktype
Recent	Alluvium
Permo-carboniferous	Gondwana sediments
-----Unconformity-----	
	Dolerite dyke
	Rapakavi granite and pegmatites
Proterozoic	Biotite augen gneiss
	Medium grained massive granites and pegmatites
	Massive quartzite with slaty and phyllitic intercalatious
Sillimanite muscovite schist ,calc silicate rocks,hornblende schist	
	Quartz mica schist

Garnetiferous biotite schist
Migmatite and composite gneisses

-----Unconformity-----

Archean Chotanagpur granite gneisses

In koderma district most of the areas are covered by biotite-granite gneiss, phyllite mica-schist, Intrusive granite, pegmatite veins, Amphibolite hornblende schist, Quartzite and alluvium. In Chandwara block three-fourth areas are covered by biotite granite gneiss and one-fourth area is covered by Phyllite mica-schist and Quartzite. In Jainagar block eighty percent area is covered by Biotite granite gneiss and twenty percent area is covered by quartzite and phyllite mica –schist. Markacho block has forty-five percent area covered by Phyllite mica schist, forty-five percent area by biotite granite gneiss and ten percent by Quartzite. In koderma block Phyllite-mica schist and Intrusive granite are the main rock types. In Satgawan block, central portion of the block and adjacent to Sakri river alluvium is the main formation. Southern portion of the district is covered by Intrusive granite, Phyllite – mica schist and quartzite while the northern portion of the block has Quartzite, Amphibolite hornblende schist and gneisses are observed.

HYDROGEOLOGY- CHARACTERISTIC OF WATER BEARING FORMATION

The rock type in the area are mainly granite gneiss, schist, pegmatite and Quartzite which have undergone intensive weathering both due to structural disturbances and physical condition. Fractures and weathered mantle form the main repository for the movement of ground water. Owing to the process of weathering the following subsurface section can normally be found in the district of Koderma. Thickness as well as depth goes on varying from one place to another.

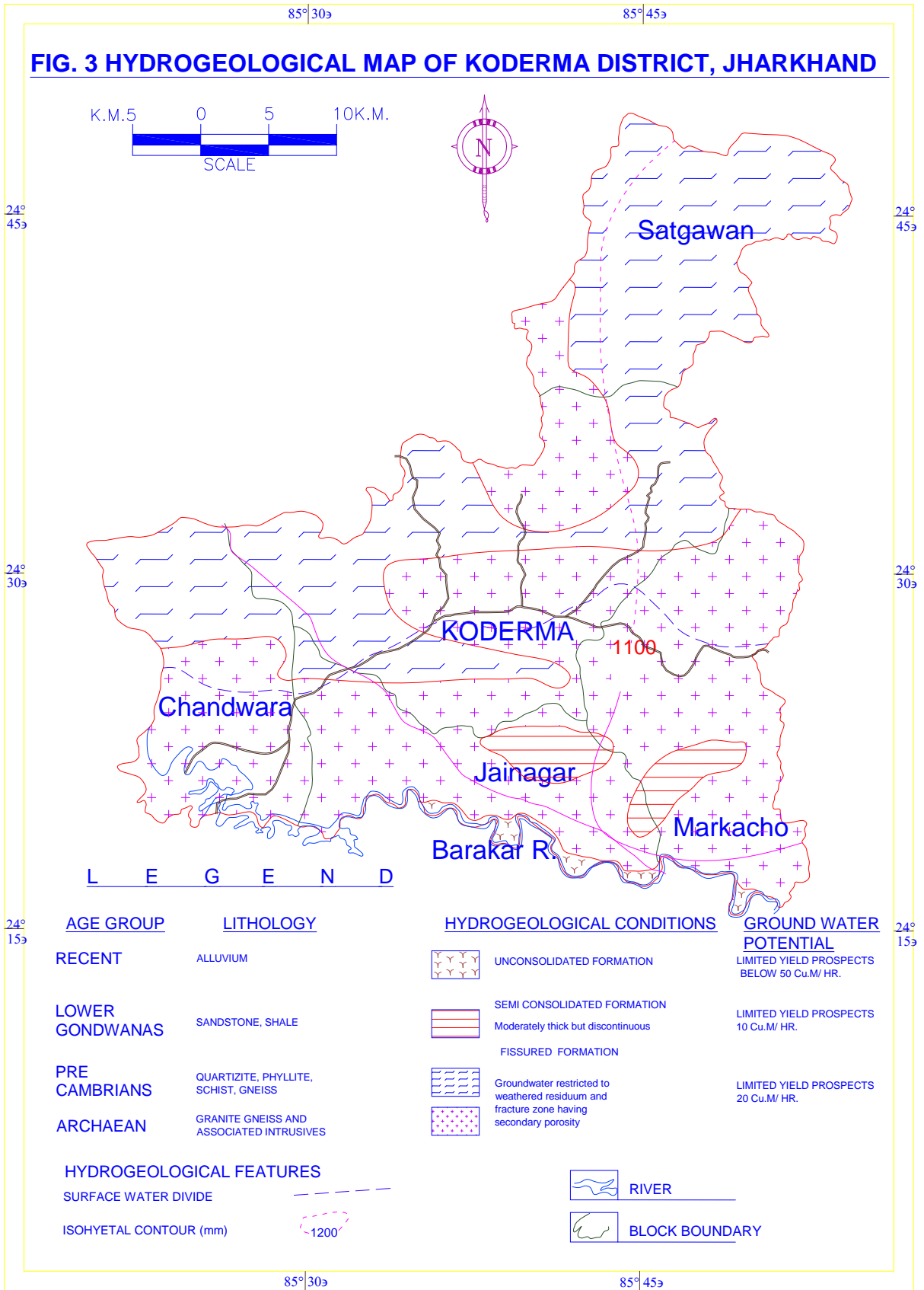
“D” Soil cover	Sandy clay and clayey sand often with Concretion.
“C” Decomposed Zone (Weathered/pediment)	Altered massive clays commonly plastic
“B” Disintegrated Zone (Saprolite)	Disintegrated crystal aggregate and rock fragments.

“A” Fresh Fracture Zone Fractured rock.

The above profile has been encountered in many places in the district. Near Domchanch thickness of section “B” is very meager, however, section ‘C’ in this area is found to be of considerable thickness. There is variation in porosity and permeability of the weathered mantle in different zones. Zone ‘C’ has comparatively more porosity as compared to other three zones. Thick weathered mantle maybe considered as potential and productive aquifer. Hence, pediment & buried pediment may be proved as Ground Water worthy area.

In places where there is thin weathered mantle ground water occurs in the fracture system. The thin weathered mantles absorb rainfall infiltration and transmit it to deeper fracture system. **(Fig. 3 Hydrogeological map)**

FIG. 3 HYDROGEOLOGICAL MAP OF KODERMA DISTRICT, JHARKHAND



4.2 GROUND WATER CONDITION

A) Archean and Pre- Cambrian rocks

Ground water mostly occurs under water table condition in weathered residuum and semi-confined condition in deeper fractures. Maximum thickness of weathered mantle is attained in Granitic rocks in favorable topographic and drainage condition. These formations has got yield prospect of approximately 2-20 cu.m/hr.

b) Lower Gondwana rocks

Gondwana rocks represent semi-consolidated formations, which are moderately thick but discontinuous. In the area where lower Gondwana sediments are exposed or underlain in relatively shallower depth, ground water occurs under water table condition. in relatively deeper Gondwana aquifer occurs under semi confined to confined condition. They have yield prospect approximately 3-10 Cu m/hr.

c) Quaternary

Thin deposits of quaternary sediments occur along the river and nala courses. Thickness of these sediments vary from 2 to 10 m. Ground Water occur under unconfined conditions.

DEPTH TO WATER LEVEL

The depth from ground at which the ground water rests is called Depth to Water level. It is deepest during pre monsoon and attains its maximum peak. It is shallowest during August and again stabilizes during the month of November and this level represents post -monsoon level.

a) PRE-MONSOON DEPTH TO WATER LEVEL

The depth to water level contour of pre monsoon is given in Fig-6. The depth to water level varies between 3-10 mbgl. Depth to water level in Koderma block is largely between 3-5 mbgl around Koderma, Jhumri Tilaiya, Chilongi and Gajhandi area. In Domchanch, Dhab area it is between 5-10 mbgl. In Chandwara block depth to water level becomes deeper from north to south. In northern portion the depth to water level varies between 3-5 mbgl where as in southern portion it varies between 7-10 mbgl. The depth to water level lies between 7-10 mbgl in Markacho block. The Satgawan block has depth to water level varying between 5-7 mbgl. The shallowest depth to water level is reported from southern portion of Jainagar block and it varies between 3-5 mbgl. **(Fig. 4 Pre-monsoon water level map)**

b) POST- MONSOON DEPTH TO WATER LEVEL

In general Post-monsoon depth to water level in Koderma block varies between 2-3 mbgl except in Gajhandi area and Southern portion of Markacho block where depth to water level is between 3-4 mbgl. In Satgawan block and Chandwara block post-monsoon depth to water level varies between 2-3 mbgl. In Markacho block depth to water level varies between 2-3 mbgl except in southern part where it is between 3-4 mbgl. Jainagar block has depth to water level between 1-2 mbgl in eastern part and 2-3 mbgl in western part of the block. **(Fig-5 Post-monsoon water level map).**

GROUND WATER EXPLORATION

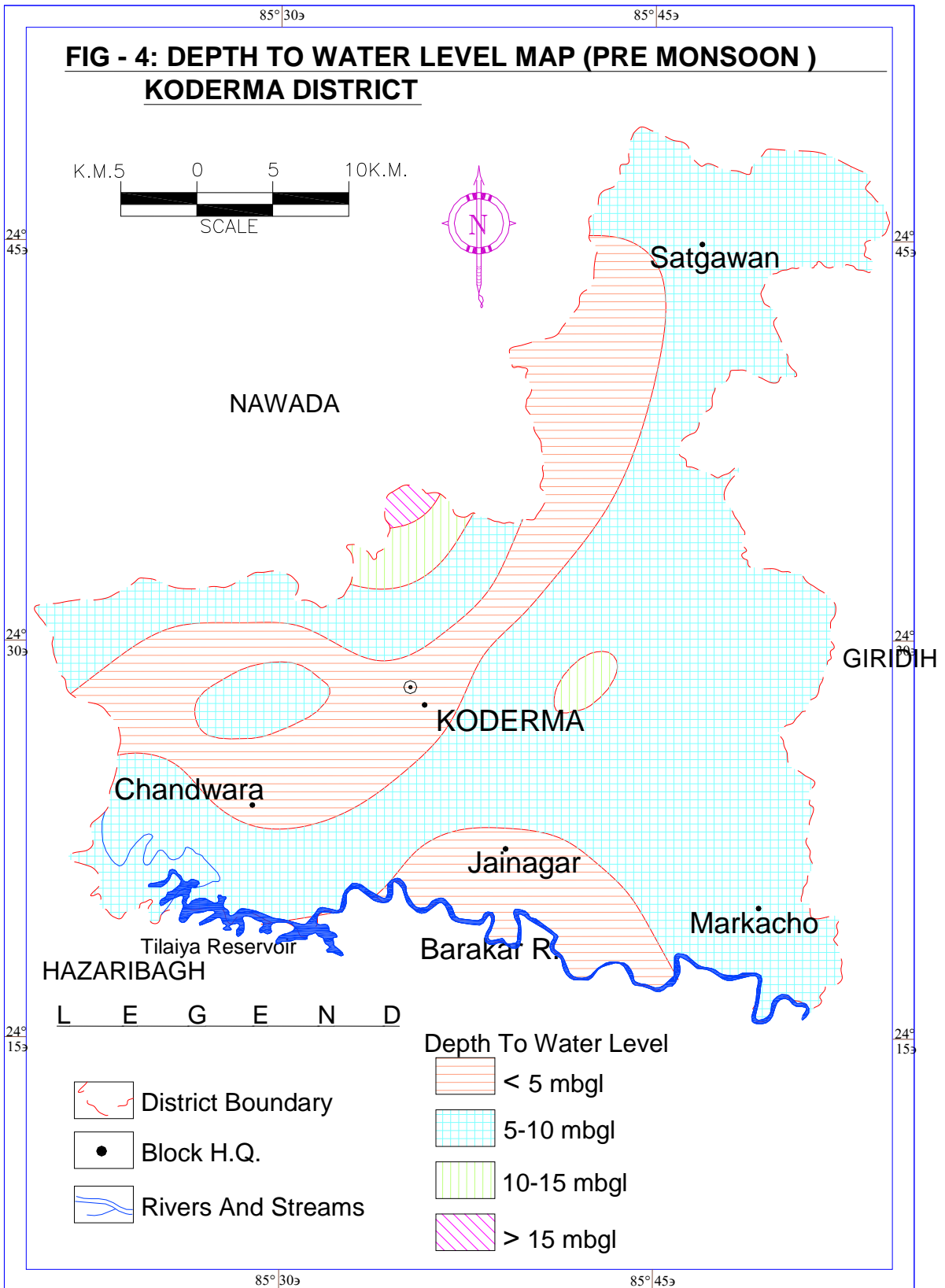
Central Ground Water Board has drilled altogether five nos. of wells in Koderma district. These wells are drilled at Chotki Dhamraj, Gumo village, J.J. College Campus, Koderma, Chutiyaro village and Koderma block campus. These wells were drilled in Granite gneiss, phyllite, mica schist and intrusive granite. The depth of casing varies

from 10.68 m at Tilaiya block compound to 24.49 m at Chutiyaro. Drilling depth varies from 130.20m at Chotki dhamrai to 172.52 m at J.J. College campus, Koderma. Fractures encountered at 50-51m, 65-67m, 83-85m, 98-100m at Chotki Dhamrai and 27-29 m, 75-77m at Gumo.

The static water level varies from 2.7m at J.J. College, Koderma to 7.38m at Gumo. The discharge varies from 1.5m³ /hr at Tilaya to 13.2m³ /hr at J.J. College, Koderma. The transmissivity is reported as 8.5m² /day, 21.12m² /day at J.J. College, Koderma respectively. The details of exploration carried by CGWB is given at **(Table-10)**

Table- 2 Exploratory wells drilled in Koderma district

Sl. No	Location	Block	Depth drilled (mbgl)	Length of Casing pipe (m)	Static water level (mbgl)	Discharge (m ³ /hr.)	Formation
1	J.J.College, Koderma	Koderma	172.52	14.00	2.7	13.2	Granite-gneiss
2	Tilaiya block campus	Koderma	149.59	10.68	6.10	1.5	Granite-gneiss
3	Chotki Dhamrai	Chandwara	130.20	21.62	5.34	12.02	Granite-gneiss
4	Gumo	Koderma	150.00	24.44	5.63	7.5	Granite-gneiss
5	Chutiyaro	Koderma	150.00	24.49	-----	-----	Mica-Schist



7.0 GROUND WATER REOURCES ESTIMATION

The Koderma district consisting of 5 blocks are having adequate ground water resources potential and only a small part of it, is being utilized. The total replenishable ground water resources is 9273.29 ha.m out of which 462.52 ha.m is left for natural discharge during non monsoon season leaving net ground water availability amounting to 8809.77 ha.m. The maximum ground water availability is in Koderma block. (2817.06 ha.m). 1278.54 ha-m has been allocated for meeting domestic and industrial requirement. The annual draft for irrigation purpose is only 1407.89 ha.m and existing ground water draft for domestic and industrial water supply has been assessed to be 849.21 ha.m. The total draft for all uses amounts to 2256.96 ha.m. The stage of ground water development in the district varies from 12.49% in Chandwara block to 38.90% in Jainagar block. The average stage of development of the district is 19.82%. **The Ground Water Resources of the Koderma district is depicted in Table 4.**

Table 3 Blockwise Ground Water Resources of Koderma district (as on 2009)

SL. No.	Assessment Unit	Total GW recharge (ha-m)	Net GW availability (ha-m)	Existing GW draft For irrigation (ha-m)	Existing GW draft for Domestic And Industrial Supply (ha-m)	Existing GW draft for all uses (ha-m)	Allocation for domestic and industrial requirement Supply (ha-m)	Net GW availability For future irrigation (ha-m)	Stage of GW development (%)
01	Jainagar	1251.07	1188.51	273.46	188.86	462.32	256.6	629.45	38.90
02	Koderma	2965.23	2817.06	383.24	280.15	663.39	423.67	2010.15	23.55
03	Markacho	1606.78	1526.45	281.16	161.28	442.44	243.90	1001.38	28.99
04	Satgawan	1751.98	1664.38	197.78	87.91	285.69	132.95	1333.66	17.17
05	Chandwara	1698.23	1613.37	272.25	131	403.11	192.42	1145.69	12.49
	Total	9273.29	8809.77	1407.89	849.21	2256..96	1278.54	6120.33	19.82

Water is very essential for life and it should be free from turbidity, odourless and free from bacteria and poisonous contents. Drinking water should be chemically soft (having low T.D.S.) and all other chemical constituents should be within prescribed limit set by Bureau of Indian Standards (BIS1991). Excessive and longer use of ground water beyond these limits may endanger to stomach problem, deformation and even death.

42 number of hand pump samples were collected throughout the district. The results of ground water samples of koderma district were evaluated in accordance with the standard (BIS 1991) for drinking purpose. All the constituents are within permissible limit except fluoride. Ground water of the district is generally potable except few localities in Koderma block and Satgawan block where fluoride concentration is above permissible limit prescribed by BIS1991. The results of deeper water samples are tabulated in (Table 3)

Table 4 Range of chemical constituents of deeper ground water in Koderma district

Sl. No.	Chemical constituents	Ranges	BIS 105000 Desirable limit	Permissible limit in the absence of an alternative source
1.	pH	6.5-8.37	6.5-8.5	No relaxation
2.	E.C. as Micro siemens/cm. At 25°C	176-2100	--	---
3.	T.D.S. (mg/l)	113-1344	500	2000
4.	Total hardness (as CaCO ₃) mg/l	50-840	300	600
5.	Chlorides (mg/l)	10.6-391	250	1000
6.	Sulphates (mg/l)	0-197.1	200	400
7.	Bicarbonates (mg/l)	42.7-403		
8.	Fluoride (mg/l)	0.11-5.7	1.5	1.9
9.	Calcium (mg/l)	12-164	75	200
10.	Sodium (mg/l)	12-189		
11.	Potassium (mg/l)	0.5-7.1		

Table 5- Range of chemical constituents of Shallow Ground water in Koderma district

Sl. No.	Chemical constituents	Ranges	BIS 105000 Desirable limit	Permissible limit in the absence of an alternative source
1.	pH	6.88-9.13	6.5-8.5	No relaxation
2.	E.C. as Micro siemens/cm. At 25°C	168.7-2600	--	---
3.	T.D.S. (mg/l)	107.52-1664	500	2000
4.	Total hardness (as CaCO ₃) mg/l	50-1380	300	600
5.	Chlorides (mg/l)	14.2-809.4	250	1000
6.	Sulphates (mg/l)	0-197.1	200	400
7.	Bicarbonates (mg/l)	48.8-573.4		
8.	Fluoride (mg/l)	0.12-5.07	1.5	1.9
9.	Calcium (mg/l)	12-126	75	200
10.	Sodium (mg/l)	11-287		
11.	Potassium (mg/l)	1.1-18.8		

Table 6 Blockwise results of chemical analysis of water samples of Koderma district

Sl. No	Block	Range	EC in micro siemens / cm at 25 ⁰ c	P ^H	TH as CaCO ₃	Ca	Mg	Na	K	HCO ₃	Cl	SO ₄	CO ₃	F
						← mg / l →								
1	Koderma	Maximum	2340	9.13	690	200.4	48.6	287	9.0	573.4	383.4	100.6	12	5.53
		Minimum	138	6.40	50	12.0	4.8	10	0.6	48.8	10.6	12.8	ND	0.44
2	Jainagar	Maximum	2660	8.15	740	192.0	63.2	128	34	384.3	376	108.5	ND	0.84
		Minimum	191	7.50	70	8.0	2.4	14	0.5	73.2	14.2	22.65	ND	0.16
3	Markacho	Maximum	1210	8.29	1380	232	126.4	196	19	262.3	809	197.1	18	1.38
		Minimum	96	7.40	40	12.0	2.4	12	0.7	42.7	14.2	22.2	12	0.11
4	Satgawan	Maximum	1848	8.44	520	100	65.6	189	18.8	542.9	259	112	30	2.23
		Minimum	429	7.33	70	16	7.3	46	1.2	122	21	23	18	0.30
5	Chandwara	Maximum	1313	8.46	840	232	73.0	108	4.3	403	391	19.0	30	1.20
		Minimum	462	7.13	80	24	2.4	11	0.4	85	18	1.4	12	0.07

RECOMMENDATION

1. As the district is dominated by small and marginal farmers. Dugwell and shallow borewell should be given importance for ground water development. It requires less capital investment and maintenance cost. Loans and subsidies should be provided to the small and marginal farmers for construction of ground water structure.
2. From observation, it is evident that parts of Koderma and Satgawan blocks have been contaminated by Fluoride concentration. As preventive measure ground water of hand pumps contaminated with fluoride should be red marked. Chemical analysis on regular basis must be carried out to confirm any changes in its concentration.
3. Ground Water user association may be constituted for overall operational maintenance of the ground water structure.
4. Although there is ample scope for Ground water development. The importance of water harvesting and artificial recharge is needed to be mention. Suitable artificial recharge structure like percolation tank, gully plugging, sub surface dike should be constructed at carefully selected sites to enhance the local ground water potentiality and sustainability.
5. Mica schist areas are devoid of ground water.
6. In certain patches the dugwell go dry during the summer. In such places the well should be deepen so that it taps the entire saturated thickness of weathered residuum.
7. Lineaments have proven their worth as good ground water storage and yielding zone. They should be carefully demarcated up to the finest level with the help of satellite imageries in large scale.
8. Post monsoon water level map reveals that two third of the district area is prone to water logging. Hence, more development in agricultural sector is required.