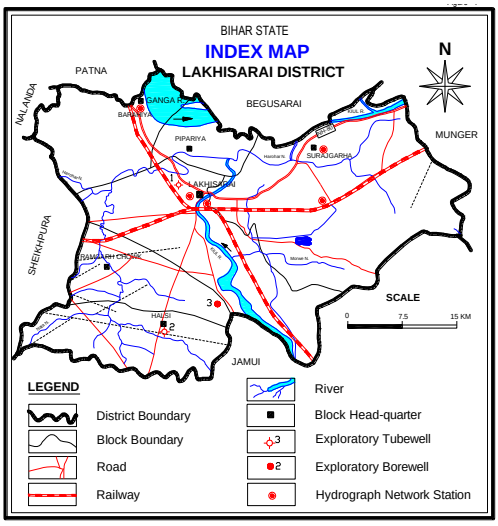
भूजल सूचना पुस्तिका

लखीसराय जिला, बिहार

Ground Water Information Booklet

Lakhisarai District, Bihar State



केन्द्रीय भूमिजल बोर्ड
जल संसाधन मंत्रालय
(भारत सरकार)
मध्य-पूर्वी क्षेत्र
पटना

Central Ground water Board
Ministry of Water Resources
(Govt. of India)
Mid-Eastern Region
Patna

सितंबर 2013

September 2013

PREPARED BY	-	Mr. Mukesh Kumar Mandal, STA (HG)
UNDER SUPERVISION OF	-	Dr. K.K.Singh, Scientist'D'
CARTOGRAPHY BY	-	Mr. J.K. Tandon, Draughts man (Gr.- II)
UPDATED BY	-	Mr. S.N.Dwivedi, Sc-C & Dr. Fakhre Alam, STA(Hg)

Ground Water Information Booklet

Lakhisarai District, Bihar State

CONTENTS

LAKHISARAI DISTRICT AT A GLANCE

Sl. No.	ITEMS	Statistics	
1.	GENERAL INFORMATION		
	i) Geographical area (SqKm)	1301	
	Administrative Division		
	i) Number of Tehsil/ Block	06	
	ii) Number of Punchyat/Villages	476	
	iii) Population (As on 2011 Census)	1000723	
	iv) Average Annual Rainfall (mm)	1170	
2.	GEOMORPHOLOGY		
	Major physiographic unit:	Hill, Pediplain, Alluvial Plain	
	Major Drainages:	Ganga, kiul, Harohar	
3.	LAND USE (SqKm)		
	a) Forest area:	134.45	
	b) Net area sown:	597.38	
	c) Cultivable area:	861.51	
4.	MAJOR SOIL TYPE	Inceptisols, Entisols and Alfisols	
5.	AREA UNDER PRINCIPAL CROPS	Paddy, Wheat, Maize	
6.	IRRIGATION BY DIFFERENT SOURCES (Areas Sqkm and Number of Structures)	Area	No.
	Dugwell	0.95	-
	Tubewell/Borewell	300.17	-
	Tank/ponds	-	-
	Canals	166.40	-
	Other sources	46.32	-
	Net irrigated area	-	
	Gross irrigated area	513.84	
7.	NUMBER OF GROUND WATER MONITORING WELLS OF CGWB (2011)		
	No of Dug wells	04	
	No of Piezometers	Nil	
9.	HYDROGEOLOGY		
	Major Water bearing formation	a) Hard rock/fissured formation of Quartzite Phyllite and Granite. b) b) Unconsolidated Sediment of Alluvium Plain.	
	(Pre-monsoon Depth to water level during 2011) m bgl.	7.58 – 9.80	
	(Post-monsoon Depth to water level during 2011) m bgl.	1.28 – 6.09	
	Long term water level trend in 10 yrs (2002-2011) in m/yr	-	
10.	GROUND WATER EXPLORATION BY CGWB (As on 31-03-2013)		

	No of wells drilled (EW, OW, PZ, SH, Total)	03, 03, Nil, Nil
	Depth range (m)	60-119
	Storativity (S)	
	Transmissivity (m^2/day)	
11.	GROUND WATER QUALITY	
	Presence of Chemical constituents more than permissible limit (e.g EC, F, As, Fe)	Fluoride (0.6 – 7.07 ppm)
	Type of water	Potable
12.	DYNAMIC GROUND WATER RESOURCES (as on 31st March 2009)- in mcm	
	Annual Replenishable Ground water Resources	279.41
	Net Annual Ground Water Draft	117.19
	Projected Demand for Domestic and industrial Uses up to 2025	21
	Stage of Ground Water Development	41.9%
13.	AWARENESS AND TRAINING ACTIVITY	
	Mass Awareness Programmes organized	Nil
	Date:	-
	Place:	-
	No of participant :	-
	Water Management Training Programmes organized	Nil
	Date	-
	Place	-
	No of participant	-
14.	EFFORT OF RTIFICIAL RECHARGE & RAIN WATER HARVESTING	
	Project completed by CGWB(No & Amount spent)	Nil
	Project under technical guidance of CGWB (Numbers)	Nil
15.	GROUND WATER CONTROL AND REGULATION	
	Number of OE Blocks	Nil
	Number of Critical Blocks	Nil
	Number of Blocks notified	Nil
18	MAJOR GROUND WATER PROBLEMS AND ISSUES	Geogenic contamination of ground water with fluoride and source finding.

Ground Water Information Booklet

Lakhisarai District, Bihar State

1.0 Introduction

1.1 Administration

Lakhisarai district was a carved out of erstwhile Munger district on 3rd July 1994. Earlier it was a sub-division within Munger District. It is located in southern part of Bihar state and extends from 25^0 01' to 25^0 22' North Latitude and 85^0 50' to 86^0 17' East Longitudes with a geographical area of 1301 km². The district is bounded on the north by Patna and Begusarai districts, on the west by Nalanda and Sheikhpura, on the east by Munger, while on the south it is bounded by Jamui district. Lakhisarai district is a part of Munger division. It has 06 developmental blocks (Fig.-1) comprising 476 villages with its headquarters at Lakhisarai. The total population of the district is 4476043 as per census year 2011 with a Rural : 4311466 & Urban 164577 population.

Lakhisarai was an established administrative and religious centre during the golden period of Pal bansh. Lord Buddha also stayed here for three years on Chaliya Mountain and deliver the Sermons.

1.2 Basin/sub-basin, Drainage

Lakhisarai district forms a part of Phalgu-Kiul sub-basin of Ganga Basin. The district comprises catchments of Ganga and Kiul river systems. The district is having moderate to low drainage density with dendritic and radial patterns dominating in the hilly regions, while parallel to sub-parallel drainage pattern in the plains. The Ganga, Kiul and Harohar are the three main rivers flowing through the district. The Ganga flowing to the east touches the northern border while Kiul river flowing to the north almost bisects the district and joins the river Ganga in the north.

1.3 Irrigation Practices

The agroclimatic conditions of the district favours the plantation of cereal crops such as paddy, wheat, maize etc and pulses like gram and masoor. These together with vegetables form the main crops. Irrigational facilities are not sufficient. There are only two irrigation systems, the Kiul minor irrigation and Shringi Rishi dam. As per the statistics of year 2004-2005 (Govt. of Bihar) the gross irrigated area is 51384 hectares where 30017ha is irrigated by deep and shallow tube wells, 16640 ha by canals and 4632 ha by other sources out of total cultivable area of 86151 hectare. Conjunctive use of surface and ground water can bring the desired development in this water scarce district.

1.4 Studies/ activities carried out by CGWB

Central Ground Water Board has carried out hydrogeological surveys and ground water explorations in the district. So far, a total six wells have been drilled by CGWB, out of these 3 are exploratory wells and 3 are observation wells. There are 04 tube wells in alluvial area and 02 bore wells in hard rock areas. Regular monitoring of four hydrograph stations in the district is being done four times in a year since 1975 by CGWB. It has generated invaluable data on water level fluctuation and chemical quality of ground water. Ground water resources of the district have been estimated (GEC-1997, norm) in the year 2004, which highlighted the stage of ground water development as 33% on an average.

2.0 Rainfall and Climate

The climate of the district is somewhat extreme in nature, i.e., quite hot during the summer and fairly cold during the winter. January is the coldest month when the mean minimum temperature comes down to approximately 4^{o} C. The temperature starts rising from March and reaches its peak in May when the mercury touches about 45^{o}C. The average annual rainfall of the district is 1170 mm and about 85% of the rainfall is by South-west monsoon during June to September.

3.0 Geomorphology and Soil types

3.1 Geomorphology

The district has a diverse landscape ranging from hills to flood plains. The major geomorphic units are rocky upland, pediplain, alluvial plain and flood plains (fig-5).

a) The Rocky Upland area comprises series of Kachhua and Kajra hills. These hill tracts constitute elevated and rugged landmasses surrounded by alluvial plains. The altitude of hills varies from 250 to 500m amsl. It comprises mainly quartzite, phyllite and schist of Kharagpur formation. The rocks of Kharagpur formation have undergone tectonic deformation giving rise to variety of deformational structures. The rocky uplands are limited mainly in Surajgarha block.

b) Pediplain is represented by an area formed through coalescence of pediments and thus forms rolling topography and comprises residual soil overlain by mixture of sheet wash deposits. It extends all along the Kharagpur hills.

c) Older Alluvial Plain forms a major part of the district. It comprises sediments deposited by Ganga river and also the sediments derived from the denudation of Chota Nagpur plateau and Kharagpur hills. This is also known as marginal alluvial plain due to its limited thickness. Although the thickness

of this alluvium at Ashok dham village is about 123m but reduces considerably in the southeastern parts ranging from 15 to 20m.

d) Younger Alluvial Plain forms the northern parts of the district and stretches few km to the south of Ganga rive. Almost all of Pipariya and some part of Barahiya blocks are considered as flood prone area. These areas remain inundated in rainy season. Locally, this is called “Tal” area. Diara area is level to gently undulating ground. The mighty Ganga meanders in this parts and usually remains flooded from middle of July to the end of September. The relief of this plain varies on an average from 25 to 65m above mean sea level.

3.2 Soils

The Lakhisarai district consists mainly of Inceptisols, Entisols and Alfisols group of soils generated under different lithological and pedogenic conditions. Calcareous alluvial soil of Inceptisols group occurs on the southern bank of Ganga, particularly in Barahiya and Pipariya blocks. Younger alluvial soil of Entisols group occurs in major part of the district. It is deficient in nitrogen, phosphoric acid and humus. Texturally these soils are sandy to loamy and the pH value is on the alkaline side. Older alluvial soil of Alfisols group is developed mainly in the marginal areas along the foothills.

4.0 Ground Water Scenario

4.1 Hydrogeology

Hydrogeologically, the district is divided into two parts (a) hard rock/ fissured formation (b) unconsolidated / porous formations (Fig.-5))

(a) The hard rock / fissured formation: It comprises rocks of Chotanagpur Gneissic Complex (CGC) and Kharagpur formation. They are composed mainly of granite gneisses, quartzites and phyllites. In general, these rocks possess poor aquifers until or unless they have developed secondary porosities by means of weathering and/or fracturing. The drainage pattern of the terrain indicates that the basement rocks have undergone poly-tectonic deformations giving rise to deep seated tensile and shear fractures. These fractures appear on the surface in the form of lineaments. These lineaments are delineated with the help of Satellite Images (Fig. - 5). The lineaments are potential areas for ground water exploration and recharge. Weathered residium, saprolite zone and fractures within 15 - 35m depths constitute shallow aquifers. In Lakhisarai district, two bore wells have been drilled and the maximum depth drilled is 135m at Gunsagar village in Halsi block. Ground water occurs generally under semi-confined condition in these areas.

(b) Porous Formation: The Quaternary alluvium constitutes this hydrogeological unit. Its thickness is maximum in the northern and western parts of district, while in eastern and southern part reduces to as low as 5m. The variation in thickness of the alluvium is mainly due to uneven bedrock topography and proximity of hill ranges. The alluvium comprises clay, silt and sand of various thickness. Aquifers in this formation occur under unconfined to semi-confined conditions. CGWB has drilled 04 tube wells in this formation and maximum thickness of alluvium is 123 m at Ashokdham village of Lakhisarai block. In general the alluvial thickness varies from 60 to over 120m. Details of exploratory bore wells drilled are given in table1.

There are four hydrographs network station (HNS) in the district (Fig.-1). These HNS are being monitored four times in a year since 1975 by CGWB. The pre-monsoon 2011, water level in the district ranges between 7.58 to 9.8 and in post-monsoon 2011, its ranges between 1.28 to 6.09 m bgl. Long-term water level data (2002-2011) indicate no significant declining in water levels. Depth to water level maps of pre and post-monsoons of the year 2011 are shown in Fig. 2 and 3 respectively.

4.2 Ground Water Resources

Dynamic ground water resources of the district was estimated (GEC-1997, norm) in the year 2009 by adopting groundwater estimation methodology 1997, Govt. of India. There are wide variations in the ground water potential of various hydrogeological units identified in the district. The net annual replenishable ground water resource of the district is 27941 ha m. The gross draft for all uses is 11719 ha m and allocation for domestic and industrial requirement supply by next 25 years is 2100 ha m. The present stage of ground water development of the district is 41.9% and hence all the six blocks of district fall under safe category for ground water development point of view (Fig. 4). At present, maximum ground water development has taken place in Ramgarh Chowk Block (65.3%), while minimum in Barahia block (24.5%). Details of ground water resources of all blocks are shown in Table 2 and Fig 6.

4.3 Chemical Quality of Ground Water

Chemical analysis of water samples collected from the HNS and exploratory wells reveals that the ground water of the district is suitable for drinking and irrigation purposes. Villages of Halsi block, viz., Silwe and Gunsagar were found to bear fluoride more than the permissible limit i.e. 1.5 ppm and therefore the ground water is not suitable for drinking purposes without treatment. Phreatic aquifers at some places are also affected with fluoride contaminations. In general the pH of ground water varies from 7.40 - 7.73, Electrical Conductivity (EC) ranges from 730 to 750 (micro Seimens/cm),

Chloride from 21 to 64 ppm and Fluoride from 0.5 to 1.8 ppm. EC contour and point value of fluoride and iron are shown in Fig. - 5.

4.4 Status of Ground Water Development- Block wise

The occurrence and movement of ground water is controlled by diverse geology and landform of the district. An attempt has been made to summarise block wise information on suitable well type, depths, discharge and suitable drilling method (Table 3).

5.0 Ground Water Management Strategy

5.1 Ground Water Development

The most suitable area for ground water development is Younger alluvial plain and marginal alluvial plain along the Kiul river. Alluvial thickness over 120 m was encounter at Ashokdham village. Direct and reverse rotary drillings are suitable in unconsolidated formation while in the hard rock area of the district ground water development with DTH rigs can be done by selecting suitable sites with the help of remote sensing and geophysical techniques. Depth of weathering ranges from 5 to 10m in general. Detail information related to depth, discharge, drilling methods etc are given in table-3.

5.2 Water Conservation and Artificial Recharge

As per statistics of the state govt., the gross irrigated area of district is about 60% of the total cultivable land. As there is scarcity of water in the hard rock area it is advisable to practice water saving devices such as sprinkler and drip irrigation techniques that would bring more area under irrigation. The district receives an average annual rainfall of 1170 mm, but most of the rain water goes as run off. Construction of suitable artificial recharge structure will help to reduce the run off as well as it would also recharge the aquifer and retain the soil moisture. Artificial recharge structure such as contour bunding, check dam, gully plug, percolation tank etc are suitable in hard rock areas, while recharge shaft and percolation tank are more suitable in unconsolidated formation. Selection of suitable site is important for optimum benefits of these structures.

6. 0 Ground Water Related Issue and Problems

The southeastern part of district is occupied by hard rocks thus most of the rain water goes as run off without recharging the aquifers sufficiently which leads to water scarcity in non-monsoon periods. On the contrary, there is water logging problem in Tal area. The chemical quality of ground water is good and suitable for irrigation and other purposes, in general, with exception

to fluoride contaminations in some of the villages. Peoples of Silwe village are affected from fluoride contamination. Potable water in this village should either be supplied form adjacent village or defluorination plant be established for safe drinking water.

7. 0 Mass Awareness and Training Activity

7.1 Mass Awareness Programme

Mass Awareness Programme (MAP) and Training Activity have not been organized in this district so far and will be taken up in near future.

8.0 Area notified by CGWA/SGWA

All blocks of Lakhisarai district is under safe category for ground water development point of view. So far no block has been notified by the Authorities.

9.0 Recommendation

1. Ground water exploration has been done by CGWB in fluoride affected areas of Lakhisarai district indicate that all the potential fractures down to a depth of 100 m is contaminated by fluoride. The weathered zone tapped by the dug wells within 5 -15 m depths is also affected by fluoride contamination.

2. Community based fluoride removal plant can tackle the fluoride menace. There are numbers of fluoride removal techniques. Nalgounda technique is simple and effective.

3. The stage of ground water development is around 33% indicating that there is a large scope for further ground water development however the artificial recharge including rainwater harvesting should be taken to augment the ground water reserve, in Lakhisarai and Surajgarha blocks (Fig-6).

4. Suitable structure for artificial recharge in the area under porous formation are recharge shaft and percolation tank.

5. Suitable structures for artificial recharge in hard rock areas are contour bunding, check dam, gully plug, and percolation tank.

6. The district headquarter Lakhisarai to be taken up under artificial recharge of ground water, keeping in view of rapid increase in ground water draft. The ground water draft in Lakhisarai urban area is to the tune of 32 lakhs lpd. Roof top rain water harvesting to be taken up to recharge the aquifer in Lakhisarai urban area.

Figure - 1

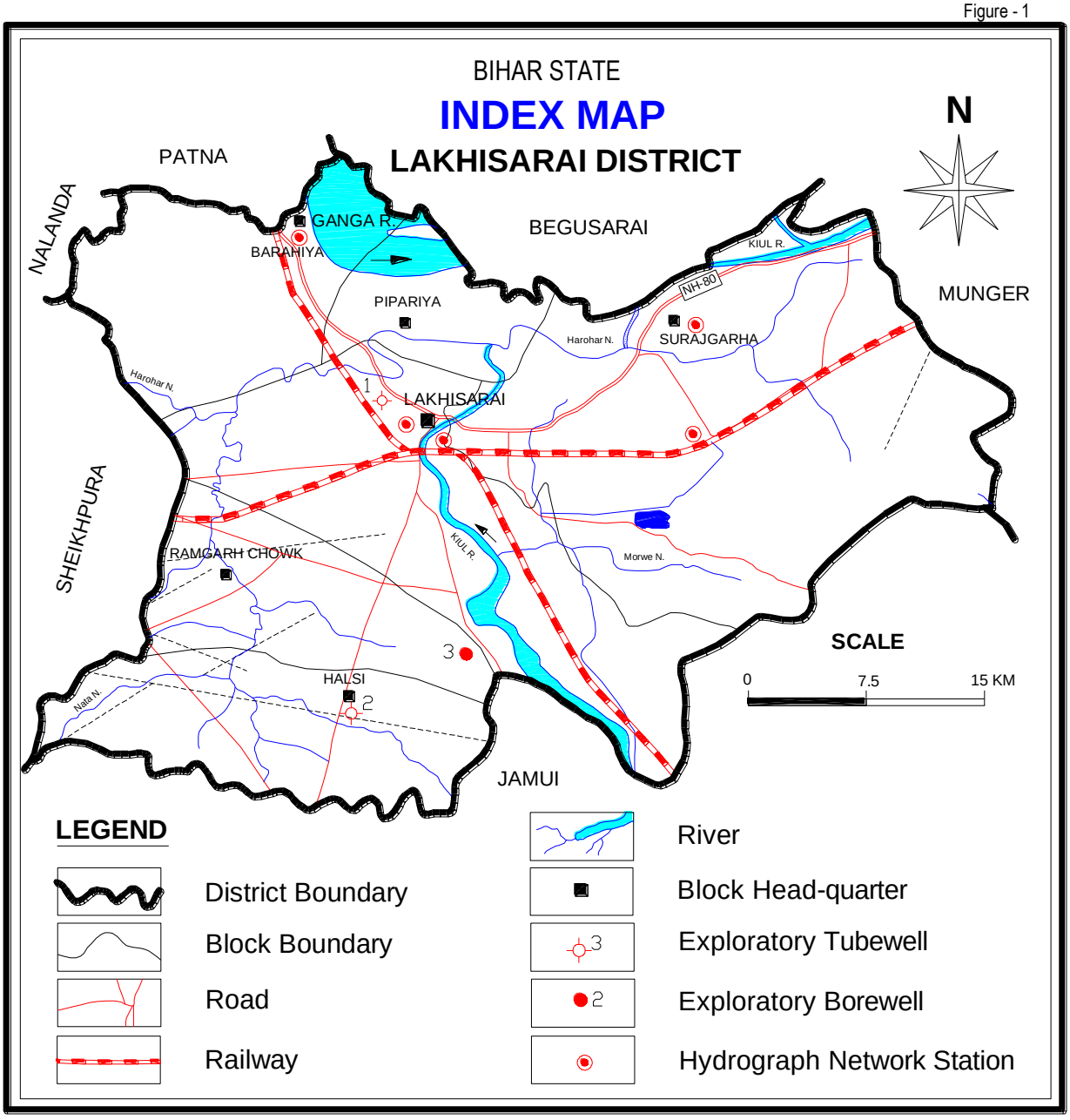
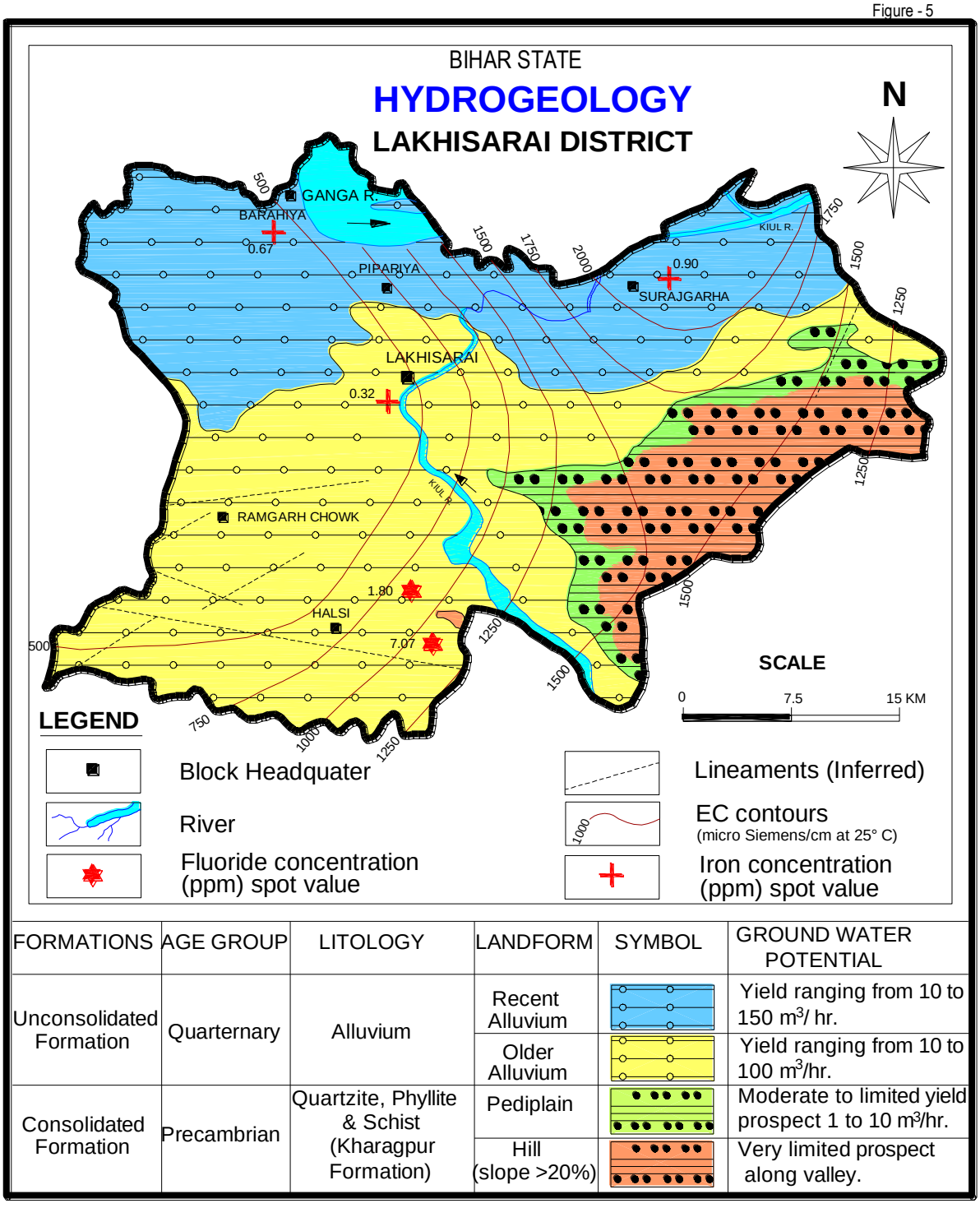


Fig.1 Index map showing the location of the study area.

Figure - 5



FORMATIONS	AGE GROUP	LITOLOGY	LANDFORM	SYMBOL	GROUND WATER POTENTIAL
Unconsolidated Formation	Quarternary	Alluvium	Recent Alluvium		Yield ranging from 10 to 150 m^3/ hr.
			Older Alluvium		Yield ranging from 10 to 100 m^3/hr.
Consolidated Formation	Precambrian	Quartzite, Phyllite & Schist (Kharagpur Formation)	Pediplain		Moderate to limited yield prospect 1 to 10 m^3/hr.
			Hill (slope >20%)		Very limited prospect along valley.

Fig.2 Hydrogeological Map of the study area.

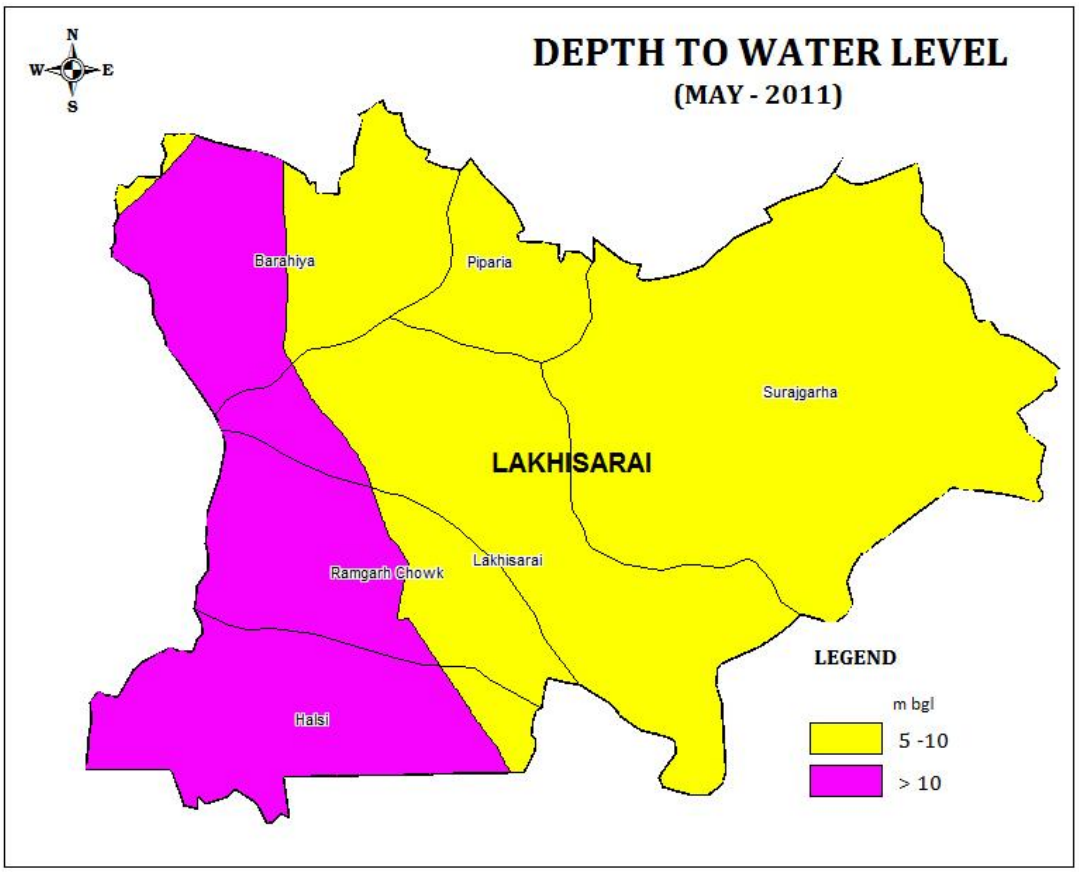


Fig. 3 Depth to water level map of pre-monsoon 2011.

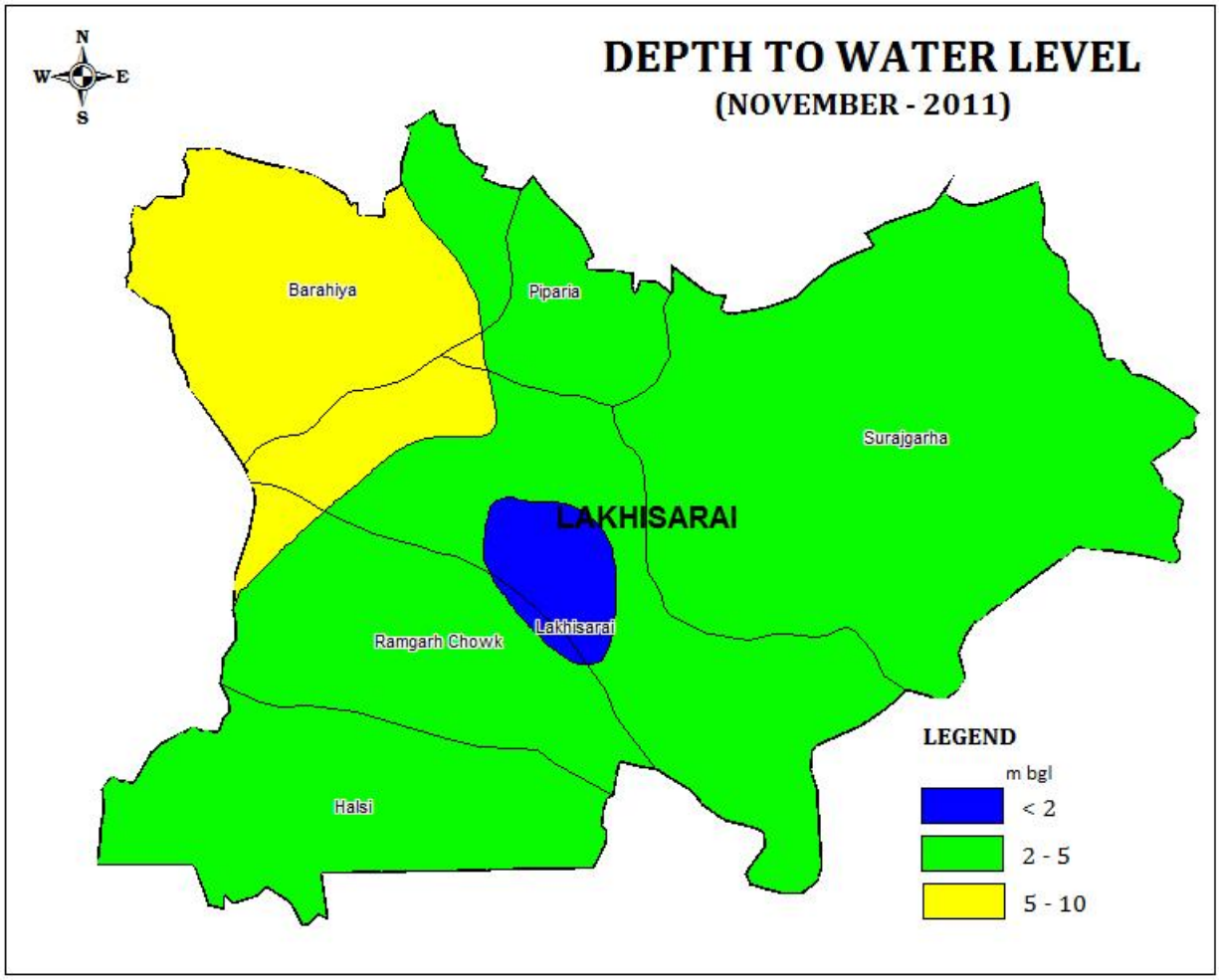


Fig. 4 Depth to water level map of post-monsoon 2011.

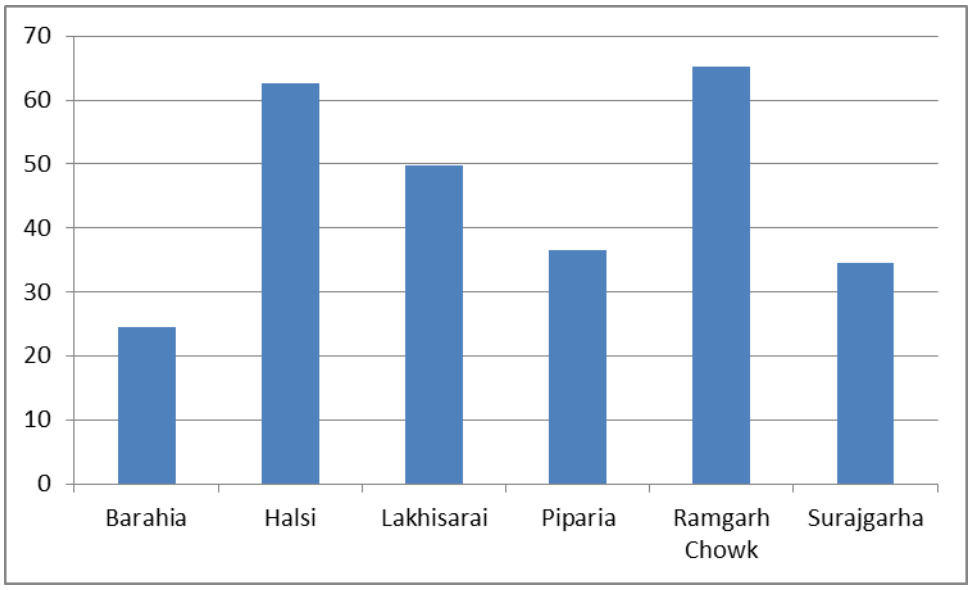


Fig.5 Block-wise stage of ground water development

Table - 01

DETAILS OF EXPLORATORY WELL (EW), LAKHISARAI DISTRICT.

Explora-tory Well No.	Location	Formation	Depth Drilled (m bgl).	Discharge (m3/hr.)	Transmissivity (m^2/day)	Storativity	Quality of water
1	2	3	4	6	7	8	9
1	ASHOKDHAM	Alluvium	116.60	120.00	–	–	Potable
	OW	Alluvium	123.00	–	–	–	Potable
2	HALSI	Alluvium	59.50	237.36	1238.40	2.08 $X10^{-4}$	Potable
	OW	Alluvium	55.40	–	–	–	Potable
3	GUNSAGAR	Quartzite	119.75	15.36	–	–	F Contaminated
	OW	Quartzite	131.50	–	–	–	F Contaminated

F- Fluoride
OW- Observation well

Table 02

Assessment of Dynamic Ground Water Resources of the Bihar state Lakhisarai district(as on 31st March 2009)

(in hectare meters)

Sl.No	AssessmentUnit/District	Net Annual Ground water Availability	Existing Gross Ground Water Draft for Irrigation	Existing Gross Ground water Draft for Domestic and Industrial Water Suply	Existing Gross Ground Water Draft For all Uses (10+11)	Allocation for Domesticand Industrial Requirement suply upto next 25 years	Net Ground Water Availability for future irrigation development (9-10-13)	Stage of Ground Water Development (12/9)*100 (%)
1	2	9	10	11	12	13	14	15
1	Barahia	6914	1300	395	1695	346	5268	24.5
2	Halsi	3431	1993	154	2147	222	1216	62.6
3	Lakhisarai	7263	3157	462	3619	731	3375	49.8
4	Piparia	1749	586	53	639	76	1086	36.5
5	Ramgarh Chowk	2110	1257	121	1378	174	679	65.3
6	Surajgarha	6475	1860	381	2242	550	4065	34.6
	Total	**27941**	**10153**	1566	**11719**	**2100**	**15688**	41.9

Table - 03

Block wise data on type wells, design and suitable pump of Lakhisarai District.

S.No	Block Name	Suitable Well type	Expected Discharge (LPM)	Recomm-ended depth (m)	Diameter of well	Suitable Drilling method	Type of pump	Success rate
1.	Barahiya	Tube well	100-500	100-150	6 inch	Rotary	Submersible	Good
2.	Halsi	Tube well	100-500	100-150	6 inch	Rotary	Submersible	Moderate
		Bore well	100-300	100-150	4 inch	DTH	Submersible	Moderate to poor
3.	Lakhisarai	Tube well	100-500	100-150	6 inch	Rotary	Submersible	Good
		Bore well	100-300	100-150	4 inch	DTH	Submersible	Moderate to poor
4.	Pipariya	Tube well	100-500	100-150	6 inch	Rotary	Submersible	Good
5.	Ramgarh chwok	Tube well	100-200	40-70	6 inch	Rotary	Submersible	Good
6.	Surajgarha	Dug well	80-100	10-15	2.5-3.5 m	Manual	Centrifugal	Moderate
		Tube well	100-500	100-150	6 inch	Rotary	Submersible	Good
		Bore well	100-300	100-150	4 inch	DTH	Submersible	Moderate to poor