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भारत सरकार

Central Ground Water Board

Department of Water Resources, River
Development and Ganga Rejuvenation,
Ministry of Jal Shakti
Government of India

AQUIFER MAPPING AND MANAGEMENT OF GROUND WATER RESOURCES

SARGUJA DISTRICT, CHHATTISGARH

उत्तर मध्य छत्तीसगढ़ क्षेत्र, रायपुर

North Central Chhattisgarh Region, Raipur

FOREWORD

Groundwater resources are being developed over years in order to meet domestic, irrigation and industrial requirements. The spatial distribution of availability of ground water resources however, is uneven and is being indiscriminately exploited by various users thereby creating relentless pressure. On the other hand, rapid urbanization, industrialization and land use changes has resulted decline of water levels in many parts of the country.

There is an urgent need for scientific approach for proper management of the available ground water resources for sustainability of this precious natural resource for present and future generation.

Central Ground Water Board has been in the forefront of activities for occurrence, development, and management of this resource through various scientific studies and techniques. Over the last four decades CGWB, NCCR, Raipur has gathered a huge amount of data regarding ground water resources of Chhattisgarh. Based on this experience aquifer mapping of Raigarh district was prepared with the vast amount of data generated and available with North Central Chhattisgarh Region. The report embodies all the features of ground water and related aspects of the study area including physiography, meteorological conditions, hydrology, drainage, geomorphology, geology, hydrogeology, ground water resources, hydrochemistry, geophysics, ground water problems etc.

The report titled "A REPORT ON AQUIFER MAPS AND GROUNDWATER MANAGEMENT PLAN OF SURGUJA DISTRICT, CHHATTISGARH" is prepared by Sh Uddeshya Kumar, Scientist-B under supervision of Sh. A.K.Patre, Scientist-D. I appreciate the concerted efforts put by the author to make it possible to bring the report in its present shape. I hope this report will no doubt be useful and worthy for the benefit of Raigarh district and would be a useful document for academicians, administrators, planners and all the stakeholders in ground water.

Though utmost care has been taken to minimize the errors, some errors may have inadvertently crept in. It is expected that these mistakes will be taken in the proper spirit.

Dr. Santanu Samanta
(REGIONAL DIRECTOR (I/C))

Executive summary

Aquifer mapping is a multidisciplinary scientific process wherein a combination of geological, hydrogeological, geophysical, hydrological and quality data is integrated to characterize the quantity, quality and movement of ground water in aquifers. However, due to paradigm shift in focus from development to management of ground water in last one decade, the need for more reliable and comprehensive aquifer maps on larger scale has been felt for equitable and sustainable management of the ground water resources at local scale. Volumetric assessment of ground water and strategies for future development and management are the primary objectives of aquifer mapping.

Under the aquifer mapping programme, all the development blocks of Surguja District namely Ambikapur, Lakhanpur Udaipur, Lundra, Sitapur, Batauli and Mainpat of Surguja district was taken up covering an area of 5191.19 sq. km. It falls in the Survey of India's Degree Sheet No. 64 I, J, M and N between the latitude 22°37'36" to 23°16'33" North and longitude 82°45'27" to 83°41'51" East. Surguja district is situated in the northern part of the Chhattisgarh state and surrounded by Surajpur and Balrampur districts in the north, Koriya district in the west, Korba and Raigarh districts in the south and Jashpur district in the east. The district has a well-developed road network and district headquarter Ambikapur is connected to rail network operated by SECR under Bilaspur Division.

The total population of the study area as per 2011 Census is 8,40,352 out of which rural population is 7,03,650 & the urban population is only 1,36,702.

The study area experiences sub-tropical climate. The average annual rainfall for the study area is around 998 mm (Average of the last five years i.e. 2013 to 2017)

Geomorphologically the study area displays Structural Plains, Pediment/Pediplain, Denudational Hills and Valleys with an elevation ranging from 440 to 1116 mamsl.

The net sown area is 1,55,004 hectares, while double-cropped area is 20,832 hectares. Rice is sown in nearly 75% of the net sown area.

The net irrigated area in the study area is 17,203 hectares where ground water contribution is 5,807 Ha only. Percentage of Area Irrigated by ground water with respect to net irrigated area is 33.75%. About 90% area with respect to net sown area is dependent on rain only.

Based on the exploratory drilling data generated for the blocks, the existing aquifer systems in the area may be divided into phreatic and semiconfined aquifer. The major aquifers present in the study area are (1) Granite/ Gneiss (2) Sandstone (3) Basalt. In Granite/Gneiss, Discharge varies from 0- 12 lps having Av. Drawdown of 27 m and higher yields are obtained where thick weathered zones are associated with bedrock fracturing. In Sandstone (Gondwana), Discharge varies from 0- 12.5 lps having Av. Drawdown of 26 m.

Sandstones having felsdpathic composition and medium to coarse grained, it is then porous and permeable and forms good aquifers.

As per 2017 ground water resource calculation stage of ground water development in the study area is only 34.23%. So, there is scope of utilizing more ground water for future irrigation purpose and other purposes. Additional number of Ground water abstraction structure may be developed for the effective utilization of ground water resources.

The major ground water issues identified during the survey in the study area are as follows: (i) The aquifers are low yielding ones in terms of groundwater. (ii) During summer, dug wells in some villages becomes dry at many locations. Several handpumps also stop yielding water. (iii) It has been observed during fieldwork, there is colossal wastage of groundwater through private well and public water supply system. (iv) Poor stage of groundwater development. (v) In some areas the water level remains below 3 m during the post-monsoon period in the study area which needs to be attended for intervention.

In study area because of complex hydrogeological conditions ground availability is scattered. In area where ground water availability is limited surface water may be conserved and utilized. High value of Fluoride and Iron has been reported from several locations. In granitic aquifer system at many places ground water is contaminated with Fluoride because of geogenic reasons. The problem of fluoride contamination in drinking water may be tackled by setting up of small defluorination units in affected villages or alternate source may be identified. Similarly, Iron filter may be used for the villages having high Iron concentration. Regular ground water quality monitoring is also required.

So far as Management strategies are concerned for ground water availability, Artificial Recharge structures may be constructed in suitable locations especially in the areas where the water level remains deeper than 3m in the post-monsoon period. In order to achieve 70% stage of ground water withdrawal in these blocks, ground water development may be taken up by construction of suitable abstraction structures. De-siltation of existing Tanks and Talabs to be carried out for efficient storage of rainwater. Also, Rain water harvesting structures may be constructed in villages to reduce stress on groundwater. Massive awareness campaigns are essential to aware people about the effective utilization of ground water resources and importance of community participation in saving water.

Acknowledgement

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AQUIFER MAPS AND GROUND WATER MANAGEMENT PLAN, SURGUJA DISTRICT, CHHATTISGARH

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AQUIFER MAPS AND GROUND WATER MANAGEMENT PLAN SURGUJA DISTRICT, CHHATTISGARH

CONTENTS

ABBREVIATIONS

a msl	above mean sea level
BDR	Basic Data Report
BW	Borewell
CGWB	Central Ground Water Board
Dia	Diameter
DTW	Depth To Water
DW	Dugwell
EC	Electrical Conductivity
EW	Exploratory Wells
GS	Gabion structures
GW/ gw	Ground Water
ham	Hectare meter
HP	Handpump (Shallow)
lpcd	litres per capita per day
lpm	litres per minute
lps	liters per second
m	meter
m bgl	meter below ground level
m2/day	Square meter/ day
m3/day	cubic meter/day
MCM/mcm	Million Cubic Meter
NCCR	North Central Chhattisgarh Region
NHNS/ NHS	National Hydrograph Network Stations
OW	Observation Well
PZ	Piezometre
STP	Sewage Treatment Plan
T	Transmissivity
TW	Tubewell

1. Introduction
1.1 Objective

The groundwater is the most valuable resource for the country. However, due to rapid and uneven development, this resource has come under stress in several parts of the country. Central Ground Water Board (CGWB) is, therefore, involved in hydrogeological investigations for Re-appraisal of ground water regime. CGWB has also carried out ground water exploration in different phases with prime objective of demarcating and identifying the potential aquifers in different terrains for evaluating the aquifer parameters and also for developing them in future. The reports and maps generated from the studies are mostly based on administrative units such as districts and blocks and depict the subsurface disposition of aquifer on regional scale. However, due to paradigm shift in focus from development to management of ground water in last one decade, the need for more reliable and comprehensive aquifer maps on larger scale has been felt for equitable and sustainable management of the ground water resources at local scale.

1.2 Scope of study

The demand for ground water for various types of use is increasing day by day; consequently, indiscriminate development of ground water has taken place and the ground water resource has come under stress in several parts of the country. On the other hand, there are also areas where adequate development of ground water resources has not taken place. These facts underscore the need for micro- level study of the aquifer systems of the country. The water resource managers and planners to develop and implement effective long term as well as short term aquifer management strategies, a host of scientific questions must be answered. These questions can be best answered through a comprehensive process that integrates the available scientific data. Aquifer mapping study thus is a multidisciplinary scientific process wherein a combination of geological, hydrogeological, geophysical, hydrological and quality data is integrated to characterize the quantity, quality and movement of ground water in aquifers. It primarily depends on the existing data that are assembled, analyzed and interpreted from available sources. The data gap analysis carried out helped to generate data from data newly collected through activities such as exploratory drilling, groundwater level monitoring on a regular basis for a considerable period and groundwater quality analysis. These existing as well as generated data were analyzed in ordered to prepare regional hydrogeological, thematic, water quality maps, cross-sections, 2 –D and 3-D aquifer disposition maps. The aquifer maps are the maps depicting aquifer disposition, giving lateral and vertical extension. The maps will also provide information on the quantity and quality. It explains the components of the Aquifer Classification System, outlines the assumptions underlying the map information presented and summarizes the content of an aquifer classification map. The goal is to help the map users understand the strengths and limitations of the information contained on the aquifer classification maps so that they can apply that information appropriately to their particular water and land management needs. The system and maps are designed to be used together and in conjunction with other available information as a screening tool for setting groundwater management priorities. These provide a way of comparing aquifers within a consistent hydrogeological context and prioritizing future actions at various planning levels. The maps may provide some background information for site-specific projects. However, the maps are not to be used for making site-specific decisions. The classification of an aquifer reflects the aquifer as a whole and at a specific time. Groundwater conditions, such as the degree of vulnerability and water quality, may vary locally and over time respectively. This variability in the data sometimes requires subjective decision-making and generalizing of information for an entire aquifer.

1.3 Approach and Methodology

The activities under the aquifer project can be summarized as follows:

i) **Data Compilation & Data Gap Analysis:** One of the important aspects of the aquifer mapping programme was the synthesis of the large volume of data already collected during specific studies carried out by the Central Ground Water Board and various other government organizations with a new set of data generated that broadly describe an aquifer system. The data were compiled, analyzed, synthesized and interpreted from available sources. These sources were predominantly non-computerized data that were converted into computer-based GIS data sets. On the basis of these available data, Data Gaps were identified.

ii) **Data Generation:** It was evident from the data gap that additional data should be generated to fill the data gaps in order to achieve the objective of the aquifer mapping programme. This was done by multiple activities like exploratory drilling, hydrochemical analysis, use of geophysical techniques as well as detail hydrogeological surveys.

iii) **Aquifer map Preparation:** On the basis of integration of data generated through various hydrogeological and geophysical studies, aquifers have been delineated and characterized in terms of quality and potential. Various maps have been prepared bringing out the Characterization of Aquifers. These maps may be termed as Aquifer Maps depicting spatial (lateral and vertical) variation of the aquifers existing within the study area, quality, water level and vulnerability (quality and quantity).

iv) **Aquifer Management Plan:** Based on the integration of these generated, compiled, analysed and interpreted data, the management plan has been prepared for sustainable development of the aquifer existing in the area.

1.4 Area Details

Under the aquifer mapping programme, all the 07 development blocks of surguja district was covered and aquifer map and management plan prepared for all the blocks. Surguja district is located in the northern part of Chhattisgarh. It is bounded by latitude 22°37'36" to 23°16'33" N and longitude 82°45'27" to 83°41'51" E. It is surrounded by Surajpur and Balrampur districts in the north, Koriya district in the west, Korba and Raigarh districts in the south and Jashpur district in the east. It covers an area of about 5191.19 Sq Km. Nearly 27 % of the total geographical area of the District is covered by forest.

The total population of district as per 2011 Census is 840352 out of which male population is 424492 while the female population is 415860 and having population density of 162 per sq km. In the district rural population is 703650 while the urban population is 136702.

1.4.1 Administrative Division

Ambikapur district has 568 villages and for administrative convenience these villages are grouped into 7 no. of development blocks. Ambikakur is the districts headquarter. The block headquarters are at Ambikapur, Lakhanpur Udaipur, Lundra, Sitapur, Batauli and Mainpat. The administrative map for the Surguja district is given in **Fig 1.**

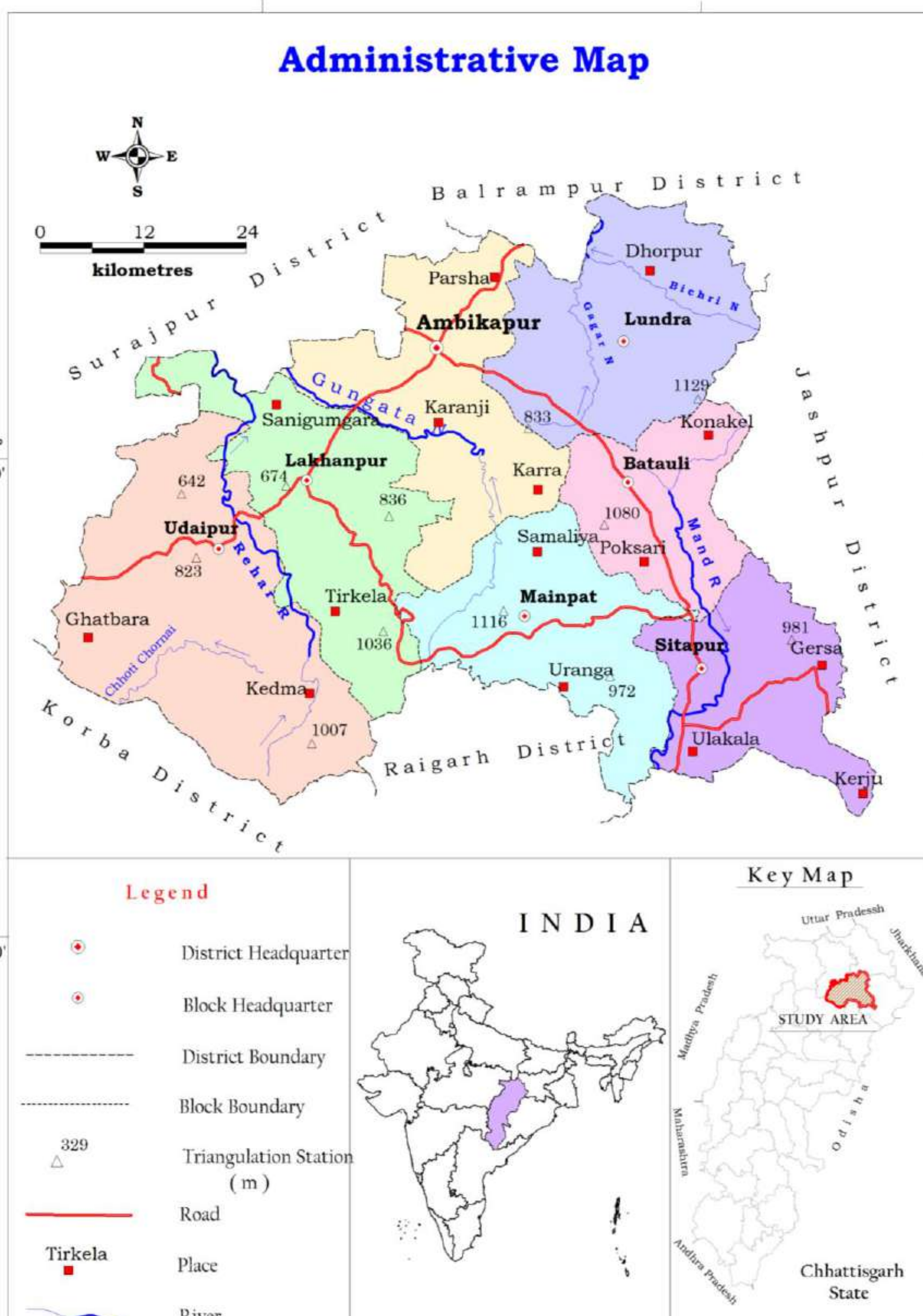

Figure 1 Administrative Map of Surguja District

1.5 Data Availability, Data Adequacy and Data gap Analysis

The hydrogeological data already available including number of key wells, VES, exploratory wells, chemical parameters have been collected and analysed which shows that in the Surguja district the required number of ground water monitoring stations is 80 for unconfined aquifer against which only 25 stations are available leading to the data gap of 55 and for semiconfined aquifer monitoring stations is 04 against 45. Similarly, the required number of ground water exploratory wells is 45 against which only 25 stations are available leading to the data gap of 20. Likewise, the required number of ground water quality monitoring stations is 135 against which only 32 stations are available leading to the data gap of 103. For geophysical data, the required number of VES is 90 against which 40 are available leading to the data gap of 50.

1.5.1 Data Gap Analysis

On the basis of the NHS data, VES data and chemical data available in the study area, the data gap analysis has been prepared to ascertain the data gap in the Surguja district which is presented in summary in Table 1.

Table 1 Data gap analysis in Surguja district

Activity	Required	Available	Gap
Exploration EW/OW	45	25	20
GW Monitoring (Unconfined aquifer)	80	25	55
GW Monitoring (Semiconfined aquifer)	45	4	41
Quality monitoring	135	32	103
VES	90	40	50

1.6 Rainfall-spatial, temporal and secular distribution

The Surguja district receives rainfall mainly from south-west monsoon. 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. The average annual rainfall for the Surguja district is around 998.6 mm (Average of the last five years i.e. 2013 to 2017) which is presented below in **Table 2**.

Table 2 Annual Rainfall (mm) in Surguja district for the years (2013 to 2017)

Year	2013	2014	2015	2016	2017
Surguja	1008.0	831.1	957.0	1061.7	1135.0

Source: District Statistical Handbook 2018

1.7 Physiography/Geomorphology

Physiographically the district is divided in three parts are Mountains (high lands), Plateaus and Hills (uplands) and Central plain. Surguja district displays structural plains in western part covering Udaipur, Lakhanpur and Ambikapur blocks. Mainpat and adjoining areas of Udaipur, Lakhanpur and Ambikapur blocks is region of Plateau. Lundra block and adjoining area with Ambikapur block and Batauli block represents denudational plateau. Eastern part of Lundra blocks represent denudational hills and valleys. Sitapur block along with adjoining blocks represent pediments. The elevation of this region ranges from 440 to 1116 meters. **Fig 2** shows the Geomorphology in the study area.

1.8 Land use

There is 144015.3 ha is forest area in the district. Area not available for cultivation is 43663 ha. Details are presented in Table 3.

Table 3: District Land Use Pattern (Ha)

Total geographical area	Forest Area	Area not available for cultivation	Non agricultural & Fallow land	Agricultural Fallow land	Net sown area	Double cropped area	Gross cropped area
519119	144015.3	25267	72266	30908	155004	20832	175836

1.9 Soil

The soils in the district are having wide variations. About 33% of the district area, is covered by Alfisols- red sandy soil, covering mainly Udaipur block, northern part of Ambikapur block and eastern part of Sitapur and Batauli block. About 42% area of the district covering part of Lakhanpur, Sitapur, Batauli and Ambikapur blocks covered by Ultisols- red and yellow soils. About 19 % of district area i.e. Mainpat block and adjoining area of Lakhanpur block have the Ultisols in the form of laterites. The remaining part of the district is represented by light grey and shallow black inceptisols, Fig 3 shows the soil map of the area.

1.10 Hydrology and Drainage

Surguja district forms a part of Mahanadi basin with rivers viz. Hasdeo, Gej, Chornai and Mand as well as Ganga basin with rivers viz Mahan, gagar and Bichri. The Ganga basin covers 65 % of the area however the remaining area is drained by the Mahanadi basin. The drainage pattern in the District is dendritic to sub-dendritic and the drainage density is high in central and southern parts.

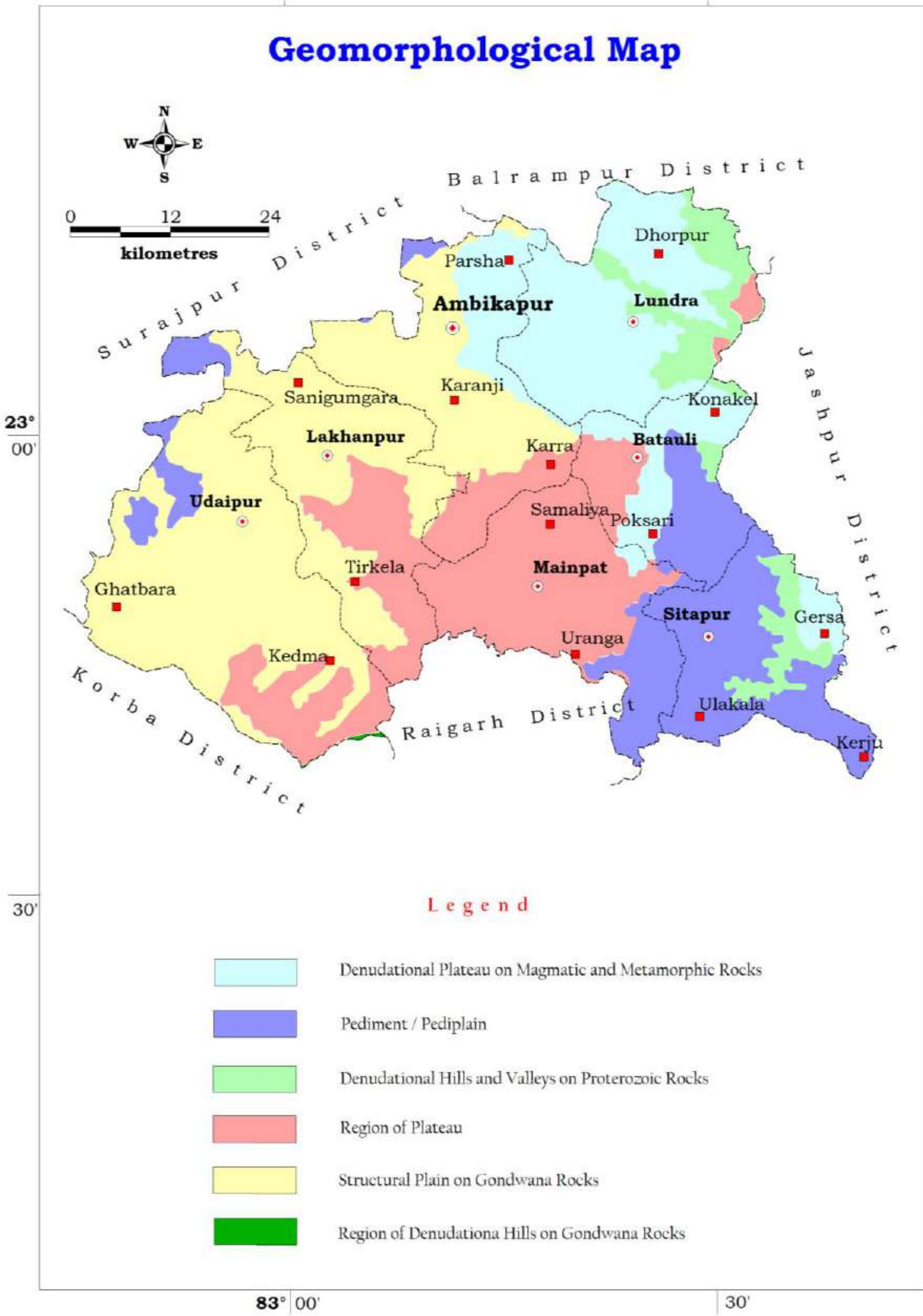

Figure 2 Geomorphological Map of Study Area

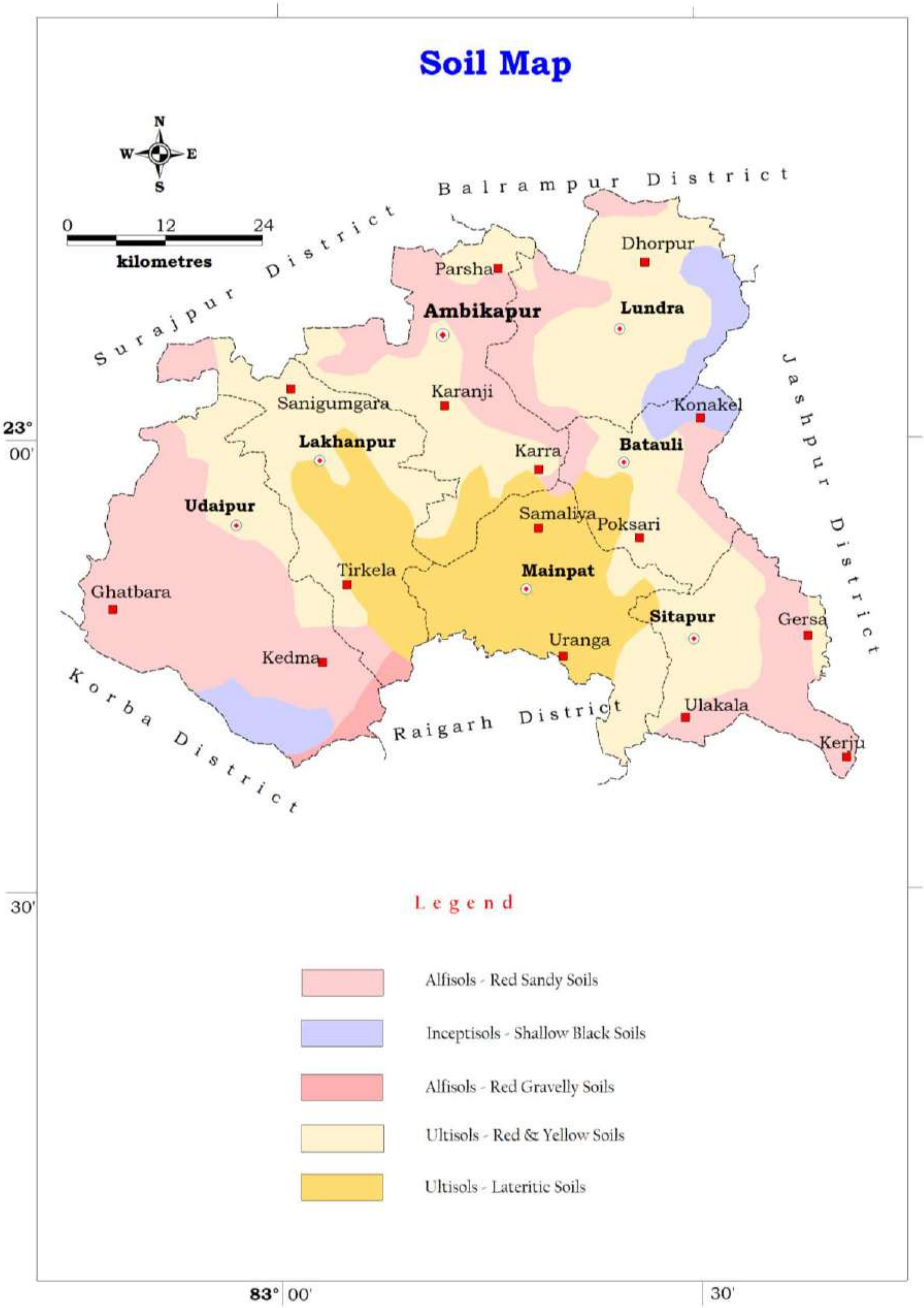

Figure 3 Soil Map of Study Area

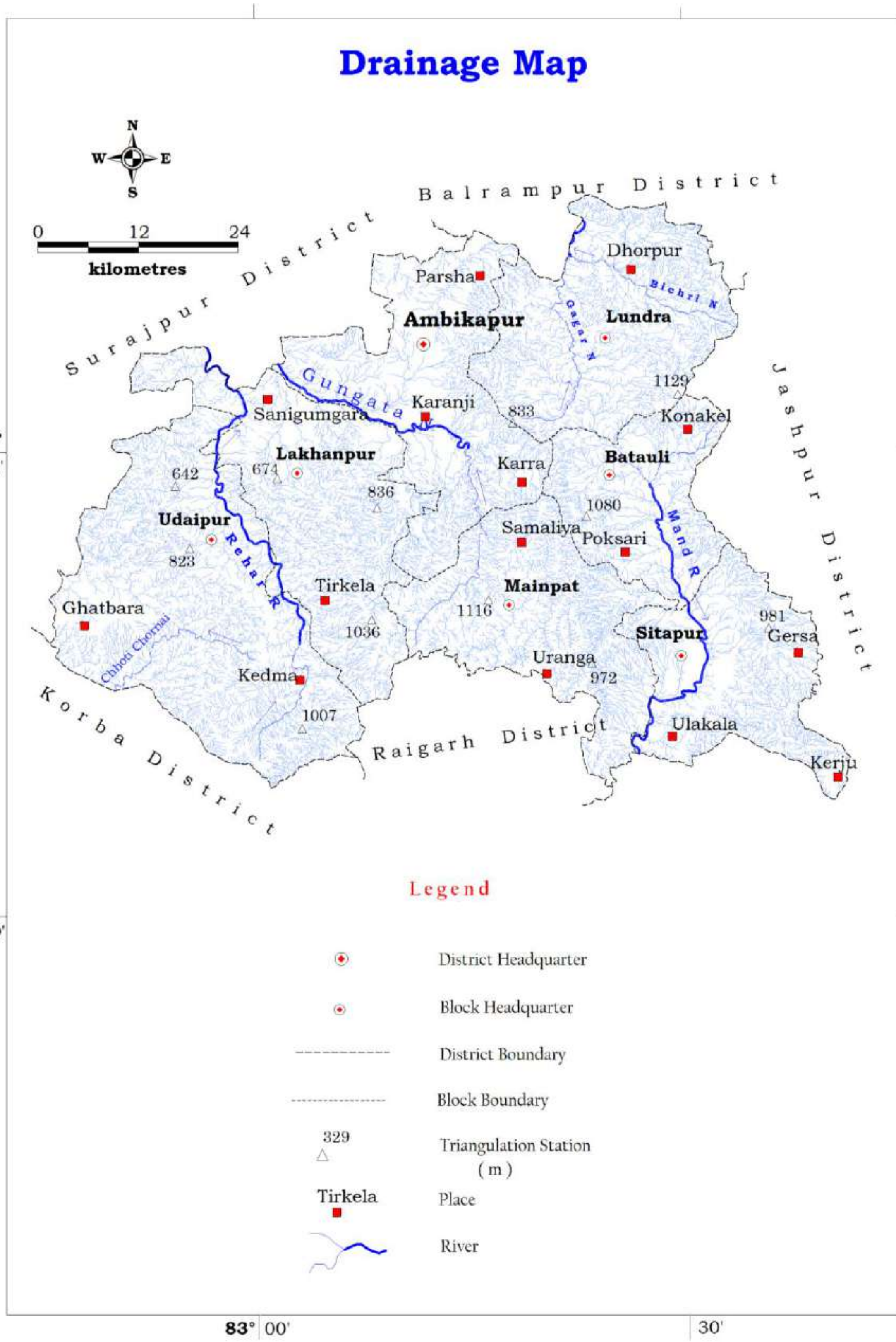

Figure 4 Drainage Map of Study Area

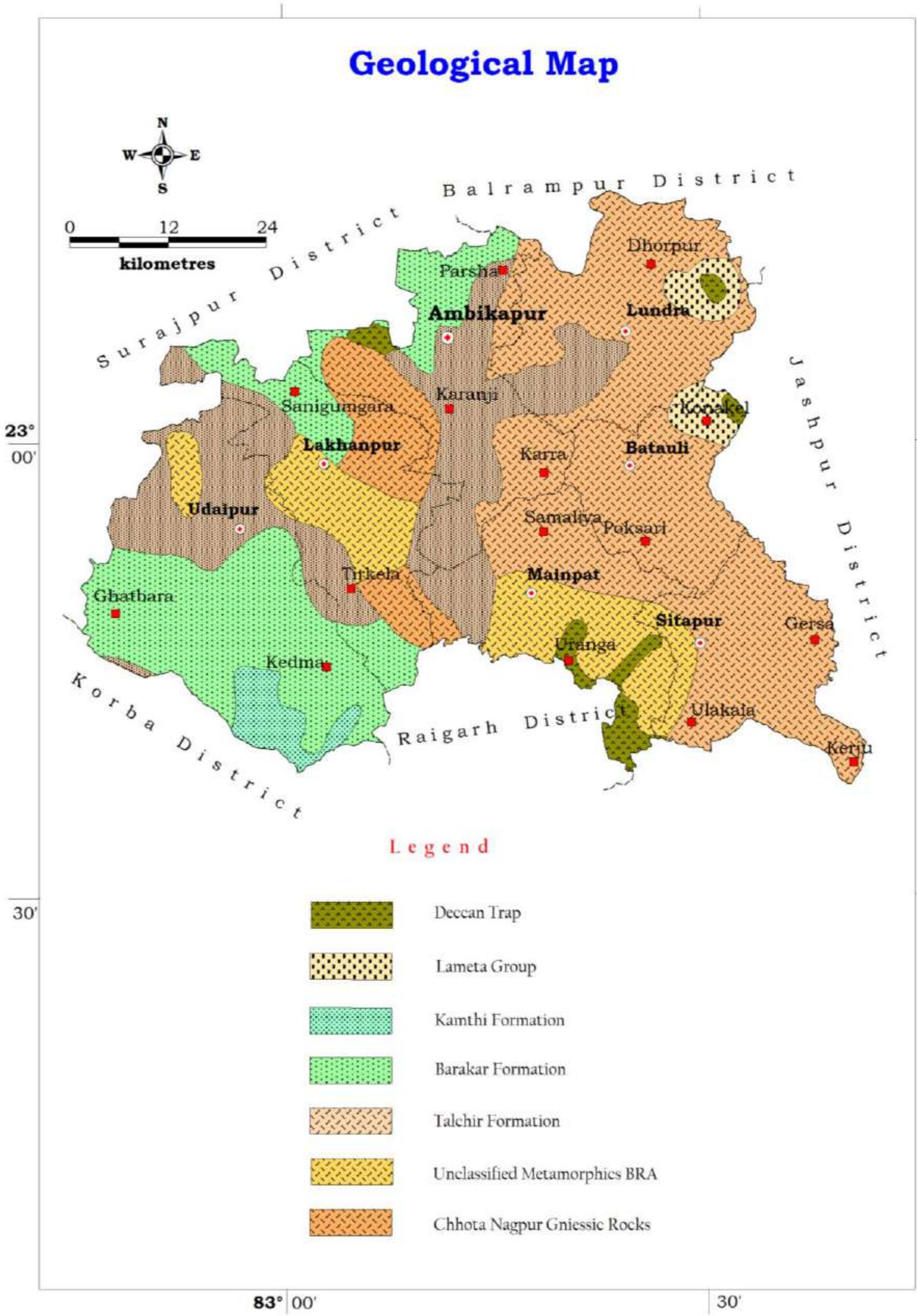

Figure 5 Geological Map of Study Area

1.11 Geology and Hydrogeology

The district is underlain mainly by three distinct geological formations ranging in age from Achaean to recent. The crystalline basement, occupy eastern parts of the district, comprising of granite and granitic gneiss rocks belonging to Chhota Nagpur group, severally intruded by the quartz veins and basic dykes. Western part of the district mainly Udaipur block and part of Lakhanpur and Ambikapur block of the district is occupied by the rocks of Gondwana Super Group and represented by the sandstone, shale and coal seam. In Mainpat area there is exposure of Deccan trap.

Basement crystalline:
The ground water mainly occurs in phreatic conditions and at places under semi-confined conditions. Average weathered thickness is 21m. The weathered and fractured formation constitutes the aquifers. Invariably the fractures are limited to a depth of 9 to 158m.

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. The uneveness 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. 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. A few outliers of hard bedded sandstones overlie the Barakars comprising hard gritty arkosic sandstone and pebbles of quartizitic these formation are known as supra Baraker formation. Exploratory drilling has brought out the fact that the lower unit of Barakar and suprabarakar formations is more productive, potential aquifer encountered upto 191 mbgl.

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 hornblned, quartz, etc. and exposed in Mainpat block. The upper part of each flow is vesicular and comprises rounded to oval shaped vesicles, which are generally filled with zeolities, calcites or quartz.

Lameta Formations: These are Laterites of Pleistocene and Recent age occur over large areas of this District as capping on formations. They are mostly ferruginous in nature (at places aluminous) and due to concentration of aluminous material deposits of Bauxite are formed at localised places. At places the laterite is 25 to 30 meters thick.

1.12 Agriculture, Irrigation, Cropping Pattern

Agriculture is practiced in the area during Kharif and Rabi season every year. During the Kharif, cultivation is done through rainfall while during the Rabi season, it is done through ground water as well as partly through surface water like canals and other sources. The groundwater abstraction structures are generally Dugwells, Borewells /tubewells. The principal crops are paddy, wheat, maize, oil seeds, vegetables and pulses.

In some areas, double cropping is also practiced. The agricultural pattern, cropping pattern and area irrigated data of Surguja districtis given in Table 4, 5 and 6.

Table 4: Cropping pattern (in ha)

Kharif	Rabi	Cereal					Pulses	Tilhan	Fruits and Vegetables	Sugarcane	Mirch Masala
		Wheat	Rice	Jowar & Maize	Rajgira	Others					
150848	24988	5280	116068	8562	2173	26	12821	18558	8780	2016	1245

Table 5: Area irrigated by various sources (in ha)

No. of canal s (private and Govt.)	Irrigated area	No.of bore wells/ Tube wells	Irrigated area	No. Of dug wells	Irrigated area	No. of Talabs	Irrigated area	Irrigated area by other sources	Net Irri-gated area	Gross irrigated area	% of irrigated area wrt. Net sown area
52	7006	3409	922	11256	4885	779	417	9009	17203	19521	9.84

Table 6 : Statistics showing Agricultural land Irrigated

Net Irrigated Area	Net Irrigated Area by ground water	Percentage of Area Irrigated by ground water wrt. net irrigated area
17203	5807	33.75

2.0 Data Collection and Generation

2.1 Hydrogeological Data Keeping in view of the diverse hydrogeology of the Surguja district additional 80 key well has been established in unconfined aquifer and 49 key well in semiconfined aquifer for monitoring of water level and other hydrogeological information. A total of 129 key well (**Table 7**) has been established and monitored in pre monsoon and post monsoon period.

Table 7 Details of monitoring well (Key well)

SL	Location	Block	Latitude	Longitude	Well Type	WL_Premonsoon	WL_Post Mon	Fluctuation
1	Amgashi	Lakhanpur	22.9513	83.0066	DW	6.95	3.1	3.85
2	Argoti	Lakhanpur	22.7968	83.0758	DW	8.9	4.25	4.65
3	Bargai	Lakhanpur	22.9452	83.1941	DW	5	1.5	3.5
4	Bargidih	Batauli	22.9967	83.45	DW	6.5	2.65	3.85
5	Beljera	Sitapur	22.7997	83.558	DW	5.6	4.3	1.3
6	Belkharika	Lakhanpur	22.9912	83.1501	DW	7.7	3.4	4.3
7	Belkota	Batauli	23.0181	83.3815	DW	7	6.5	0.5
8	Bhagwanpur	Ambikapur	23.1603	83.1655	DW	8	2	6
9	Brimkela	Batauli	22.899	83.4949	DW	5.8	2.4	3.4
10	Chainpur	Udaipur	22.9813	82.9743	DW	7.15	3.65	3.5
11	Chikhladih	Ambikapur	23.1981	83.1997	DW	7.5	4	3.5
12	Fulchuhi	Udaipur	22.9363	82.8478	DW	3.5	1.6	1.9
13	Ghutrapara	Lakhanpur	22.955	83.0489	DW	7.3	3.4	3.9
14	jamdih	Udaipur	23.0369	82.9389	DW	7.5	4.1	3.4
15	Kadampara	Ambikapur	23.0967	83.1962	DW	8.4	2.55	5.85
16	Baneya	Sitapur	22.7166	83.5123	DW	4.1	1.65	2.45
17	Karabet	Mainpat	22.8362	83.4739	DW	3.9	1.4	2.5
18	Karji	Ambikapur	23.0432	83.1949	DW	4.1	3.4	0.7
19	kedna	Udaipur	22.7724	83.0588	DW	7.8	4.95	2.85
20	Keori	Lakhanpur	22.9864	83.0997	DW	5.65	3.2	2.45
21	Kewra	Lakhanpur	22.9998	83.0671	DW	3.85	2.45	1.4
22	Latori	Lakhanpur	23.0099	82.994	DW	7.7	4.35	3.35
23	Mahamaya Chowk	Ambikapur	23.123	83.1981	DW	0	0	0
24	Motipur	Ambikapur	22.9842	83.196	DW	8.72	4.8	3.92
25	Murta	Sitapur	22.8187	83.5259	DW	7.6	4.3	3.3
26	Pandaridand	Udaipur	22.9186	82.8506	DW	3.6	2.25	1.35
27	Parsoudi	Ambikapur	23.0787	83.0352	DW	4.2	2.6	1.6

SL	Location	Block	Latitude	Longitude	Well Type	WL_Premonsoon	WL_PostMon	Fluctuation
28	Patpariya	Ambikapur	23.1348	83.1665	DW	6.35	4.15	2.2
29	Rikhi	Udaipur	22.98	82.9186	DW	4.9	1.97	2.93
30	Sajar	Udaipur	22.7971	83.0179	DW	9.35	6.71	2.64
31	Sakalo	Ambikapur	23.1842	83.2002	DW	3.7	1.25	2.45
32	Sargawan	Ambikapur	23.1687	83.206	DW	8.8	4.3	4.5
33	Shrigarh	Ambikapur	23.1017	83.222	DW	8.23	4.2	4.03
34	Sonpur Khurd	Ambikapur	23.0993	83.0727	DW	7.8	4.45	3.35
35	Suarpara	Batauli	22.9268	83.4393	DW	4.9	2.1	2.8
36	Sumerpur	Lundra	23.0805	83.2851	DW	7.7	4.7	3
37	Udari	Lundra	23.1223	83.3397	DW	6.5	4.15	2.35
38	Uparpara (bakima)	Ambikapur	23.0982	83.1127	DW	9.2	5.95	3.25
39	Koichal	Mainpat	22.6973	83.3985	DW	4	2.3	1.7
40	Paiga	Mainpat	22.8691	83.3985	DW	4.1	3	1.1
41	Kardana	Mainpat	22.9127	83.3505	DW	3.3	1.85	1.45
42	Girhuldih	Sitapur	22.821	83.6214	DW	3.9	2.2	1.7
43	Shivnathpur	Sitapur	22.7437	83.6073	DW	4.7	2.4	2.3
44	Pasena	Lundra	23.1122	83.4929	DW	5	2.7	2.3
45	Kakalo	Ambikapur	23.0711	83.2119	DW	8.38	1.44	6.94
46	Mangari	Batauli	22.9056	83.45	DW	8.9	5.26	3.64
47	Nagadand	Mainpat	22.8994	83.2903	DW	16.6	2.65	13.95
48	Rajpari	Ambikapur	23.0303	83.2411	DW	4.45	1.06	3.39
49	Ambikapur	Ambikapur	23.1083	83.2	DW	9.9	5.03	4.87
50	Amdih	Lundra	23.2272	83.4097	DW	7.26	6.34	0.92
51	Amgachi	Lakhanpur	22.9508	83.0053	DW	5	1	4
52	Baghima	Ambikapur	23.2417	83.3139	DW	4.62	2.41	2.21
53	Bandana	Mainpat	22.8472	83.4139	DW	7.36	4.67	2.69
54	Batauli Kunkurikala	Batauli	22.9719	83.4122	DW	5.2	2	3.2
55	Bulga	Lundra	23.1	83.3542	DW	8.86	4	4.86
56	Chatakpur	Ambikapur	22.9822	83.2203	DW	5.7	3.68	2.02
57	Dandgaon	Udaipur	22.895	82.8569	DW	7	3.47	3.53
58	Dandgaon Koltapara	Lundra	23.1097	83.3831	DW	10.1	5	5.1
59	Darima	Ambikapur	23.0031	83.2303	DW	8	4.2	3.8
60	Dhaurpur	Lundra	23.195	83.4383	DW	8.3	4	4.3
61	Gangapur	Lundra	23.046	83.3265	DW	9.76	6	3.76
62	Jajga	Udaipur	22.9421	82.9688	DW	7.22	6	1.22

SL	Location	Block	Latitude	Longitude	Well Type	WL_Premonsoon	WL_PostMon	Fluctuation
63	Kamleswarpur	Mainpat	22.8292	83.2881	DW	15.32	10.4	4.92
64	Kunni	Lakhanpur	22.8667	83.0667	DW	8.75	5	3.75
65	Lakhanpur	Lakhanpur	22.9806	83.0472	DW	7	4.18	2.82
66	Lundra	Lundra	23.1167	83.4083	DW	9.36	6	3.36
67	Nawapara	Ambikapur	22.9522	83.2639	DW	9.06	5	4.06
68	Parsa	Ambikapur	23.1878	83.2675	DW	8.62	4	4.62
69	Pratapgarh	Sitapur	22.7333	83.4764	DW	9	5	4
70	Rajakatel	Lakhanpur	22.9194	83.0417	DW	9.2	4.1	5.1
71	Rajpurikhurd	Ambikapur	23.1647	83.2464	DW	5.15	3	2.15
72	Sargawan	Ambikapur	23.1689	83.2058	DW	7	3.17	3.83
73	Sedam	Mainpat	22.9364	83.2967	DW	8.36	7	1.36
74	Silsila	Lundra	23.0325	83.3831	DW	7	4	3
75	Singhitana	Lakhanpur	23.0014	82.9647	DW	10	7	3
76	Sontarai	Sitapur	22.7792	83.4911	DW	6	3	3
77	Sumerpur	Lakhanpur	22.9803	83.0533	DW	7	4	3
78	Udaipur	Udaipur	22.9083	82.95	DW	13.91	4.18	9.73
79	Udaipur Dhah	Ambikapur	23.0583	83.1	DW	6.9	4	2.9
80	Keshavpur	Ambikapur	23.1029	83.1518	DW	9.5	6	3.5
81	Belkharika	Lakhanpur	22.9915	83.1511	BW	11.49	9.05	2.44
82	Kewra	Lakhanpur	22.9951	83.0686	BW	16.5	12.25	4.25
83	Katinda	Lakhanpur	22.9392	83.05	BW	13.26	7.34	5.92
84	Kedma	Udaipur	22.7564	83.0468	HP	17	12.06	4.94
85	Kunni	Lakhanpur	22.8653	83.0669	BW	13.18	5.18	8
86	Tirkela	Lakhanpur	22.8407	83.0765	BW	26.96	18.45	8.51
87	Karaichapar	Lakhanpur	22.8106	83.0638	bw	8.76	4.62	4.14
88	Salhe	Udaipur	22.8635	82.7758	bw	16.18	8.04	8.14
89	Parsa	Udaipur	22.8451	82.8135	hp	13.32	6.04	7.28
90	chakeri	Udaipur	22.8484	82.8903	bw	12.79	8.02	4.77
91	Keshavpur	Ambikapur	23.1068	83.1537	bw	13.5	7.04	6.46
92	Uparpara	Ambikapur	23.0973	83.1139	hp	7	5	2
93	Sonpur Khurd	Ambikapur	23.0993	83.0727	hp	8.08	2.75	5.33
94	Gumgara kalan	Lakhanpur	23.0681	83.0138	bw	17.7	14.95	2.75
95	Amgashi Hp	Lakhanpur	22.9575	83.0042	hp	21.5	16.15	5.35

SL	Location	Block	Latitude	Longitude	Well Type	WL_Premonsoon	WL_Post Mon	Fluctuation
96	Badkapara	Udaipur	22.9802	82.975	hp	11.5	5.17	6.33
97	Devgarh	Udaipur	23.019	82.9404	bw	8.4	3.83	4.57
98	Kothala	Udaipur	22.9588	82.8975	bw	6.6	5.18	1.42
99	Udari	Lundra	23.1223	83.3397	hp	14	12.25	1.75
100	Lundra	Lundra	23.123	83.4003	hp	15.22	8.45	6.77
101	Karji	Ambikapur	23.0432	83.1949	hp	28.5	20.5	8
102	Damali	Ambikapur	22.9247	83.189	hp	12.3	4.9	7.4
103	Bisarpani	Mainpat	22.8847	83.2891	BW	14.5	8.4	6.1
104	Chathirma	Ambikapur	23.1778	83.138	HP	13.06	5.25	7.81
105	Balsedi	Ambikapur	23.2199	83.1524	HP	18.44	9.14	9.3
106	Sargaon	Ambikapur	23.1687	83.2059	HP	22.06	14.5	7.56
107	Sitapur-d	Sitapur	22.7694	83.4917	BW	8.8	3.61	5.19
108	Udaipur-s	Udaipur	22.9083	82.9472	BW	14.45	8.96	5.49
109	Batauli S	Batauli	22.9881	83.4031	BW	11.75	3.85	7.9
110	Dhaurpur S	Lundra	23.195	83.4133	BW	11	0.65	10.35
111	Ambikapur-s	Ambikapur	23.1083	83.2	BW	16.4	8.77	7.63
112	Laiga	Batauli	22.9529	83.3591	HP	14.04	6.28	7.76
113	Karra	Ambikapur	22.9697	83.3109	HP	19.04	8.24	10.8
114	Parsa	Ambikapur	23.1961	83.2695	HP	17.03	8.45	8.58
115	Sapnadar	Mainpat	22.8496	83.2948	HP	13.95	5.74	8.21
116	Uranga	Mainpat	22.7593	83.3376	HP	17.86	7.47	10.39
117	Paiga	Mainpat	22.8689	83.2431	HP	12.15	4.36	7.79
118	Bandana	Mainpat	22.8463	83.4098	HP	14.4	9.36	5.04
119	Jamdih	Mainpat	22.834	83.4653	HP	12.36	5.92	6.44
120	Guturma	Sitapur	22.7	83.4702	HP	17.14	7.95	9.19
121	Koichal	Mainpat	22.7013	83.4025	HP	16	12.26	3.74
122	Petla	Sitapur	22.7335	83.5373	HP	22.25	14.08	8.17
123	Sarga	Sitapur	22.7677	83.586	HP	18.4	12.95	5.45
124	Bharatpur	Sitapur	22.8116	83.6405	HP	16.15	15.24	0.91
125	Bhusn	Sitapur	22.84	83.539	HP	11.5	6.04	5.46
126	Birimkala	Batauli	22.8989	83.4949	HP	15.14	6.28	8.86
127	Suarpara	Batauli	22.9164	83.4524	HP	14.28	7.4	6.88
128	Bargidih	Lundra	23.0444	83.4156	HP	15.5	8.44	7.06
129	Bodapar	Batauli	22.9836	83.4934	HP	20.7	11.93	8.77

2.2 Hydrochemical Data

To know the hydro chemical behaviour of the ground water in the study area, 135 nos. of ground water samples were collected from the key wells during pre-monsoon period of measurement and analysed in the chemical laboratory of Central Ground Water Board, NCCR, Raipur for determination of various chemical parameters.

2.3 Geophysical Data

To delineate the disposition of the existing aquifer system 45 Transient electromagnetic (TEM) method were carried out. Along with 40 VES data and 45 TEM different water zone identified in the district.

2.4 Exploratory Data

A total of 25 exploratory wells exist in the Surguja district before the NAQUIM study. During the year 2019-20 additional 17 exploratory and 05 observation well has been constructed. Table-8 summarizes the status of exploratory wells in the study area.

Table 8 Detail of Exploration in the Surguja district

Sl NO	location	Well Type	Block	LAT	LONG	Depth	casing	Zone_encountered	SWL (mbgl)	Discharge	Drawdown (mbgl)	T (m2/day)
1	Parsa(Kete)	EW	Udaipur	22.844007	82.815915	202	37.5	41-44,71.5-74.60	19.4	3.4	28.2	75.7
2	Parsa(Kete)	OW	Udaipur	22.844007	82.815915	202	37.5	44-46, 72-75`		3		
3	Bisunpur (Pandripani)	EW	Udaipur	22.934701	82.904016	202	31.4	111.2-114.2,120.3-123.4	14.76	3	25	12.98
4	Bisunpur (Pandripani)	OW	Udaipur	22.934701	82.904016	202	31					
5	Ammal bhitti	EW	Lakhanpur	23.53333333	83.139575	202	24	30-35	6.8	12	23.5	25.78
6	Ammal bhitti	OW	Lakhanpur	23.009723	83.132326	202	24	26-27;102-103;105-106	7.56	4		
7	Chodeya	EW	Lakhanpur	22.897969	83.049186	202	7	92.9-95.9,117.3-120.3, 132.5-135.6,138.6-141.7	5.33	6.3	20	10.27

8	Chodeya	OW	Lakhanpur	22.897969	83.049186	202	8	120-123, 130-132, 135- 138		5		
9	Khurd Taparkela	EW	Lakhanpur	22.996413	83.088075	202	20	135.6-138.6	4.22	0.5	41.78	3.34
10	Jamdhusa	EW	Lakhanpur	22.859422	83.061456	202	25	74.6-77.6	2.58	0.5	32.7	4.76
11	Sohga	EW	Ambikapur	23.03944	83.222521	202	19.2	25.8-28.8,65.4-68.5	9.21	5.5	26.49	18.27
12	Sohga	OW	Ambikapur	23.047206	83.220826	202	19		10.12	Dry		
13	Bargawan	EW	Ambikapur	22.968621	83.202314	202	26.5	156-160	14.6	0.5	30	5.48
14	Darima	EW	Ambikapur	22.995392	83.200058	202	26	19-20	4.75	0.5	25.35	3.52
15	Nawaparakalan	EW	Ambikapur	22.958792	83.262436	202	12.1			Dry		
16	Balseri	EW	Ambikapur	23.2	83.15	209.53	194	69-71.5,73-94,97-103,106-130,133-156159-166.5,168-172,181-183,186-191	Flowing 3.11 magl	12.5	35.65	159.1
17	Balseri	OW	Ambikapur	23.2	83.15	69.89	67	32-46,52-65	Flowing 3.11 magl	5.46		
18	Deotikara	EW	Lakhanpur	23.0625	82.9542	99		49-98	6.5	Negligible		
19	Kalyanpur	EW	Ambikapur	23.21	83.1525	222	127	30-42, 49-57,66-111,119-124	9.28	3.68	13.78	85.19
20	Rewatpur	EW	Ambikapur	23.2244	83.2683	94.73	78	33-45,63-75	5.76	4.74	28.72	
21	Rewatpur	OW	Ambikapur	23.2244	83.2683	7.2		Abandoned				
22	Rewatpur	OW	Ambikapur	23.2244	83.2683	14.5		Abandoned				
23	Rewatpur	OW	Ambikapur	23.2244	83.2683	92.56	78	63.0-75	6.9	4	25	

24	Udaipur	EW	Udaipur	22.9167	82.95	152.6	90	41-48.5,54.5-68.5,75.5-87	17.25	3.4	15.45	
25	Bhakura	EW	Ambikapur	23.1711	83.2394	126.5	24	28.5-29,110-110.5	--	0.8		
26	Bhittikalan	EW	Ambikapur	23.08	83.1464	105.9	25.72	28.5-28.8, 124.5-125	6.315	6	32.095	16.22
27	Dandgaon	EW	Udaipur	22.8978	82.8583	129.03	7.5	74.5		0.5		
28	Salkapra	EW	Udaipur	22.9578	82.9261	96.62	24.3	106.5	3.99	3.3	44.52	1
29	Batouli	EW	Batauli	22.9881	83.4031	135.5	15	88-88.20		0.5		
30	Boda	EW	Batauli	22.9717	83.49	111.37	17.43	-	4.3	2.06	34.52	32.59
31	Katkalo	EW	Mainpat	22.7692	83.4322	132.14	18.26			See page		
32	Jamdohi	EW	Mainpat	22.6792	83.4067	114.44	29.2		5.64	2.06	41.1	2.5
33	Bandana	EW	Mainpat	22.8383	83.4161	136.04	14.46			See page		
34	Sitapur	EW	Sitapur	22.7803	83.495	78.61	24.31	40.40.2	6.5	12.71	13.97	43.72
35	Salka	EW	Udaipur	22.9581	82.9242	202.62	31	NIL		see page		
36	Rajpuri kala	EW	Lakhanpur	23.0275	83.0822	199.4	18	24.60 - 28.20	9.82	5	14.6	
37	Rajpuri kala	OW	Lakhanpur	23.0275	83.0822	155	18.36	24.60 - 28.20	5.19	4.65	22.8	
38	Sayar Rai	EW	Lundra	23.05	83.3317	199.4	32.6	24.60 - 32.00	7.32	0.82	31.6	
39	Sayar Rai	OW	Lundra	23.05	83.3317	47.4	31.75	22 -28	3	See page	-	
40	Sayar Rai	OW	Lundra	23.05	83.3317							
41	Dhourpur	EW	Lundra	23.1917	83.4442	200.9	20.5	20.50 - 23.80	7.5	2.24	31.5	4.22
42	Dadgaon	EW	Lundra	23.1072	83.395	198.6	47.5	54.2 - 58.2, 111.4 - 115	10.06	3	37.3	3.69

43	Dadgaon	OW	Lundra	23.1072	83.395	130.2	50	54.20 - 58.20 ,115 - 119	4.9	3	26.5	
44	kakna	EW	Ambikapur	23.2225	83.3053	198.6	6.1	98	6.86	0.2	35.5	
45	Kunni	EW	Lakhanpur	22.8653	83.0669	196.5	22.2	43 -46.6	11.38	4.43	24.5	5.65
46	Kunni	OW	Lakhanpur	22.8653	83.0669	61.8	23.1	50 - 52	11.42	3.22	29.1	
47	Kunni	OW	Lakhanpur	22.8653	83.0669	61.8	23.94	46.6 - 50.60	11.62	-	-	
48	Hansdond	EW	Lakhanpur	22.9533	83.0178	200	12	nil				
49	Bilaspur	EW	Batauli	22.9833	83.4578	175.8		77-78,92-93,126-127,156.6-158	9.2	4.5	16.85	
50	Bilaspur	EW	Batauli	22.9833	83.4578	118.6		21-23,50-52.5,73-74,115-118	9.3	12	24	
51	Bilaspur	EW	Batauli	22.9833	83.4578	77		54.2-55.2,69.4-70.4	8.3	2	0.94	
52	Chiranga	EW	Batauli	22.9728	83.4117	122.6		19.8-20.8,27.8-28.8,31-32,103-104	10.8	12		
53	Chiranga	EW	Batauli	22.9728	83.4117	99.8			10.7	4	20.3	

3. Data Interpretation, Integration and Aquifer Mapping

Based on the depth to water level periodical monitoring data of the key wells established in the study area, pre-monsoon and post-monsoon depth to water level maps as well as seasonal fluctuation maps have been prepared.

Water Level Behavior:

(i) Premonsoon Water Levels

Water Levels in Phreatic aquifer in Granite and Granite gneiss is varies from 3.30 to 16.60 m below ground level with average of 7.06 m bgl whereas in deeper fracture aquifer it varies from 6.60 to 22.25 mbgl with average 14.16 mbgl. In Sandstone (Gondwana) formation, Water Levels in Phreatic aquifer varies from 3.50 to 13.91 mbgl with average of 7.34 mbgl whereas in deeper fracture aquifer it varies from 8.40 to 28.50 mbgl with average 15.64 m.

(ii) Post Monsoon Water Levels

Water Levels in Phreatic aquifer in Granite and Granite gneiss is varies from 1.0 to 10.40 m below ground level with average of 3.84 m bgl wheras in deeper fracture aquifer it varies from 0.65 to 16.15 m bgl with average of 7.85 m bgl. In Sandstone (Gondwana) formation, Water Levels in Phreatic aquifer varies from 1.06 to 7.00 mbgl with average 3.80 mbgl whereas in deeper fracture aquifer it varies from 3.83 to 20.50 m bgl with average 9.22 m.

(iii) Seasonal water level fluctuation: The water level fluctuation data indicates that in study area, water level fluctuation in phreatic aquifer in Granite and Granite gneiss varies from 0.50 to 13.95 m with an average fluctuation of 3.22 m whereas in Sandstone varies from 0.70 to 9.73 m with an average fluctuation of 3.54 m. Water level fluctuation in semiconfined Aquifer in Granite and Granite gneiss varies from 0.91 to 10.80 m with an average fluctuation of 6.31 m whereas in Sandstone varies from 1.75 to 9.30 m with an average fluctuation of 6.43 m.

The long term water level trend indicates that there is decline in pre-monsoon water level in Ambikapur block, in urban area there is significant decline in water level. In other parts of the Surguja district there is no significant decline in water level.

Aquifer Geometry and Characterization

Based on the exploratory drilling data generated for the blocks, the existing aquifer systems in the area may be divided into two namely phreatic and deeper fractured aquifer in all the major three aquifer systems.

Granite Aquifer System:

Groundwater occurrence is largely limited to secondary permeability, such as weathered zones, joints, fractures or faults. The potential of weathered zones depends on the degree and depth of weathering and associated fracturing, and the saturated thickness. The aquifers are generally discontinuous, and often confined. Higher yields are obtained where thick weathered zones are associated with bedrock fracturing.

The average thickness of the weathered portion in the area is around 21.60 m. In general, the discharge varies from meagre to 12.71 lps. The average drawdown of the formation is around 26.52 m. DTH drilling technique is preferred in Granite aquifer where well construction is required depending upon the thickness of weathered zone. Water zone has been encountered up to 158 mbgl in the formation. Transmissivity range observed is upto 43.72 sq meter/day.

Sandstone Aquifer System:

After studying the exploratory well details in Sandstone aquifer system, it has been envisaged that Gondwana rock 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. 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.

The average thickness of the weathered portion is around 21 m. In general, the discharge varies from meagre to 12.5 lps. The average drawdown of the formation is around 27 m. Well construction is required depending upon the water zone and formation encountered. Water zone has been encountered up to 191 mbgl at Balsedi in Ambikapur. Transmissivity range observed is 3.74 to 159.1 sq. meter/day.

Basalt Aquifer System:

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. 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 from1.5 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.

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.

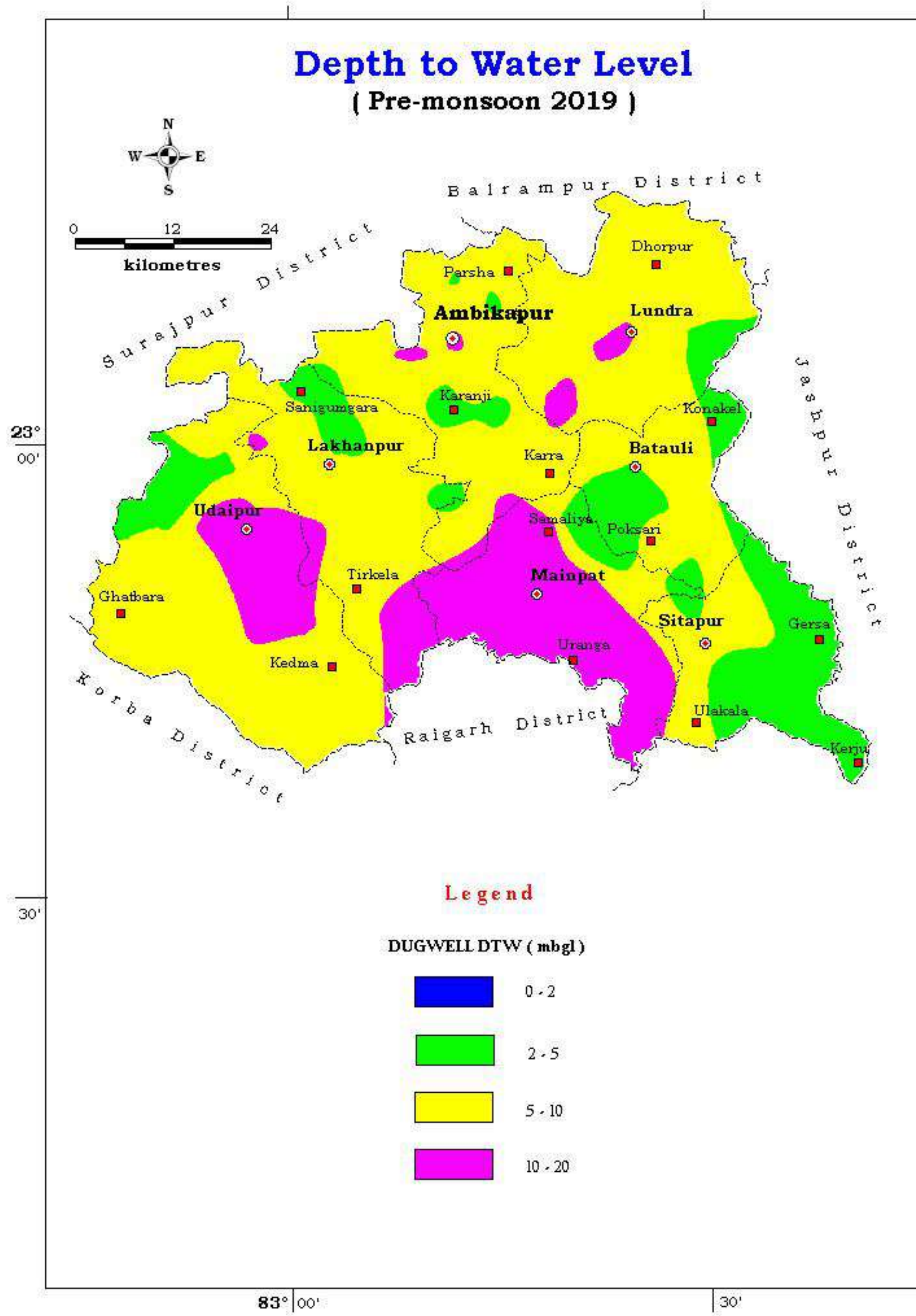

Figure 6 Depth to water level map Phreatic Aquifer (Pre-monsoon)

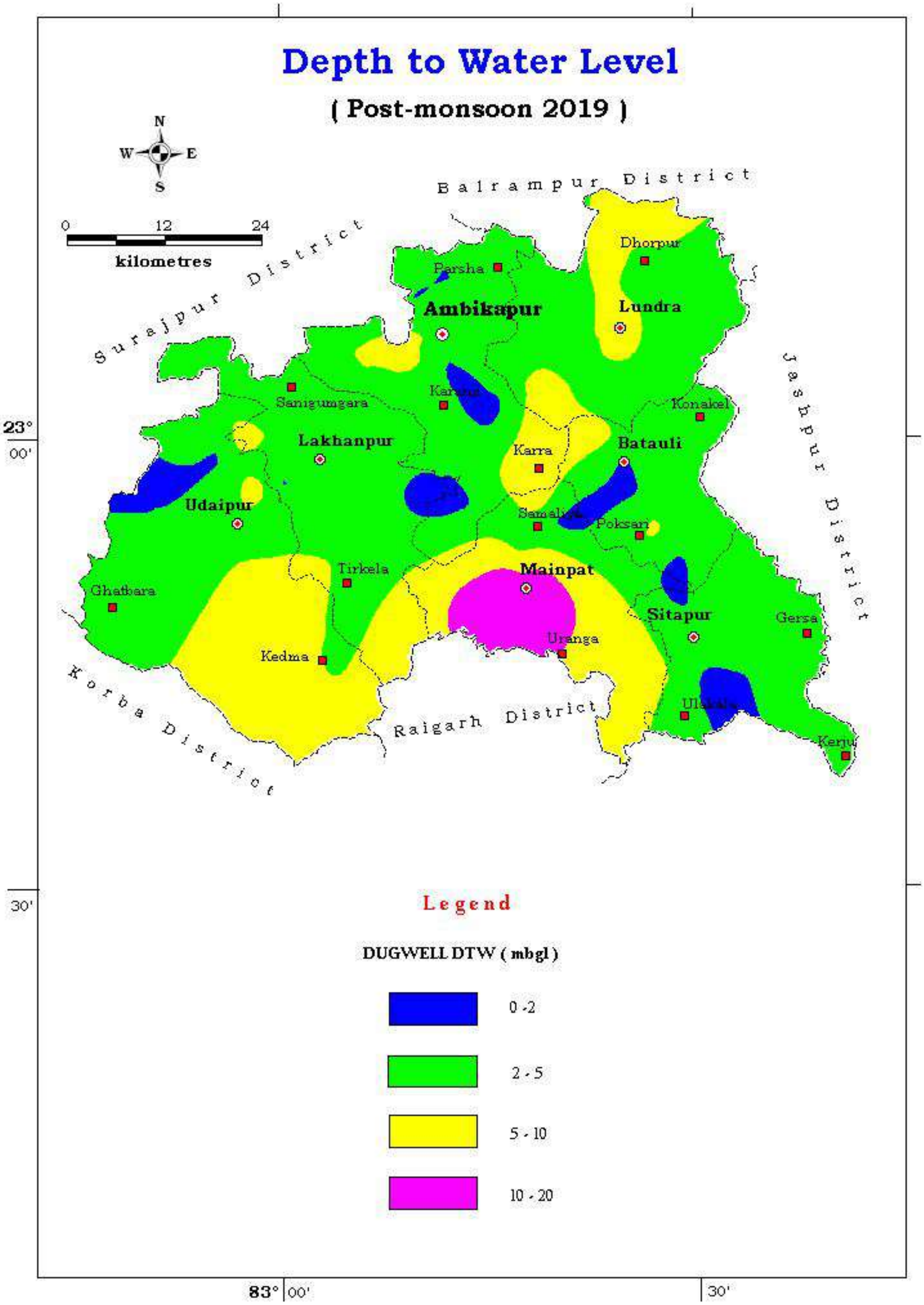

Figure 7 Depth to water level map Phreatic Aquifer (Post-monsoon)

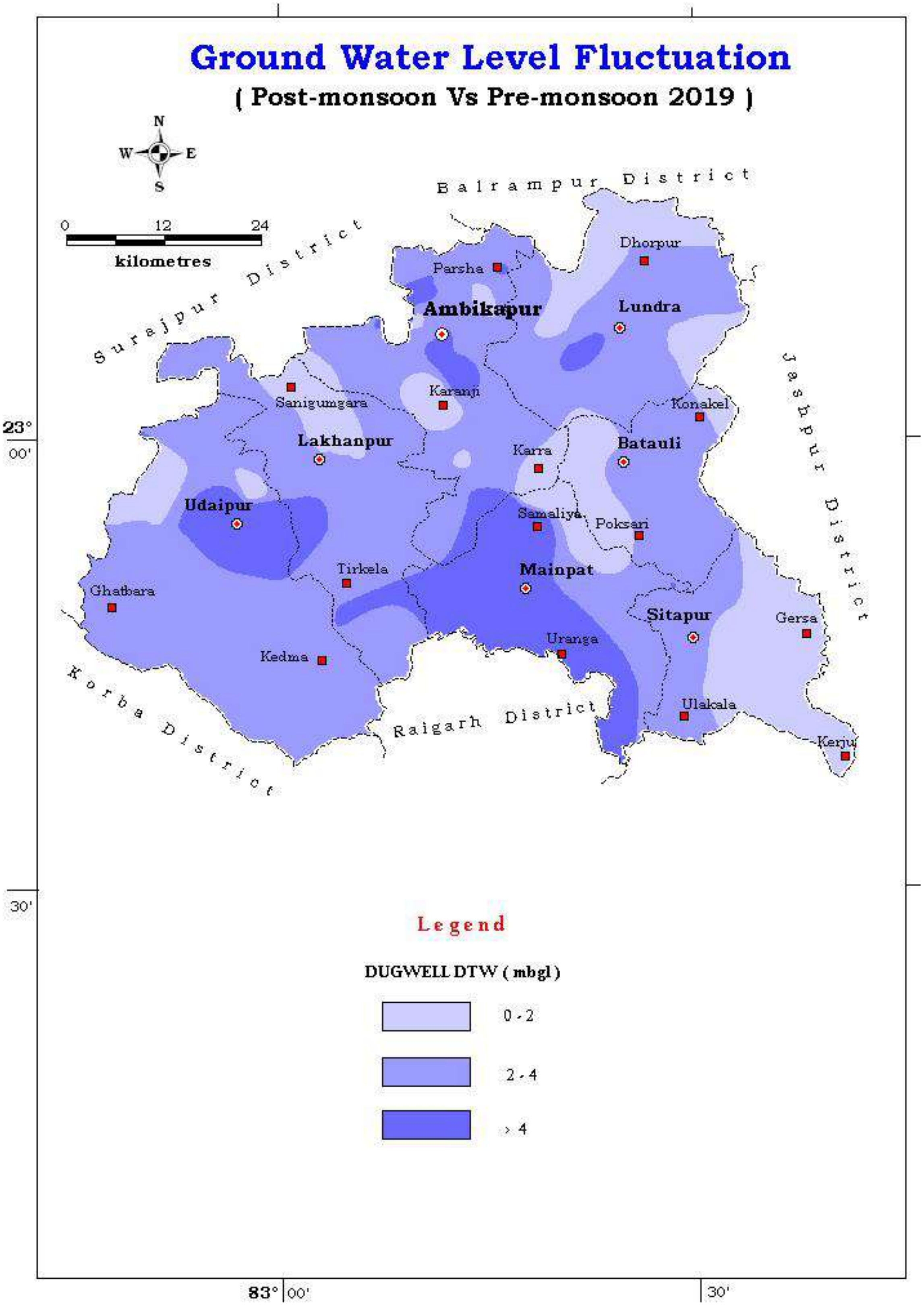

Figure 8 Depth to water level fluctuation map of Phreatic Aquifer

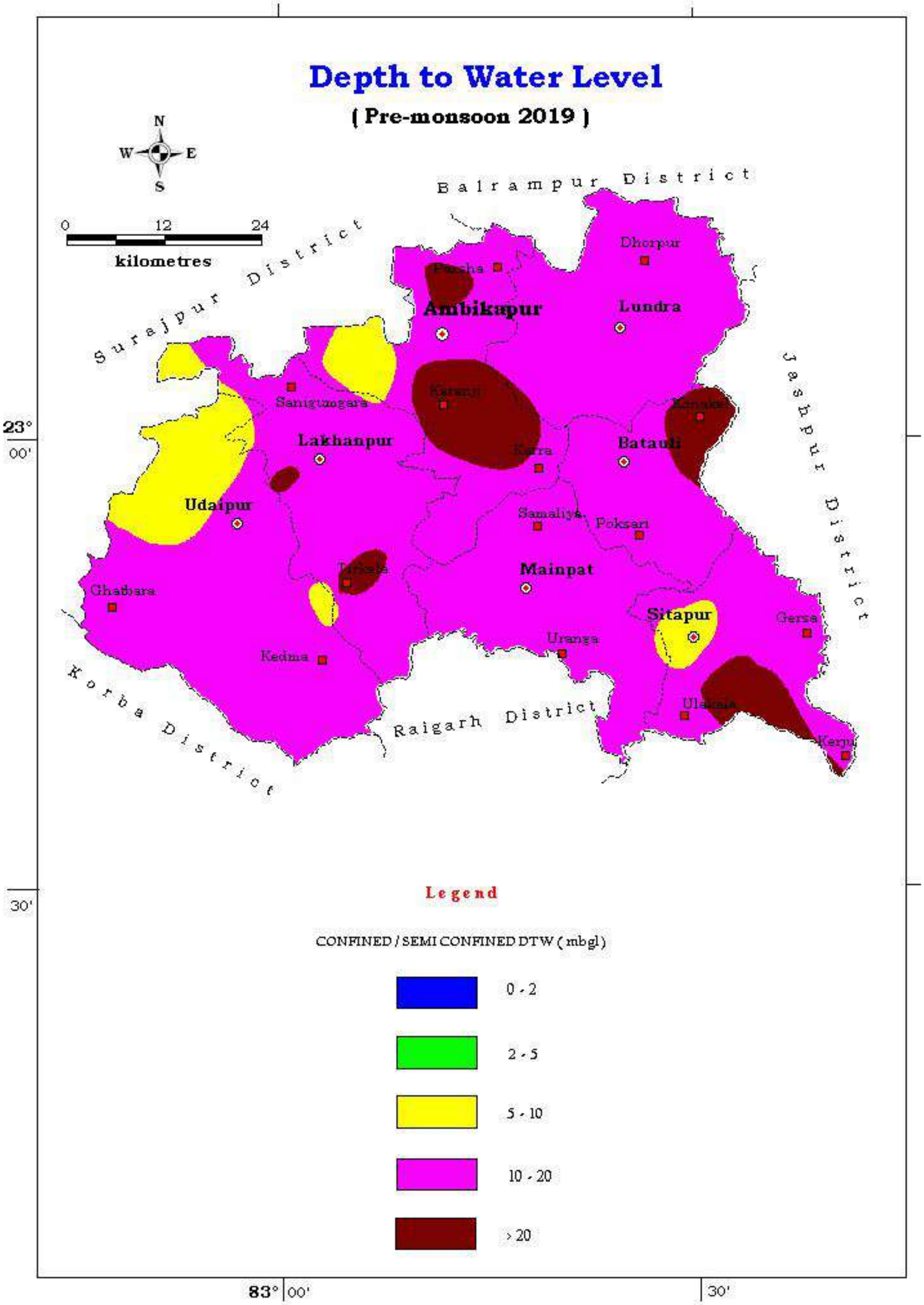

Figure 9 Depth to water level map Semiconfined Aquifer (Pre-monsoon)

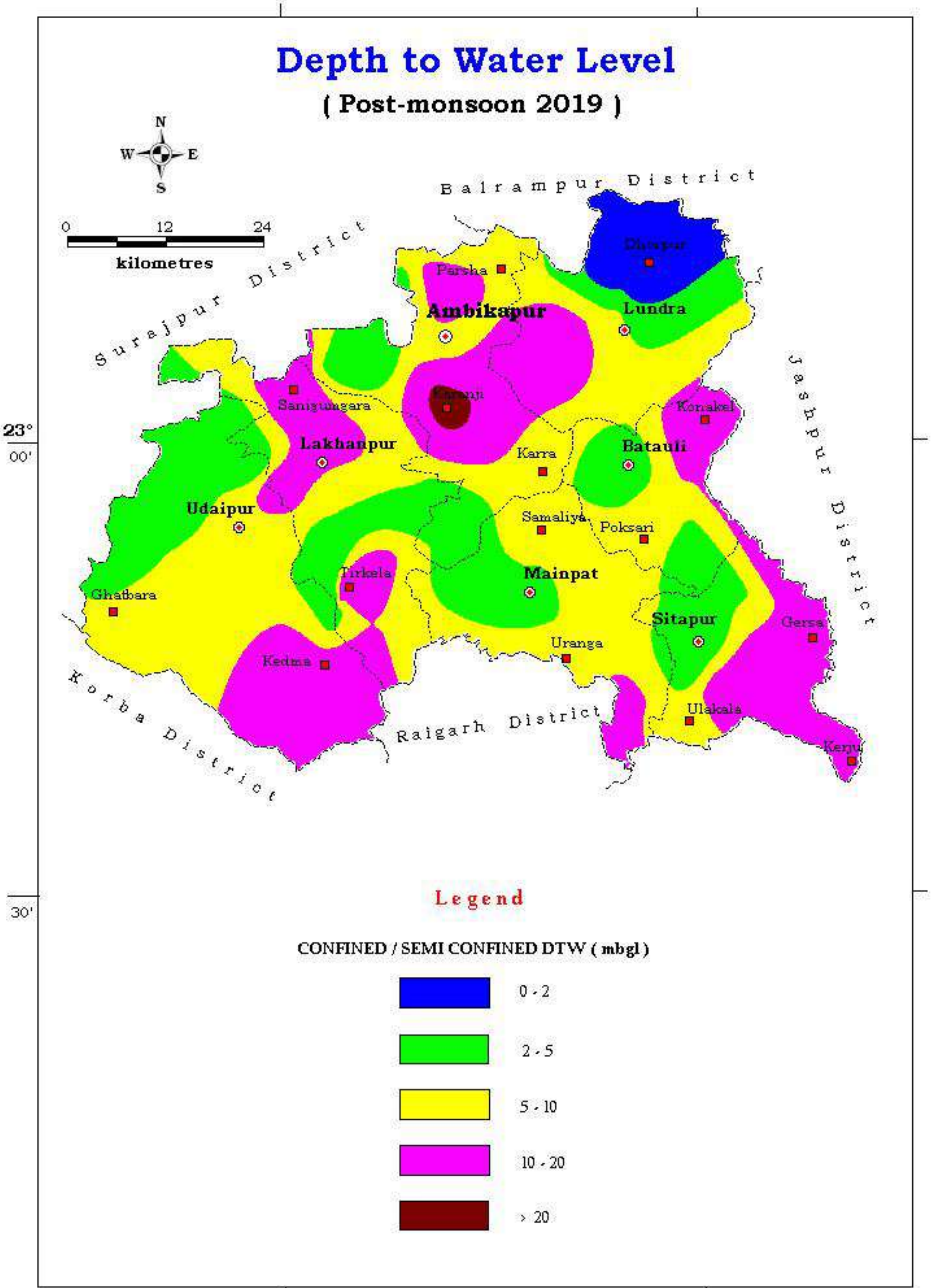

Figure 10 Depth to water level map Semiconfined Aquifer (Post-monsoon)

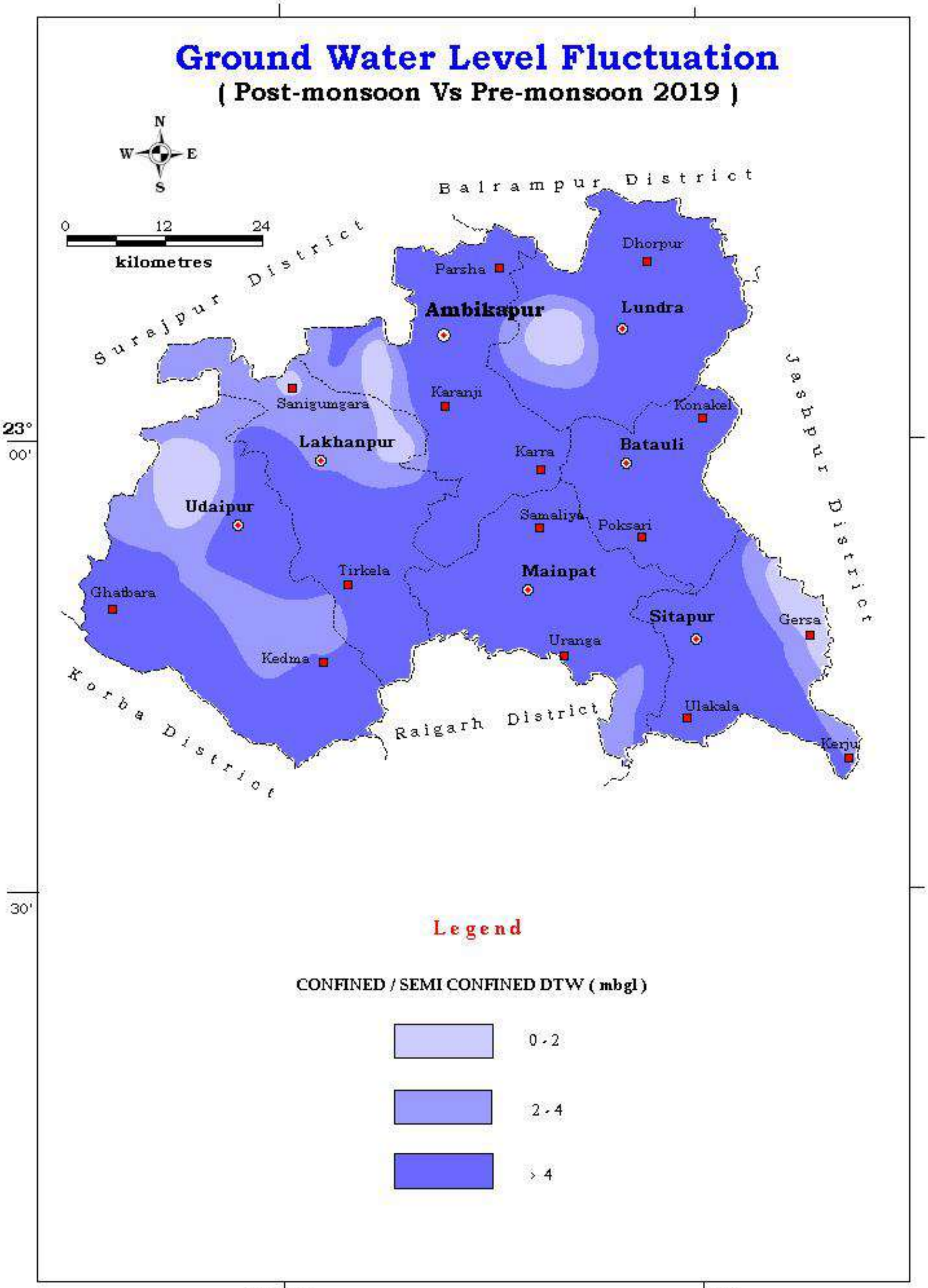

Figure 11 Depth to water level fluctuation map of Semiconfined Aquifer

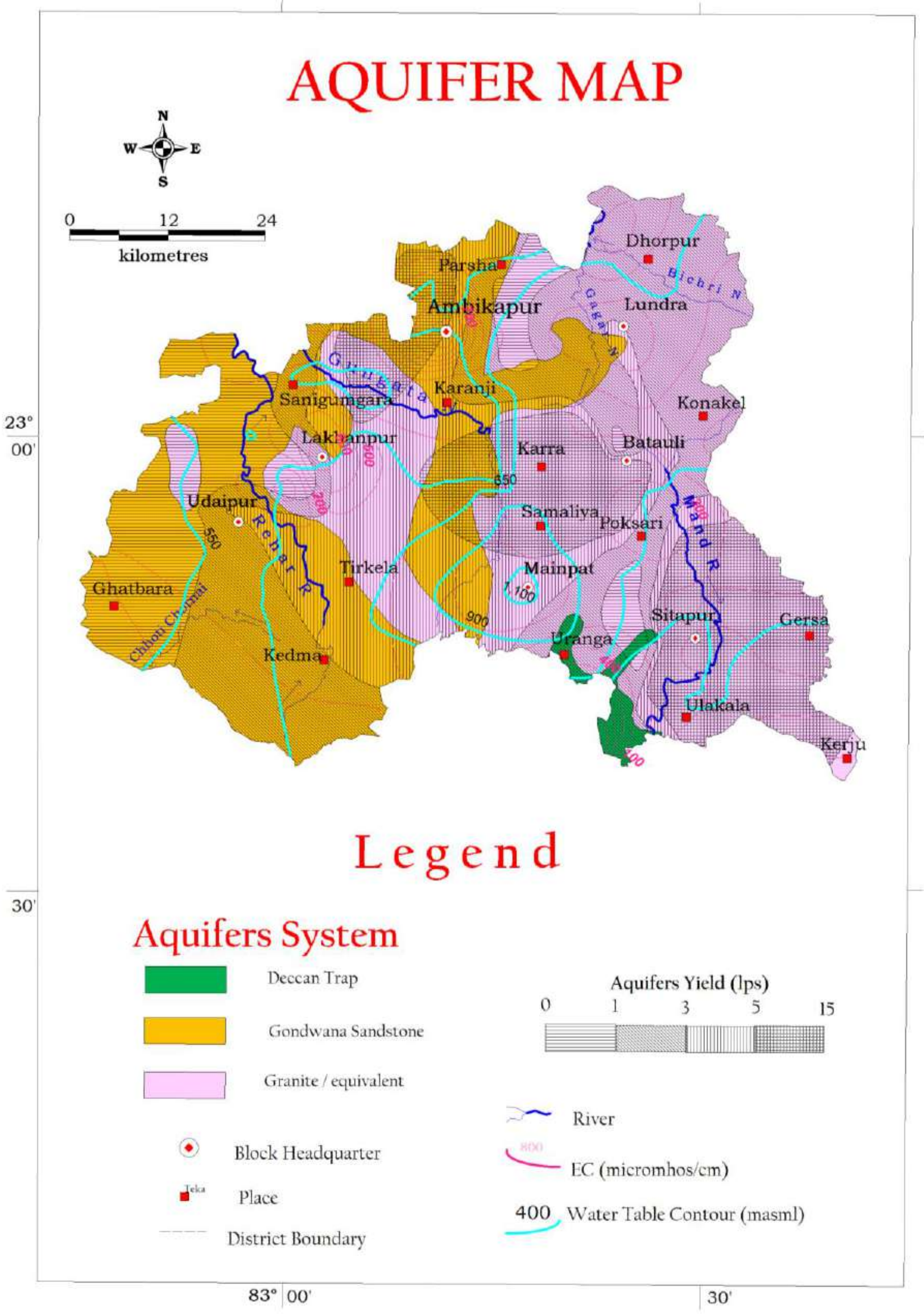

Figure 12 Aquifer Map of Surguja District

4. GROUND WATER RESOURCES

Groundwater Resource Availability and Extraction: Based on the resource assessment made, the resource availability in Surguja district upto 200 m depth is given in the table-9.

Table – 9: Ground Water Resources of Surguja district in Ham

Block/District	Dynamic resource Unconfined Aquifer (Ham)	Dynamic Ground Water Resource Confined Aquifer (Ham)	Total Static Resources Unconfined Aquifer (Ham)	Total Resource (Ham)	Stage of Ground Water Extraction (%)	Categorization
Ambikapur	8366.71	106.48	12459.84	20933.03	54.14	Safe
Batauli	4225.96	79.40	7479.41	11784.77	37.38	Safe
Lakhanpur	5740.90	99.21	14394.82	20234.93	39.96	Safe
Lundra	6431.33	118.48	13739.93	20289.74	32.58	Safe
Mainpot	2695.48	112.64	12326.67	15134.79	27.01	Safe
Sitapur	4103.25	70.60	9301.38	13475.23	31.22	Safe
Udaipur	9973.73	187.14	25739.59	35900.46	17.16	Safe
Total (District)	41537.36	773.94	95441.64	137752.94	34.23	Safe

Existing and Future Water Demand (2025)*:* The existing demand for irrigation in the area is 12120 Ham while for domestic demand is 2093.60 Ham. To meet the future demand for ground water, a total quantity of 27047.90 ham of ground water is available for future use.

Table – 10: Ground Water Existing and Future Water Demand (2025) of Surguja district

Block/ District	Annual Extractable Ground Water Recharge (Ham)	Current Annual Ground Water Extraction (Ham)				Annual GW Allocation for Domestic Use as on 2025	Net Ground Water Availability for future use
		Irrigation Use	Industrial Use	Domestic Use	Total Extraction		
Ambikapur	8366.71	3793.42	2.95	733.05	4529.42	834.77	3735.57
Batauli	4225.96	1410.50	0.00	168.97	1579.47	189.14	2626.32
Lakhanpur	5740.90	1999.66	1.82	292.44	2293.92	331.89	3407.53
Lundra	6431.33	1804.00	0.00	291.11	2095.11	329.42	4297.91
Mainpot	2695.48	543.67	0.00	184.27	727.94	206.38	1945.43
Sitapur	4103.25	1049.90	0.00	231.08	1280.98	253.93	2799.42
Udaipur	9973.73	1518.90	0.00	192.68	1711.58	219.11	8235.72
Total (Dist)	41537.36	12120.05	4.78	2093.60	14218.42	2364.64	27047.90

5. GROUND WATER RELATED ISSUES

(i) During summer, dugwells in some villages becomes dry at many locations. Several handpumps also stop yielding water. The aquifer itself is a low yielding one.

(ii) In Granite aquifer system potential zone for ground water is related with occurrence of fracture, so drilling a high yield well is always a challenge. Proper scientific study coupled with geophysical investigation may minimize the failure of well.

(iii) Problems in Tube well / Bore well construction in Sandstone Aquifer System: In case of filter point wells drilled with hand bores, the depth of penetration is variable and whenever the Shale or any other compact layers are encountered, further drilling becomes difficult. When portable rotary rigs are deployed for drilling, the drilling operations become very slow and the pore spaces in fine grained layers are invaded by drilling fluid as a result the discharges tend to be poor. Proper well development is seldom carried out by private drillers and as a result fine sands get deposited in the bore. Sometimes caving of wells are commonly reported particularly when the top loss sand is cased and the bottom shales are drilled with down the hole hammer rig.

(iv) Problems in ring well construction Sandstone Aquifer System: The common problem is sand filling inside the rings during and after the lowering of rings, thereby practically eliminating the change of deepening of wells to tap more saturated column in summer months. The weep holes provided in the rings allow water with fine sands and gets filled up as and when sand removal is in progress thereby making it difficult for lowering of rings is highly saturated sands.

(v) High value of Fluoride and Iron has been reported from several locations.

6. MANAGEMENT STRATEGY

(i) It has been observed during fieldwork, there is colossal wastage of groundwater through private well and public water supply system. So, Information, Education and Communication (IEC) activities need to be organized to sensitize people on the issues of depleting groundwater resource. Massive awareness campaigns are essential to aware people about the importance of community participation in saving water.

(ii) Desiltation of existing Tanks and Talabs to be carried out for efficient storage of rainwater. Also Rain water harvesting structures may be constructed in villages to reduce stress on groundwater.

(iii) It has been observed that the demand of ground water is increasing for irrigation, industrial and domestic uses. At locations where water level is declining, we have to go for artificial recharge on a long-term sustainability basis. Artificial Recharge structures may be constructed at suitable locations especially in the areas where the water level remains more than 3m in the post-monsoon period in this block to arrest the huge non-committed run-off and augment the ground water storage in the area. The different types of artificial structures feasible in the block are described in table-11. Probable sites are also identified for the construction of Artificial Recharge structure such as percolation tank, Nala bunding/ cement plug/ check dam, Gully Plugs/ gabion structures in district as shown in fig. 13 and details of the sites has been provided in Annexure. Abandoned tube well and dug well may be used for the recharge through shaft especially in urban and water stressed areas.

Table-11: Types of Artificial Recharge structures feasible

Block/District	Area Feasible for recharge (sq.km)	Volume of Sub Surface Potential for Artificial recharge (MCM)	Types of Structures Feasible and their Numbers			
			Percolation tank	Nalas bunding/ cement plug/ check dam	Gravity head /Dug well/ tube well/Recharge shaft	Gully plugs/ Gabion structures
Recharge Capacity - (MCM)/structure			0.2192	0.0326	0.00816	0.0073
Ambikapur	109.30	6.518	19	28	121	62
Batouli	34.11	1.924	4	14	33	44
Lakhanpur	204.02	7.200	20	30	159	74
Lundra	215.17	7.325	21	26	176	60
Mainpat	113.32	5.897	16	26	130	66
Sitapur	57.54	2.195	5	14	43	40
Udaipur	352.35	8.087	21	43	171	94
Total (dist)	1085.81	39.145	106	181	833	440

(iv) Fluoride and Iron filter plant may be installed in the villages having higher value of contaminants.

(v) In urban areas STP may be installed for the treatment of sewage water in proper numbers to avoid contamination of ground water. Treatment of sewage water in village through soak pit for the individual houses and Seechewal model or similar model for community level may be adopted to avoid contamination of ground water. Treated water may also be reused for irrigation and other industrial purposes.

(vi) Since the stage of development in the district is 34.23 %. There is scope of utilizing more ground water for future irrigation purpose. Additional number of Ground water abstraction structure may be developed for the effective utilization of ground water resources in the block. The ground water is presently developed through dug wells and tube wells (fig 14). Yield potential for the block has been shown in Aquifer map (fig 12). Sites for wells need to be selected only after proper scientific investigation. The ground water quality also needs to be ascertained and the wells used for water supply should be first checked for Iron, Fluoride and other pollutants.

Table 12: Potential of Additional GW abstraction structure creation

Block/ District	Net Groundwater availability (ham)	Stage of ground water Development (%)	Present ground water draft (Ham)	Ground water draft at 70% stage of development (ham)	Surplus ground water at present Stage of Development (ham)	Number of TW/ BW Recommended in each block (Assuming unit draft as 1.6 ham/structure/year)	Number of DW Recommended in each block (Assuming unit draft as 0.72 ham/structure/year)
Ambikapur	8366.71	54.14	4529.42	5856.70	1327.28	498	737
Batauli	4225.96	37.38	1579.47	2958.17	1378.70	517	766
Lakhanpur	5740.90	39.96	2293.92	4018.63	1724.71	647	958
Lundra	6431.33	32.58	2095.11	4501.93	2406.82	903	1337
Mainpat	2695.48	27.01	727.94	1886.84	1158.90	435	644
Sitapur	4103.25	31.22	1280.98	2872.28	1591.30	597	884
Udaipur	9973.73	17.16	1711.58	6981.61	5270.03	1976	2928
Total (District)	41537.36	239.44	14218.42	29076.15	14857.73	5571.65	8254.30

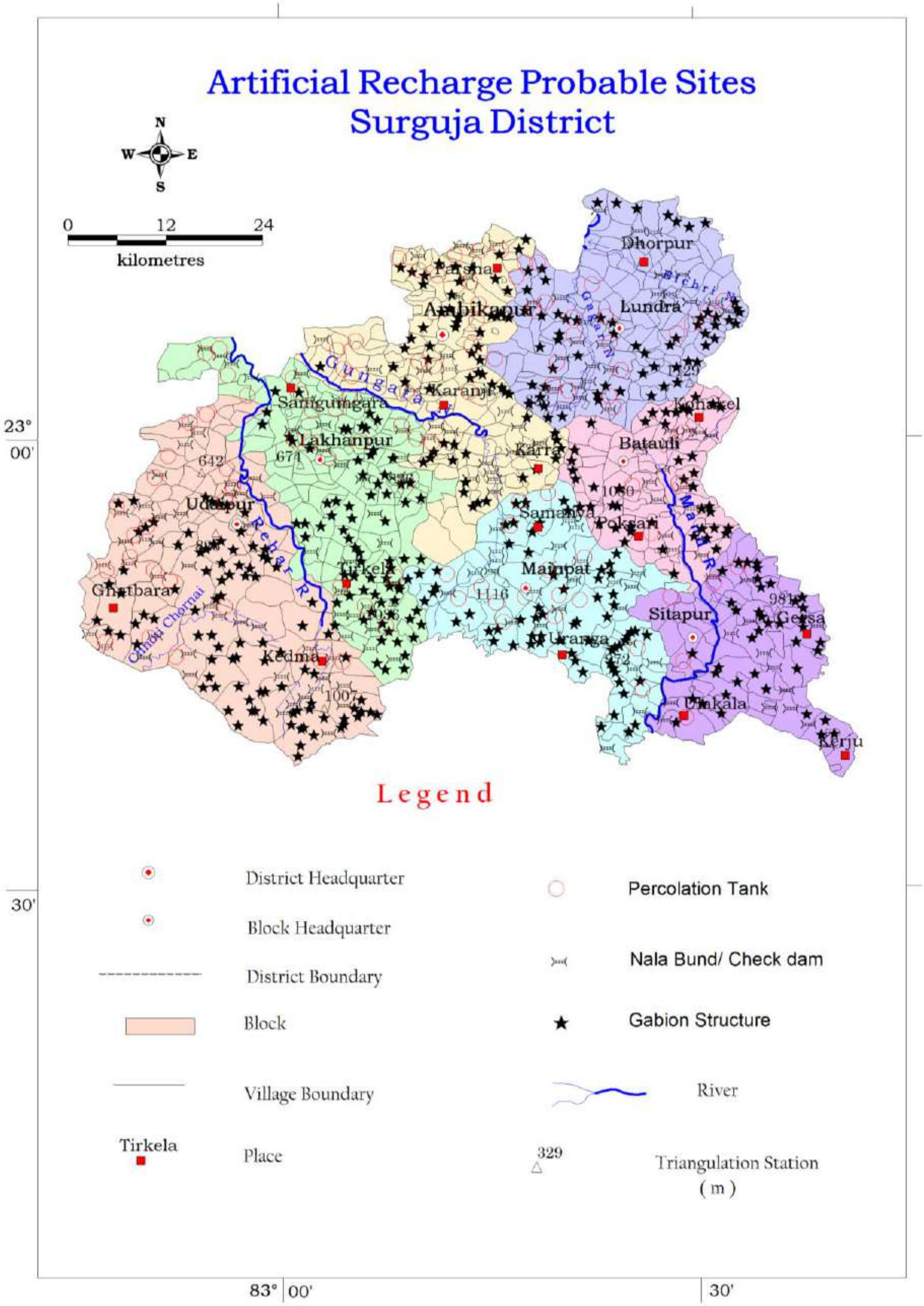

Figure 12 Probable Sites for Artificial Recahrge

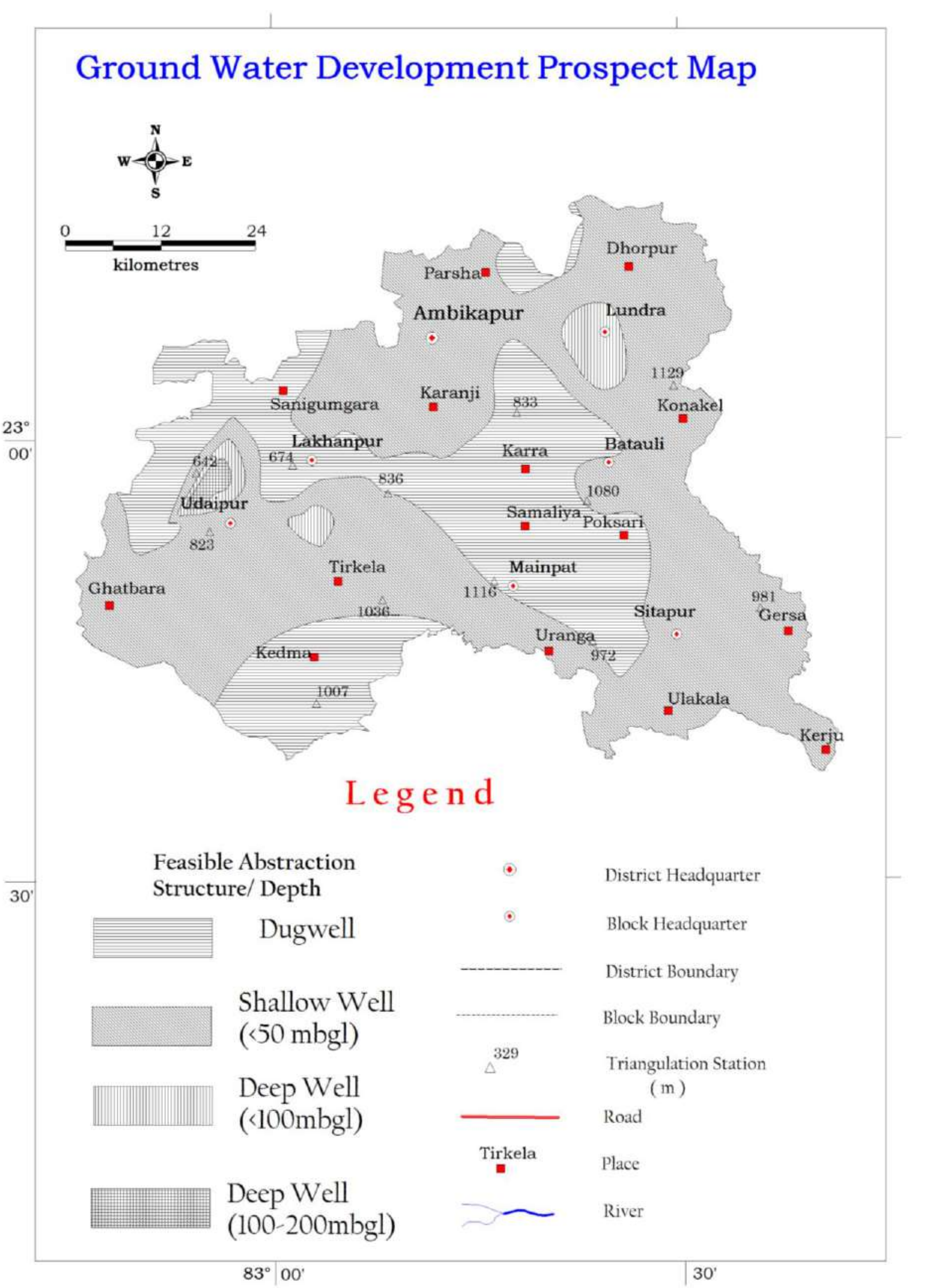

Figure13 Ground Water Development Prospect Map

7. CONCLUSION:

For effective utilization of Ground water existing draft for irrigation may be coupled with micro irrigation system. Change in irrigation pattern, optimum use of available resource, use of ground water potential created after artificial recharge can lead to groundwater savings and increase in gross cropped area of the district (Table: 13).

Table 13: Detail of groundwater saved through change in cropping pattern and other interventions

Block/District	Existing Gross Ground Water Draft for Irrigation in Ham	Additional Saving of GW after using Micro Irrigation methods in Ham (Assuming 30 % saving)	GW Potential created after Artificial recharge structure in Ham	Development by new GW abstraction structure	Additional GW irrigation Potential created in Ham	Additional Irrigation potential creation for Maize/ wheat in winter season in Ha (Assuming 500 mm water requirement)	Percent increase in Crop area compare to Gross cropped area
Ambikapur	3793.42	1138.03	651.76	1327.28	3449.01	6898.01	19.65%
Batauli	1410.50	423.15	192.37	1378.70	1937.79	3875.58	19.67%
Lakhanpur	1999.66	599.90	719.96	1724.71	2968.22	5936.44	21.23%
Lundra	1804.00	541.20	732.50	2406.82	3663.88	7327.75	22.21%
Mainpat	543.67	163.10	589.74	1158.90	1847.95	3695.89	19.17%
Sitapur	1049.90	314.97	219.53	1591.30	2078.89	4157.78	17.20%
Udaipur	1518.90	455.67	808.66	5270.03	6419.62	12839.24	77.24%
Total (District)	12120.05	3636.01	3914.51	14857.73	22365.35	44730.71	25.44%

Annexure: Probable sites for Artificial Recharge

Sl No	Longitude	Latitude	Village	Panchayat	Block	Feasible AR Structure
1	83.0511	23.1117	Fattepur	Fattepur	Ambikapur	Check Dam
2	83.1623	23.0548	Bakmer	Bardhodhi	Ambikapur	Check Dam
3	83.2508	23.053	Amadarha	Sakhauli	Ambikapur	Check Dam
4	83.2717	23.0311	Sakhauli	Sakhauli	Ambikapur	Check Dam
5	83.2052	23.0782	Kanthi	Kanthi	Ambikapur	Check Dam
6	83.2025	23.0937	Pachphedi	Manipur	Ambikapur	Check Dam
7	83.1745	23.0765	Majhapara	Sundarpur	Ambikapur	Check Dam
8	83.1146	23.078	Labji	Labji	Ambikapur	Check Dam
9	83.1683	23.2046	Balsedi	Khaliwa	Ambikapur	Check Dam
10	83.2196	23.2153	Rukhpur	Ghanghari	Ambikapur	Check Dam
11	83.238	23.21	Kanchanpur	Kanchanpur	Ambikapur	Check Dam
12	83.2264	23.1801	Narbadapara	Narbadapara	Ambikapur	Check Dam
13	83.2142	23.1586		Phundurdihari	Ambikapur	Check Dam
14	83.2622	23.2168	Bhafauli	Bhafauli	Ambikapur	Check Dam
15	83.2264	23.1427	Sonpur kalan	Asola	Ambikapur	Check Dam
16	83.1788	23.0016	Chhind kalo	Chhind kalo	Ambikapur	Check Dam
17	83.2064	23.0088	Darima	Darima	Ambikapur	Check Dam
18	83.1882	23.0148	Koteya	Koteya	Ambikapur	Check Dam
19	83.2295	22.9564	Khajuri	Khajuri	Ambikapur	Check Dam
20	83.2485	22.9731	Nawanagar	Nawanagar	Ambikapur	Check Dam
21	83.258	22.9417	Kumharta	Kumharta	Ambikapur	Check Dam
22	83.258	22.9556	Nawanagar	Nawanagar	Ambikapur	Check Dam
23	83.2542	22.9631	Nawanagar	Nawanagar	Ambikapur	Check Dam
24	83.2973	22.9923	Tihpatra	Mohanpur	Ambikapur	Check Dam
25	83.3014	22.9839	Karra	Karra	Ambikapur	Check Dam
26	83.2816	22.9854	Lawaidih	Mohanpur	Ambikapur	Check Dam
27	83.2878	23.0136		Mohanpur	Ambikapur	Check Dam
28	83.3136	22.9953	Maheshpur	Pondi kalan	Ambikapur	Check Dam
29	83.0883	23.0715	Mudesa	Mudesa	Ambikapur	Percolation Tank
30	83.0704	23.1004	Sapna	Sapna	Ambikapur	Percolation Tank
31	83.0922	23.1105		Bakirma	Ambikapur	Percolation Tank
32	83.0776	23.0797	Ranpur kalan	Ranpur kalan	Ambikapur	Percolation Tank
33	83.1871	23.0827	Jagdishpur	Jagdishpur	Ambikapur	Percolation Tank
34	83.2317	23.1052	Shrigarh	Nawagarh	Ambikapur	Percolation Tank
35	83.2286	23.0533	Bakalo	Bakalo	Ambikapur	Percolation Tank
36	83.1683	23.0875	Majhapara	Sundarpur	Ambikapur	Percolation Tank
37	83.1831	22.997	Chhind kalo	Chhind kalo	Ambikapur	Percolation Tank
38	83.1539	23.0525	Bakmer	Bardhodhi	Ambikapur	Percolation Tank

Sl No	Longitude	Latitude	Village	Panchayat	Block	Feasible AR Structure
39	83.268	23.211	Bhafauli	Bhafauli	Ambikapur	Percolation Tank
40	83.2422	23.2106	Kanchanpur	Kanchanpur	Ambikapur	Percolation Tank
41	83.2125	23.2053	Ghanghari	Ghanghari	Ambikapur	Percolation Tank
42	83.1692	23.1888	Mendra khurd	Mendra khurd	Ambikapur	Percolation Tank
43	83.2304	23.1756	Deogarh	Rajpuri khurd	Ambikapur	Percolation Tank
44	83.2378	23.1321		Khairwar(F.V.)	Ambikapur	Percolation Tank
45	83.1442	23.2025	Balsedi	Khaliwa	Ambikapur	Percolation Tank
46	83.2404	23.1506	Sonpur kalan	Asola	Ambikapur	Percolation Tank
47	83.1919	23.1832	Kishunnagar	Sakalo	Ambikapur	Percolation Tank
48	83.1467	23.1929	Khaliwa	Khaliwa	Ambikapur	Gully plugs/ GS
49	83.1589	23.1139	Keshopur	Keshopur	Ambikapur	Gully plugs/ GS
50	83.1374	23.0821	Jhumarpara	Thor	Ambikapur	Gully plugs/ GS
51	83.151	23.1029	Sundarpur	Sundarpur	Ambikapur	Gully plugs/ GS
52	83.0498	23.0828	Sukhari	Sukhari	Ambikapur	Gully plugs/ GS
53	83.1516	23.0656	Jogibandh	Rampur	Ambikapur	Gully plugs/ GS
54	83.1981	22.9968	Darima	Darima	Ambikapur	Gully plugs/ GS
55	83.1859	22.9875	Chhind kalo	Chhind kalo	Ambikapur	Gully plugs/ GS
56	83.1812	22.9808	Motipur	Motipur	Ambikapur	Gully plugs/ GS
57	83.1731	22.976	Motipur	Motipur	Ambikapur	Gully plugs/ GS
58	83.2103	22.9955	Darima	Darima	Ambikapur	Gully plugs/ GS
59	83.2245	22.9853	Nawgai	Saskalo	Ambikapur	Gully plugs/ GS
60	83.2324	22.9262	Kumharta	Kumharta	Ambikapur	Gully plugs/ GS
61	83.2381	22.9304	Kumharta	Kumharta	Ambikapur	Gully plugs/ GS
62	83.2484	22.9322	Kumharta	Kumharta	Ambikapur	Gully plugs/ GS
63	83.2218	22.9422	Pampapur(Rapa)	Pampapur(Rapa)	Ambikapur	Gully plugs/ GS
64	83.2237	22.9537	Pampapur(Rapa)	Pampapur(Rapa)	Ambikapur	Gully plugs/ GS
65	83.2397	23.1044	Kanti Prakashpur	Kanti Prakashp	Ambikapur	Gully plugs/ GS
66	83.2416	23.1204	Badhiya Chuwan	Khairwar(F.V.)	Ambikapur	Gully plugs/ GS
67	83.216	23.1369			Ambikapur	Gully plugs/ GS
68	83.1606	23.1877	Khaliwa	Khaliwa	Ambikapur	Gully plugs/ GS
69	83.1739	23.1739	Mendra khurd	Mendra khurd	Ambikapur	Gully plugs/ GS
70	83.1758	23.1837	Mendra khurd	Mendra khurd	Ambikapur	Gully plugs/ GS
71	83.1932	23.1967	Chikhladih	Narbadapara	Ambikapur	Gully plugs/ GS
72	83.2131	23.1939	Chikhladih	Narbadapara	Ambikapur	Gully plugs/ GS
73	83.2177	23.1769	Sakalo	Sakalo	Ambikapur	Gully plugs/ GS
74	83.2082	23.1622	Sargawan	Sargawan	Ambikapur	Gully plugs/ GS
75	83.2054	23.1464		Phundurdihari	Ambikapur	Gully plugs/ GS
76	83.2125	23.1259			Ambikapur	Gully plugs/ GS
77	83.2139	23.1314			Ambikapur	Gully plugs/ GS
78	83.2552	23.1384	Malgawan khurd	Ranpur khurd	Ambikapur	Gully plugs/ GS

Sl No	Longitude	Latitude	Village	Panchayat	Block	Feasible AR Structure
79	83.2326	23.1919	Narbadapara	Narbadapara	Ambikapur	Gully plugs/ GS
80	83.1739	23.1259	Vishunpur	Vishunpur	Ambikapur	Gully plugs/ GS
81	83.1815	23.1049	Sadwar	Harra Tikra	Ambikapur	Gully plugs/ GS
82	83.1793	23.0906	Sadwar	Harra Tikra	Ambikapur	Gully plugs/ GS
83	83.2316	23.0969	Manik Prakashpur ali	Manik Prakashp	Ambikapur	Gully plugs/ GS
84	83.1956	23.1427	Phundurdihari	Phundurdihari	Ambikapur	Gully plugs/ GS
85	83.181	23.0576	Saraitikra	Saraitikra	Ambikapur	Gully plugs/ GS
86	83.2297	23.0693	Khala	Katkalo	Ambikapur	Gully plugs/ GS
87	83.2558	23.0621	Khala	Katkalo	Ambikapur	Gully plugs/ GS
88	83.3085	22.967	Kuniya kalan	Adchi	Ambikapur	Gully plugs/ GS
89	83.2922	22.958	Kuniya kalan	Adchi	Ambikapur	Gully plugs/ GS
90	83.2087	22.978	Parsapali	Bargawan	Ambikapur	Gully plugs/ GS
91	83.2414	23.0892	Manik Prakashpur ali	Manik Prakashp	Ambikapur	Gully plugs/ GS
92	83.2677	23.0586	Amadarha	Sakhauli	Ambikapur	Gully plugs/ GS
93	83.2441	23.0734	Khala	Katkalo	Ambikapur	Gully plugs/ GS
94	83.2394	23.0751	Khala	Katkalo	Ambikapur	Gully plugs/ GS
95	83.2764	23.0514	Sakhauli	Sakhauli	Ambikapur	Gully plugs/ GS
96	83.2713	23.0536	Sakhauli	Sakhauli	Ambikapur	Gully plugs/ GS
97	83.2977	23.0248	Mohanpur	Mohanpur	Ambikapur	Gully plugs/ GS
98	83.2762	23.1361	Ramnagar	Ranpur khurd	Ambikapur	Gully plugs/ GS
99	83.2669	23.1406	Ramnagar	Ranpur khurd	Ambikapur	Gully plugs/ GS
100	83.262	23.1379	Ramnagar	Ranpur khurd	Ambikapur	Gully plugs/ GS
101	83.2754	23.1664	Parsa	Parsa	Ambikapur	Gully plugs/ GS
102	83.2607	23.1797	Parsa	Parsa	Ambikapur	Gully plugs/ GS
103	83.2974	23.2229	Bhitthi khurd	Bhafauli	Ambikapur	Gully plugs/ GS
104	83.289	23.2124	Bhitthi khurd	Bhafauli	Ambikapur	Gully plugs/ GS
105	83.2658	23.2067	Karmha	Karmha	Ambikapur	Gully plugs/ GS
106	83.3311	23.0078	Mohanpur	Mohanpur	Ambikapur	Gully plugs/ GS
107	83.3333	22.9998	Pondi kalan	Pondi kalan	Ambikapur	Gully plugs/ GS
108	83.3382	22.991	Pondi kalan	Pondi kalan	Ambikapur	Gully plugs/ GS
109	83.3322	22.979	Karra	Karra	Ambikapur	Gully plugs/ GS
110	83.4713	23.0082	Ghoghra	Ghoghra	Batauli	Check Dam
111	83.5052	23.0065		Salehadih	Batauli	Check Dam
112	83.4933	23.008	Salehadih	Salehadih	Batauli	Check Dam
113	83.4692	22.9955	Salehadih	Salehadih	Batauli	Check Dam
114	83.5191	23.003	Tirang	Tirang	Batauli	Check Dam
115	83.4336	22.9887	Batauli	Batauli	Batauli	Check Dam
116	83.4447	22.9513	Selma	Selma	Batauli	Check Dam
117	83.4548	22.9323	Pathrai	Basen	Batauli	Check Dam
118	83.4643	22.8916	Kapatbahari	Kapatbahari	Batauli	Check Dam

Sl No	Longitude	Latitude	Village	Panchayat	Block	Feasible AR Structure
119	83.5071	22.8693	Bataikela	Bataikela	Batauli	Check Dam
120	83.4944	22.9211	Naya Bandh	Birimkela	Batauli	Check Dam
121	83.4857	22.9453	Ghutrapara	Ghutrapara	Batauli	Check Dam
122	83.4721	22.8756	Kapatbahari	Kapatbahari	Batauli	Check Dam
123	83.4608	22.965	Taragi	Taragi	Batauli	Check Dam
124	83.4859	23.0068	Salehadih	Salehadih	Batauli	Percolation Tank
125	83.4242	22.948	Saraswatipur	Basen	Batauli	Percolation Tank
126	83.4461	22.8948	Mangari	Mangari	Batauli	Percolation Tank
127	83.4798	22.9504	Ghutrapara	Ghutrapara	Batauli	Percolation Tank
128	83.4141	22.8862	Chiparkaya	Chiparkaya	Batauli	Gully plugs/ GS
129	83.3776	22.9473	Chiranga	Chiranga	Batauli	Gully plugs/ GS
130	83.3738	22.9255	Kardana	Kardana	Batauli	Gully plugs/ GS
131	83.4	22.9268	Govindpur	Chiparkaya	Batauli	Gully plugs/ GS
132	83.4057	22.926	Govindpur	Chiparkaya	Batauli	Gully plugs/ GS
133	83.4081	22.945	Bhatko	Bhatko	Batauli	Gully plugs/ GS
134	83.3839	22.9065	Govindpur	Chiparkaya	Batauli	Gully plugs/ GS
135	83.4035	22.9015	Chiparkaya	Chiparkaya	Batauli	Gully plugs/ GS
136	83.4217	22.903	Chiparkaya	Chiparkaya	Batauli	Gully plugs/ GS
137	83.4214	22.8977	Chiparkaya	Chiparkaya	Batauli	Gully plugs/ GS
138	83.3602	22.9253	Kardana	Kardana	Batauli	Gully plugs/ GS
139	83.3747	23.0187	Gahila	Gahila	Batauli	Gully plugs/ GS
140	83.3523	22.9661		Kardana	Batauli	Gully plugs/ GS
141	83.351	22.9769	Kalipur	Manja	Batauli	Gully plugs/ GS
142	83.3545	22.9886	Kalipur	Manja	Batauli	Gully plugs/ GS
143	83.3556	22.9563		Kardana	Batauli	Gully plugs/ GS
144	83.536	22.8949		Nakna	Batauli	Gully plugs/ GS
145	83.5009	23.0469	Kudkel	Salehadih	Batauli	Gully plugs/ GS
146	83.5218	23.0389	Bansajhal	Bansajhal	Batauli	Gully plugs/ GS
147	83.5303	23.0352	Bansajhal	Bansajhal	Batauli	Gully plugs/ GS
148	83.4927	23.0314	Kudkel	Salehadih	Batauli	Gully plugs/ GS
149	83.4854	23.0337	Salehadih	Salehadih	Batauli	Gully plugs/ GS
150	83.4772	23.0299	Ghoghra	Ghoghra	Batauli	Gully plugs/ GS
151	83.465	23.0302	Ghoghra	Ghoghra	Batauli	Gully plugs/ GS
152	83.4489	23.0297	Manpur	Manpur	Batauli	Gully plugs/ GS
153	83.4402	23.0202	Manpur	Manpur	Batauli	Gully plugs/ GS
154	83.4642	23.0169	Ghoghra	Ghoghra	Batauli	Gully plugs/ GS
155	83.4965	22.9809	Boda	Boda	Batauli	Gully plugs/ GS
156	83.4799	22.9766	Jarhadih	Taragi	Batauli	Gully plugs/ GS
157	83.4984	22.9623	Ghutrapara	Ghutrapara	Batauli	Gully plugs/ GS
158	83.4862	22.9551	Ghutrapara	Ghutrapara	Batauli	Gully plugs/ GS

Sl No	Longitude	Latitude	Village	Panchayat	Block	Feasible AR Structure
159	83.5167	22.9253	Sarmana	Sarmana	Batauli	Gully plugs/ GS
160	83.5178	22.9187	Baijnathpur	Birimkela	Batauli	Gully plugs/ GS
161	83.5221	22.901	Nakna	Nakna	Batauli	Gully plugs/ GS
162	83.5392	22.9002	Nakna	Nakna	Batauli	Gully plugs/ GS
163	83.5131	22.8897	Nakna	Nakna	Batauli	Gully plugs/ GS
164	83.5077	22.8999	Nakna	Nakna	Batauli	Gully plugs/ GS
165	83.5071	22.9225	Naya Bandh	Birimkela	Batauli	Gully plugs/ GS
166	83.4974	22.947	Lalati	Ghutrapara	Batauli	Gully plugs/ GS
167	83.4976	22.8917	Maheshpur	Maheshpur	Batauli	Gully plugs/ GS
168	83.5246	22.8774	Bataikela	Bataikela	Batauli	Gully plugs/ GS
169	83.4473	22.9077	Mangari	Mangari	Batauli	Gully plugs/ GS
170	83.4601	22.8774	Mangari	Mangari	Batauli	Gully plugs/ GS
171	83.4734	22.8499	Vishunpur	Vishunpur	Batauli	Gully plugs/ GS
172	Longitude	Latitude	Village	Panchayat	Block	Gully plugs/ GS
173	83.0156	23.0118	Janakpur	Gorta	Lakhanpur	Check Dam
174	82.9109	23.102	Getra	Khutiya	Lakhanpur	Check Dam
175	82.9299	23.094	Getra	Khutiya	Lakhanpur	Check Dam
176	82.9429	23.085	Potka	Potka	Lakhanpur	Check Dam
177	82.9673	23.0698		Nimha	Lakhanpur	Check Dam
178	83.0351	23.0455	Katkona	Katkona	Lakhanpur	Check Dam
179	83.027	23.074	Parsondi kalan	Parsondi kalan	Lakhanpur	Check Dam
180	83.0533	23.0171	Sirkotanga	Sirkotanga	Lakhanpur	Check Dam
181	83.081	23.0393	Pipar Khar	Amera	Lakhanpur	Check Dam
182	83.0723	23.045	Pipar Khar	Amera	Lakhanpur	Check Dam
183	83.0744	22.9726	Juna Lakhanpur	Juna Lakhanpur	Lakhanpur	Check Dam
184	83.0533	22.9886	Shivpur	Lakhanpur	Lakhanpur	Check Dam
185	83.1005	22.9559	Alga	Beldagi	Lakhanpur	Check Dam
186	83.1146	22.9177	Ramla	Losanga	Lakhanpur	Check Dam
187	83.1268	22.8849	Kotbarra	Sakaria	Lakhanpur	Check Dam
188	83.0376	22.8757	Pondi	Pondi	Lakhanpur	Check Dam
189	83.1368	22.7558	Patkura	Patkura	Lakhanpur	Check Dam
190	83.1085	22.7678	Patkura	Patkura	Lakhanpur	Check Dam
191	83.0742	22.8327	Karai	Tirkela	Lakhanpur	Check Dam
192	83.0848	22.8647	Sakaria	Sakaria	Lakhanpur	Check Dam
193	83.1063	22.8145	Argoti	Argoti	Lakhanpur	Check Dam
194	83.0892	22.8047	Argoti	Argoti	Lakhanpur	Check Dam
195	83.0732	22.8062	Argoti	Argoti	Lakhanpur	Check Dam
196	83.0788	22.7818	Jiwaliya	Dhodha kesra	Lakhanpur	Check Dam
197	83.1111	22.789	Dhodha kesra	Dhodha kesra	Lakhanpur	Check Dam
198	83.1359	22.8406	Jama	Tirkela	Lakhanpur	Check Dam

Sl No	Longitude	Latitude	Village	Panchayat	Block	Feasible AR Structure
199	83.1067	23.0453	Singitana	Singitana	Lakhanpur	Check Dam
200	83.1488	23.0111	Majhgawan	Irgawan	Lakhanpur	Check Dam
201	83.142	22.9599	Tunguri	Tunguri	Lakhanpur	Check Dam
202	83.1471	22.9799	Turna	Turna	Lakhanpur	Check Dam
203	83.0685	23.0346	Puhputra	Puhputra	Lakhanpur	Percolation Tank
204	82.9114	23.0975	Getra	Khutiya	Lakhanpur	Percolation Tank
205	82.928	23.1023	Getra	Khutiya	Lakhanpur	Percolation Tank
206	82.9385	23.0729	Potka	Potka	Lakhanpur	Percolation Tank
207	82.9617	23.0503	Nimha	Nimha	Lakhanpur	Percolation Tank
208	83.0164	23.0689	Gumgara kalan	Gumgara kalan	Lakhanpur	Percolation Tank
209	83.0396	23.0334	Janakpur	Gorta	Lakhanpur	Percolation Tank
210	83.0851	23.0487	Pipar Khar	Amera	Lakhanpur	Percolation Tank
211	83.0182	23.0008	Jaipur	Umrauli	Lakhanpur	Percolation Tank
212	83.1525	22.9544	Kusu	Kusu	Lakhanpur	Percolation Tank
213	83.1468	23.0165	Majhgawan	Irgawan	Lakhanpur	Percolation Tank
214	83.1648	23.0016	Jaipur	Jaipur	Lakhanpur	Percolation Tank
215	83.0589	22.9802	Bharatpur	Gorta	Lakhanpur	Percolation Tank
216	83.0978	22.9992	Taparkela khurd	Keori	Lakhanpur	Percolation Tank
217	83.026	23.0515	Gumgara khurd	Bagdarri	Lakhanpur	Percolation Tank
218	83.037	22.9976	Lakhanpur	Lakhanpur	Lakhanpur	Percolation Tank
219	83.1018	22.8158	Argoti	Argoti	Lakhanpur	Percolation Tank
220	83.0724	22.8368	Karai	Tirkela	Lakhanpur	Percolation Tank
221	83.1385	22.8473	Labji	Sakaria	Lakhanpur	Percolation Tank
222	83.1271	22.7933	Dhodha kesra	Dhodha kesra	Lakhanpur	Percolation Tank
223	82.9795	23.0188	Jamgala	Jamgala	Lakhanpur	Gully plugs/ GS
224	82.9849	23.0328	Rampur	Latori	Lakhanpur	Gully plugs/ GS
225	83.0119	23.005	Latori	Latori	Lakhanpur	Gully plugs/ GS
226	82.9955	23.0555	Bagdarri	Bagdarri	Lakhanpur	Gully plugs/ GS
227	83.0235	23.0543	Gumgara khurd	Bagdarri	Lakhanpur	Gully plugs/ GS
228	83.126	22.7453	Patkura	Patkura	Lakhanpur	Gully plugs/ GS
229	83.1559	22.8017	Dand kesra	Patkura	Lakhanpur	Gully plugs/ GS
230	83.1643	22.8104	Dand kesra	Patkura	Lakhanpur	Gully plugs/ GS
231	83.1605	22.7809		Patkura	Lakhanpur	Gully plugs/ GS
232	83.1697	22.7951	Dand kesra	Patkura	Lakhanpur	Gully plugs/ GS
233	83.1379	22.8224	Jama	Tirkela	Lakhanpur	Gully plugs/ GS
234	83.1434	22.8347	Jama	Tirkela	Lakhanpur	Gully plugs/ GS
235	83.1428	22.838	Jama	Tirkela	Lakhanpur	Gully plugs/ GS
236	83.132	22.8377	Jama	Tirkela	Lakhanpur	Gully plugs/ GS
237	83.0833	22.8277	Tirkela	Tirkela	Lakhanpur	Gully plugs/ GS
238	83.0684	22.8202	Argoti	Argoti	Lakhanpur	Gully plugs/ GS

Sl No	Longitude	Latitude	Village	Panchayat	Block	Feasible AR Structure
239	83.1227	22.7961	Dhodha kesra	Dhodha kesra	Lakhanpur	Gully plugs/ GS
240	83.1306	22.7879	Dhodha kesra	Dhodha kesra	Lakhanpur	Gully plugs/ GS
241	83.1409	22.7759	Patkura	Patkura	Lakhanpur	Gully plugs/ GS
242	83.1499	22.7608	Patkura	Patkura	Lakhanpur	Gully plugs/ GS
243	83.1491	22.7461	Patkura	Patkura	Lakhanpur	Gully plugs/ GS
244	83.1165	22.7526	Patkura	Patkura	Lakhanpur	Gully plugs/ GS
245	83.1216	22.8197	Argoti	Argoti	Lakhanpur	Gully plugs/ GS
246	83.133	22.8064	Dhodha kesra	Dhodha kesra	Lakhanpur	Gully plugs/ GS
247	83.114	22.829	Argoti	Argoti	Lakhanpur	Gully plugs/ GS
248	83.1219	22.7776	Patkura	Patkura	Lakhanpur	Gully plugs/ GS
249	83.1004	22.8007	Argoti	Argoti	Lakhanpur	Gully plugs/ GS
250	83.1097	22.8097	Argoti	Argoti	Lakhanpur	Gully plugs/ GS
251	83.1007	22.834	Tirkela	Tirkela	Lakhanpur	Gully plugs/ GS
252	83.0659	22.7947	Jiwaliya	Dhodha kesra	Lakhanpur	Gully plugs/ GS
253	83.0953	22.8753	Sakaria	Sakaria	Lakhanpur	Gully plugs/ GS
254	83.1279	22.847	Labji	Sakaria	Lakhanpur	Gully plugs/ GS
255	83.1328	22.8583	Labji	Sakaria	Lakhanpur	Gully plugs/ GS
256	83.132	22.8663	Labji	Sakaria	Lakhanpur	Gully plugs/ GS
257	83.0975	22.866	Sakaria	Sakaria	Lakhanpur	Gully plugs/ GS
258	83.0904	22.8816	Sakaria	Sakaria	Lakhanpur	Gully plugs/ GS
259	83.083	22.8913	Turga	Manja	Lakhanpur	Gully plugs/ GS
260	83.0768	22.9008	Turga	Manja	Lakhanpur	Gully plugs/ GS
261	83.0869	22.9141	Losanga	Losanga	Lakhanpur	Gully plugs/ GS
262	83.0624	22.9171	Losanga	Losanga	Lakhanpur	Gully plugs/ GS
263	83.0833	22.9276	Losanga	Losanga	Lakhanpur	Gully plugs/ GS
264	83.0681	22.9329	Losangi	Losanga	Lakhanpur	Gully plugs/ GS
265	83.057	22.9306	Losangi	Losanga	Lakhanpur	Gully plugs/ GS
266	83.1097	22.8475	Labji	Sakaria	Lakhanpur	Gully plugs/ GS
267	83.0888	22.8495	Tirkela	Tirkela	Lakhanpur	Gully plugs/ GS
268	83.0779	22.8508	Tirkela	Tirkela	Lakhanpur	Gully plugs/ GS
269	83.0494	22.9051	Chodeya	Manja	Lakhanpur	Gully plugs/ GS
270	83.1494	22.8685		Puta	Lakhanpur	Gully plugs/ GS
271	83.1697	22.8678		Puta	Lakhanpur	Gully plugs/ GS
272	83.1513	22.9312	Puta	Puta	Lakhanpur	Gully plugs/ GS
273	83.17	22.9355	Goreya Pipar	Puta	Lakhanpur	Gully plugs/ GS
274	83.1004	22.962	Beldagi	Beldagi	Lakhanpur	Gully plugs/ GS
275	83.02	22.9081	Manja	Manja	Lakhanpur	Gully plugs/ GS
276	83.0303	22.9081	Manja	Manja	Lakhanpur	Gully plugs/ GS
277	83.0309	22.8933	Tunga	Pondi	Lakhanpur	Gully plugs/ GS
278	83.0157	23	Jaipur	Umrauli	Lakhanpur	Gully plugs/ GS

Sl No	Longitude	Latitude	Village	Panchayat	Block	Feasible AR Structure
279	83.0366	22.992	Lakhanpur	Lakhanpur	Lakhanpur	Gully plugs/ GS
280	83.0776	23.0133	Rajpuri Kalan	Rajpuri Kalan	Lakhanpur	Gully plugs/ GS
281	83.0825	23.013	Rajpuri Kalan	Rajpuri Kalan	Lakhanpur	Gully plugs/ GS
282	83.1037	23.0138	Palgadi	Singitana	Lakhanpur	Gully plugs/ GS
283	83.0996	23.0165	Palgadi	Singitana	Lakhanpur	Gully plugs/ GS
284	83.1089	23.0305	Salka	Salka	Lakhanpur	Gully plugs/ GS
285	83.1181	23.0233	Salka	Salka	Lakhanpur	Gully plugs/ GS
286	83.0945	22.9785	Keori	Keori	Lakhanpur	Gully plugs/ GS
287	83.1097	22.9845	Amdala	Amdala	Lakhanpur	Gully plugs/ GS
288	83.1132	22.9898	Amdala	Amdala	Lakhanpur	Gully plugs/ GS
289	83.1366	22.9805	Turna	Turna	Lakhanpur	Gully plugs/ GS
290	83.1458	22.9515	Kusu	Kusu	Lakhanpur	Gully plugs/ GS
291	83.1265	22.962	Tunguri	Tunguri	Lakhanpur	Gully plugs/ GS
292	83.1097	22.9395	Alga	Beldagi	Lakhanpur	Gully plugs/ GS
293	83.1181	22.9522	Chando	Amdala	Lakhanpur	Gully plugs/ GS
294	83.1287	22.9407	Soyada	Amdala	Lakhanpur	Gully plugs/ GS
295	83.1268	22.9105	Ramla	Losanga	Lakhanpur	Gully plugs/ GS
296	83.157	22.9527	Kusu	Kusu	Lakhanpur	Gully plugs/ GS
297	83.396	23.0323	Silsila	Silsila	Lundra	Check Dam
298	83.3683	23.1302	Khalpondi	Khalpondi	Lundra	Check Dam
299	83.3615	23.0456	Lamgaon	Lamgaon	Lundra	Check Dam
300	83.3322	23.0561	Sayarrai	Raghunathpur	Lundra	Check Dam
301	83.3599	23.0571	Lamgaon	Lamgaon	Lundra	Check Dam
302	83.3422	23.0361	Kot	Kot	Lundra	Check Dam
303	83.3721	23.0638	Askala	Askala	Lundra	Check Dam
304	83.3772	23.0805	Askala	Askala	Lundra	Check Dam
305	83.3989	23.0763	Askala	Askala	Lundra	Check Dam
306	83.3908	23.1045	Dorna	Dorna	Lundra	Check Dam
307	83.3403	23.0895	Batwahi	Batwahi	Lundra	Check Dam
308	83.359	23.1073	Bulanga	Bulanga	Lundra	Check Dam
309	83.3395	23.1567	Bakna Kalan	Bakna Kalan	Lundra	Check Dam
310	83.3069	23.1517	Jamdi	Jamdi	Lundra	Check Dam
311	83.3862	23.2537	Chandreshwarpur	Changori	Lundra	Check Dam
312	83.4863	23.1818	Deori	Chhermunda	Lundra	Check Dam
313	83.4611	23.1816	Deori	Chhermunda	Lundra	Check Dam
314	83.542	23.1409	Bhediya	Sapda	Lundra	Check Dam
315	83.5262	23.1514	Rawai	Dumardih	Lundra	Check Dam
316	83.495	23.1514	Gagoli	Gagoli	Lundra	Check Dam
317	83.4709	23.1601	Nawdiha	Kakni	Lundra	Check Dam
318	83.4717	23.1479	Shananpur	Shananpur	Lundra	Check Dam

Sl No	Longitude	Latitude	Village	Panchayat	Block	Feasible AR Structure
319	83.4567	23.1604	Patora	Patora	Lundra	Check Dam
320	83.4527	23.2297	Baboli	Baboli	Lundra	Check Dam
321	83.4296	23.2172	Kishunpur	Kudar	Lundra	Check Dam
322	83.4337	23.2309	Kudar	Kudar	Lundra	Check Dam
323	83.3292	23.0613	Sayarrai	Raghunathpur	Lundra	Percolation Tank
324	83.3341	23.0851	Batwahi	Batwahi	Lundra	Percolation Tank
325	83.3542	23.1157	Udari	Udari	Lundra	Percolation Tank
326	83.3529	23.1354	Chalgali	Khalpondi	Lundra	Percolation Tank
327	83.3205	23.1528	Dakai Nawgai (Dakai)	Dakai Nawgai	Lundra	Percolation Tank
328	83.2964	23.1963	Ajirma Kalan	Kepi	Lundra	Percolation Tank
329	83.2859	23.181	Kepi	Kepi	Lundra	Percolation Tank
330	83.26	23.0903	Lalmati	Lalmati	Lundra	Percolation Tank
331	83.3481	23.054	Lamgaon	Lamgaon	Lundra	Percolation Tank
332	83.3065	23.1459	Jamdi	Jamdi	Lundra	Percolation Tank
333	83.3766	23.1721	Semardih	Semardih	Lundra	Percolation Tank
334	83.3113	23.1975		Dakai Nawgai	Lundra	Percolation Tank
335	83.402	23.0351	Parwatipur	Bargidih	Lundra	Percolation Tank
336	83.3967	23.048	Jheradih	Jheradih	Lundra	Percolation Tank
337	83.4971	23.127	Pasena	Gujarwar	Lundra	Percolation Tank
338	83.3976	23.1068	Dorna	Dorna	Lundra	Percolation Tank
339	83.4787	23.1169	Gujarwar	Gujarwar	Lundra	Percolation Tank
340	83.4112	23.0766	Turiyawira	Gadhwira	Lundra	Percolation Tank
341	83.3937	23.1363	Uparpondi	Chirga	Lundra	Percolation Tank
342	83.5164	23.1411	Chitarpur	Chitarpur	Lundra	Percolation Tank
343	83.5357	23.1528	Bhediya	Sapda	Lundra	Percolation Tank
344	83.3292	23.0792	Batwahi	Batwahi	Lundra	Gully plugs/ GS
345	83.3197	23.0592	Sayarrai	Raghunathpur	Lundra	Gully plugs/ GS
346	83.314	23.0479	Purkela	Purkela	Lundra	Gully plugs/ GS
347	83.3181	23.0379	Gangapur	Unchdih	Lundra	Gully plugs/ GS
348	83.3232	23.0249		Unchdih	Lundra	Gully plugs/ GS
349	83.3001	23.0402	Purkela	Purkela	Lundra	Gully plugs/ GS
350	83.3042	23.0614	Sikilma	Purkela	Lundra	Gully plugs/ GS
351	83.3583	23.133	Chalgali	Khalpondi	Lundra	Gully plugs/ GS
352	83.3211	23.178	Dakai Nawgai (Dakai)	Dakai Nawgai	Lundra	Gully plugs/ GS
353	83.317	23.1908		Dakai Nawgai	Lundra	Gully plugs/ GS
354	83.3004	23.1885	Ajirma Kalan	Kepi	Lundra	Gully plugs/ GS
355	83.2988	23.1672	Kepi	Kepi	Lundra	Gully plugs/ GS
356	83.2958	23.1442	Kardoni	Jamdi	Lundra	Gully plugs/ GS
357	83.3159	23.138	Rata	Rata	Lundra	Gully plugs/ GS
358	83.3358	23.1405	Bakna Kalan	Bakna Kalan	Lundra	Gully plugs/ GS

Sl No	Longitude	Latitude	Village	Panchayat	Block	Feasible AR Structure
359	83.3453	23.1345	Bakna Kalan	Bakna Kalan	Lundra	Gully plugs/ GS
360	83.3371	23.1177	Udari	Udari	Lundra	Gully plugs/ GS
361	83.336	23.1115	Udari	Udari	Lundra	Gully plugs/ GS
362	83.3137	23.1032		Korima	Lundra	Gully plugs/ GS
363	83.3597	23.0937	Bulanga	Bulanga	Lundra	Gully plugs/ GS
364	83.3401	23.0262	Kot	Kot	Lundra	Gully plugs/ GS
365	83.3825	23.0507	Silsila	Silsila	Lundra	Gully plugs/ GS
366	83.3839	23.0437	Silsila	Silsila	Lundra	Gully plugs/ GS
367	83.3923	23.0597	Askala	Askala	Lundra	Gully plugs/ GS
368	83.4103	23.0537	Jheradih	Jheradih	Lundra	Gully plugs/ GS
369	83.5545	23.1407	Bhediya	Sapda	Lundra	Gully plugs/ GS
370	83.4691	23.2493	Bilhama	Bilhama	Lundra	Gully plugs/ GS
371	83.4794	23.2421	Bilhama	Bilhama	Lundra	Gully plugs/ GS
372	83.4944	23.2358	Jori	Jori	Lundra	Gully plugs/ GS
373	83.5139	23.2403	Jori	Jori	Lundra	Gully plugs/ GS
374	83.4315	23.2566	Kudar	Kudar	Lundra	Gully plugs/ GS
375	83.407	23.2634	Karra	Karra	Lundra	Gully plugs/ GS
376	83.3842	23.2636	Chandreshwarpur	Changori	Lundra	Gully plugs/ GS
377	83.5488	23.152	Bhediya	Sapda	Lundra	Gully plugs/ GS
378	83.5512	23.145	Bhediya	Sapda	Lundra	Gully plugs/ GS
379	83.5496	23.128	Sapda	Sapda	Lundra	Gully plugs/ GS
380	83.542	23.1325	Sapda	Sapda	Lundra	Gully plugs/ GS
381	83.5251	23.1267	Chalgali	Koilari	Lundra	Gully plugs/ GS
382	83.5265	23.1357	Chitarpur	Chitarpur	Lundra	Gully plugs/ GS
383	83.5164	23.1412	Chitarpur	Chitarpur	Lundra	Gully plugs/ GS
384	83.508	23.1347	Koilari	Koilari	Lundra	Gully plugs/ GS
385	83.5044	23.127	Chalgali	Koilari	Lundra	Gully plugs/ GS
386	83.5129	23.117	Kirkima	Koilari	Lundra	Gully plugs/ GS
387	83.4296	23.1042	Sasoli	Sasoli	Lundra	Gully plugs/ GS
388	83.4032	23.118	Karanki	Karanki	Lundra	Gully plugs/ GS
389	83.4013	23.1302	Lundra	Lundra	Lundra	Gully plugs/ GS
390	83.3872	23.1355	Uparpondi	Chirga	Lundra	Gully plugs/ GS
391	83.5137	23.104	Nagam	Nagam	Lundra	Gully plugs/ GS
392	83.5243	23.1115	Nagam	Nagam	Lundra	Gully plugs/ GS
393	83.4704	23.105	Korandha	Urdara	Lundra	Gully plugs/ GS
394	83.4778	23.1122	Gujarwar	Gujarwar	Lundra	Gully plugs/ GS
395	83.4783	23.0799	Barauli	Jarakela	Lundra	Gully plugs/ GS
396	83.4511	23.0809	Rai Khurd	Jarakela	Lundra	Gully plugs/ GS
397	83.4375	23.0734	Rai Khurd	Jarakela	Lundra	Gully plugs/ GS
398	83.4397	23.096	Patradih	Jamdih	Lundra	Gully plugs/ GS

Sl No	Longitude	Latitude	Village	Panchayat	Block	Feasible AR Structure
399	83.4628	23.0587	Gersa	Gersa	Lundra	Gully plugs/ GS
400	83.4476	23.0484	Kudar	Gersa	Lundra	Gully plugs/ GS
401	83.4789	23.0629	Gersa	Gersa	Lundra	Gully plugs/ GS
402	83.4922	23.0867	Riri	Gujarwar	Lundra	Gully plugs/ GS
403	83.5031	23.0854	Riri	Gujarwar	Lundra	Gully plugs/ GS
404	83.2021	22.8291	Sarbhanja	Sarbhanja	Mainpat	Check Dam
405	83.2347	22.8513	Asgawan	Paiga	Mainpat	Check Dam
406	83.3354	22.8811		Sapnadar	Mainpat	Check Dam
407	83.3357	22.8566	Kaljiwa alias Malti	Sapnadar	Mainpat	Check Dam
408	83.3525	22.8428		Kuniya	Mainpat	Check Dam
409	83.362	22.8638	Askara alias Madwasa	Kuniya	Mainpat	Check Dam
410	83.3561	22.9014		Sapnadar	Mainpat	Check Dam
411	83.3476	22.9084		Sapnadar	Mainpat	Check Dam
412	83.2599	22.8648	Supalga	Supalga	Mainpat	Check Dam
413	83.2545	22.8536	Paiga	Paiga	Mainpat	Check Dam
414	83.4019	22.8401	Bandana	Bandana	Mainpat	Check Dam
415	83.2602	22.8753	Supalga	Supalga	Mainpat	Check Dam
416	83.261	22.9001	Karmha	Bisarpani	Mainpat	Check Dam
417	83.2789	22.7958	Kesara	Kesara	Mainpat	Check Dam
418	83.305	22.8303	Rupakhar	Rupakhar	Mainpat	Check Dam
419	83.3129	22.7923	Barima	Barima	Mainpat	Check Dam
420	83.3352	22.8108		Barima	Mainpat	Check Dam
421	83.3854	22.7735		Pidiya	Mainpat	Check Dam
422	83.4085	22.8111	Udumkela	Udumkela	Mainpat	Check Dam
423	83.4226	22.8348	Udumkela	Udumkela	Mainpat	Check Dam
424	83.4305	22.8498	Kot	Kot	Mainpat	Check Dam
425	83.4495	22.7503	Khadgaon	Khadgaon	Mainpat	Check Dam
426	83.4313	22.6957	Rajapur	Rajapur	Mainpat	Check Dam
427	83.3919	22.6554	Harramar	Harramar	Mainpat	Check Dam
428	83.4182	22.7718	Chainpur	Pidiya	Mainpat	Check Dam
429	83.4245	22.7433	Pent	Pent	Mainpat	Check Dam
430	83.2775	22.9045	Bisarpani	Bisarpani	Mainpat	Percolation Tank
431	83.2885	22.9316		Samaniya	Mainpat	Percolation Tank
432	83.3227	22.9404	Amgaon	Samaniya	Mainpat	Percolation Tank
433	83.2144	22.8234	Sarbhanja	Sarbhanja	Mainpat	Percolation Tank
434	83.2008	22.8508	Parpatiya	Parpatiya	Mainpat	Percolation Tank
435	83.3227	22.8549		Sapnadar	Mainpat	Percolation Tank
436	83.3297	22.8032	Barima	Barima	Mainpat	Percolation Tank
437	83.3599	22.8214	Narbadapur	Narbadapur	Mainpat	Percolation Tank

Sl No	Longitude	Latitude	Village	Panchayat	Block	Feasible AR Structure
438	83.2687	22.7972	Pathrai	Kesara	Mainpat	Percolation Tank
439	83.2942	22.825	Rupakhar	Rupakhar	Mainpat	Percolation Tank
440	83.3354	22.8263	Kuniya	Kuniya	Mainpat	Percolation Tank
441	83.2595	22.8186	Lurena	Lurena	Mainpat	Percolation Tank
442	83.242	22.8364		Lurena	Mainpat	Percolation Tank
443	83.4288	22.7668	Chainpur	Pidiya	Mainpat	Percolation Tank
444	83.4345	22.7208	Chidapara	Chidapara	Mainpat	Percolation Tank
445	83.3661	22.8683	Askara alias Madwasa	Kuniya	Mainpat	Percolation Tank
446	83.1735	22.8212		Parpatiya	Mainpat	Gully plugs/ GS
447	83.189	22.8553	Parpatiya	Parpatiya	Mainpat	Gully plugs/ GS
448	83.1673	22.8515	Parpatiya	Parpatiya	Mainpat	Gully plugs/ GS
449	83.154	22.846	Parpatiya	Parpatiya	Mainpat	Gully plugs/ GS
450	83.3115	22.7752	Barima	Barima	Mainpat	Gully plugs/ GS
451	83.1839	22.8307		Parpatiya	Mainpat	Gully plugs/ GS
452	83.1874	22.8367	Parpatiya	Parpatiya	Mainpat	Gully plugs/ GS
453	83.2114	22.7982	Laleya	Sarbhanja	Mainpat	Gully plugs/ GS
454	83.2277	22.8068	Sarbhanja	Sarbhanja	Mainpat	Gully plugs/ GS
455	83.2506	22.7877	Kesara	Kesara	Mainpat	Gully plugs/ GS
456	83.2609	22.7892	Kesara	Kesara	Mainpat	Gully plugs/ GS
457	83.2794	22.7717	Kesara	Kesara	Mainpat	Gully plugs/ GS
458	83.256	22.7762	Kesara	Kesara	Mainpat	Gully plugs/ GS
459	83.3012	22.7727	Barima	Barima	Mainpat	Gully plugs/ GS
460	83.3023	22.7817	Barima	Barima	Mainpat	Gully plugs/ GS
461	83.3107	22.813		Kamleshwarpur	Mainpat	Gully plugs/ GS
462	83.3072	22.802	Kudaridih	Kamleshwarpur	Mainpat	Gully plugs/ GS
463	83.2887	22.8	Kudaridih	Kamleshwarpur	Mainpat	Gully plugs/ GS
464	83.3415	22.932	Kadnai	Kadnai	Mainpat	Gully plugs/ GS
465	83.3461	22.9212	Kadnai	Kadnai	Mainpat	Gully plugs/ GS
466	83.3034	22.8977		Sapnadar	Mainpat	Gully plugs/ GS
467	83.3124	22.908	Samaniya	Samaniya	Mainpat	Gully plugs/ GS
468	83.2958	22.9305	Amgaon	Samaniya	Mainpat	Gully plugs/ GS
469	83.2985	22.8752		Sapnadar	Mainpat	Gully plugs/ GS
470	83.2754	22.8847	Bisarpani	Bisarpani	Mainpat	Gully plugs/ GS
471	83.2808	22.908	Bisarpani	Bisarpani	Mainpat	Gully plugs/ GS
472	83.2841	22.9293		Samaniya	Mainpat	Gully plugs/ GS
473	83.2713	22.9057	Bisarpani	Bisarpani	Mainpat	Gully plugs/ GS
474	83.3975	22.8509	Bandana	Bandana	Mainpat	Gully plugs/ GS
475	83.3959	22.8614	Kot	Kot	Mainpat	Gully plugs/ GS
476	83.4046	22.8729	Kot	Kot	Mainpat	Gully plugs/ GS

Sl No	Longitude	Latitude	Village	Panchayat	Block	Feasible AR Structure
477	83.3825	22.8454	Bandana	Bandana	Mainpat	Gully plugs/ GS
478	83.3861	22.8549	Bandana	Bandana	Mainpat	Gully plugs/ GS
479	83.3284	22.8497		Sapnadar	Mainpat	Gully plugs/ GS
480	83.3929	22.8025	Narbadapur	Narbadapur	Mainpat	Gully plugs/ GS
481	83.3132	22.7817	Barima	Barima	Mainpat	Gully plugs/ GS
482	83.3153	22.8058		Kamleshwarpur	Mainpat	Gully plugs/ GS
483	83.336	22.7767	Narbadapur	Narbadapur	Mainpat	Gully plugs/ GS
484	83.3562	22.7972	Narbadapur	Narbadapur	Mainpat	Gully plugs/ GS
485	83.3812	22.8243	Udumkela	Udumkela	Mainpat	Gully plugs/ GS
486	83.3632	22.7413	Kandraja	Narbadapur	Mainpat	Gully plugs/ GS
487	83.354	22.7541	Kandraja	Narbadapur	Mainpat	Gully plugs/ GS
488	83.3496	22.7621	Uranga	Barima	Mainpat	Gully plugs/ GS
489	83.3526	22.7947	Narbadapur	Narbadapur	Mainpat	Gully plugs/ GS
490	83.37	22.7762		Pidiya	Mainpat	Gully plugs/ GS
491	83.3964	22.7511	Pent	Pent	Mainpat	Gully plugs/ GS
492	83.3991	22.7458	Pent	Pent	Mainpat	Gully plugs/ GS
493	83.4019	22.7408	Pent	Pent	Mainpat	Gully plugs/ GS
494	83.4068	22.73	Kunkuri Khurd	Pent	Mainpat	Gully plugs/ GS
495	83.4119	22.717	Kunkuri Khurd	Pent	Mainpat	Gully plugs/ GS
496	83.4002	22.6931	Kotchhal	Kotchhal	Mainpat	Gully plugs/ GS
497	83.3845	22.6801	Jamkani	Harramar	Mainpat	Gully plugs/ GS
498	83.3983	22.7656	Pidiya	Pidiya	Mainpat	Gully plugs/ GS
499	83.4016	22.7689	Pidiya	Pidiya	Mainpat	Gully plugs/ GS
500	83.4073	22.7704	Pidiya	Pidiya	Mainpat	Gully plugs/ GS
501	83.4144	22.7767		Pidiya	Mainpat	Gully plugs/ GS
502	83.4163	22.7807		Pidiya	Mainpat	Gully plugs/ GS
503	83.4263	22.7867	Rajkheta	Pidiya	Mainpat	Gully plugs/ GS
504	83.4214	22.7857	Rajkheta	Pidiya	Mainpat	Gully plugs/ GS
505	83.4405	22.7822	Katkalo	Katkalo	Mainpat	Gully plugs/ GS
506	83.4013	22.8158	Udumkela	Udumkela	Mainpat	Gully plugs/ GS
507	83.4002	22.8278	Udumkela	Udumkela	Mainpat	Gully plugs/ GS
508	83.3409	22.8336	Kuniya	Kuniya	Mainpat	Gully plugs/ GS
509	83.4255	22.6821	Dangbuda	Dangbuda	Mainpat	Gully plugs/ GS
510	83.4176	22.6743	Jamdhodhi	Jamdhodhi	Mainpat	Gully plugs/ GS
511	83.4315	22.7313	Chidapara	Chidapara	Mainpat	Gully plugs/ GS
512	83.5808	22.7601	Lalitpur	Lalitpur	Sitapur	Check Dam
513	83.593	22.7441	Shivnathpur	Shivnathpur	Sitapur	Check Dam
514	83.6079	22.7185	Dhodhagaon	Dhodhagaon	Sitapur	Check Dam
515	83.6125	22.6983	Dhodhagaon	Dhodhagaon	Sitapur	Check Dam
516	83.6337	22.6803	Dhodhagaon	Dhodhagaon	Sitapur	Check Dam

Sl No	Longitude	Latitude	Village	Panchayat	Block	Feasible AR Structure
517	83.6562	22.6563	Kunmera	Kunmera	Sitapur	Check Dam
518	83.5868	22.6993	Tendudand	Hardisand	Sitapur	Check Dam
519	83.469	22.7055	Belgaon	Belgaon	Sitapur	Check Dam
520	83.4606	22.686	Guturma	Guturma	Sitapur	Check Dam
521	83.5648	22.7961	Beljora	Beljora	Sitapur	Check Dam
522	83.5417	22.7823	Dharampur	Dharampur	Sitapur	Check Dam
523	83.5615	22.8411	Parsa	Bhusu	Sitapur	Check Dam
524	83.5206	22.8446	Bhusu	Bhusu	Sitapur	Check Dam
525	83.6451	22.7896	Gersa	Gersa	Sitapur	Check Dam
526	83.5498	22.8566	Bagdoli	Dhekidoli	Sitapur	Percolation Tank
527	83.5213	22.8388	Bhusu	Bhusu	Sitapur	Percolation Tank
528	83.4687	22.8238	Deogarh	Deogarh	Sitapur	Percolation Tank
529	83.4836	22.7523	Chalta	Chalta	Sitapur	Percolation Tank
530	83.4871	22.6896	Ulkiya	Ulkiya	Sitapur	Percolation Tank
531	83.5226	22.7393	Petla	Petla	Sitapur	Gully plugs/ GS
532	83.6644	22.6706		Kunmera	Sitapur	Gully plugs/ GS
533	83.6487	22.6701	Kunmera	Kunmera	Sitapur	Gully plugs/ GS
534	83.6538	22.6859	Kunmera	Kunmera	Sitapur	Gully plugs/ GS
535	83.6316	22.6927	Dhodhagaon	Dhodhagaon	Sitapur	Gully plugs/ GS
536	83.5487	22.7293	Petla	Petla	Sitapur	Gully plugs/ GS
537	83.5348	22.715	Ara	Ara	Sitapur	Gully plugs/ GS
538	83.5063	22.7055	Hardisand	Hardisand	Sitapur	Gully plugs/ GS
539	83.4949	22.7107	Belgaon	Belgaon	Sitapur	Gully plugs/ GS
540	83.4745	22.6849	Guturma	Guturma	Sitapur	Gully plugs/ GS
541	83.5288	22.6942	Hardisand	Hardisand	Sitapur	Gully plugs/ GS
542	83.6451	22.7633	Gersa	Gersa	Sitapur	Gully plugs/ GS
543	83.6201	22.7435	Shivnathpur	Shivnathpur	Sitapur	Gully plugs/ GS
544	83.5693	22.7383	Petla	Petla	Sitapur	Gully plugs/ GS
545	83.5829	22.721	Petla	Petla	Sitapur	Gully plugs/ GS
546	83.5264	22.7458	Petla	Petla	Sitapur	Gully plugs/ GS
547	83.4949	22.7613	Keshla	Sitapur	Sitapur	Gully plugs/ GS
548	83.5511	22.862	Bagdoli	Dhekidoli	Sitapur	Gully plugs/ GS
549	83.5663	22.7781	Lalitpur	Lalitpur	Sitapur	Gully plugs/ GS
550	83.575	22.7861	Lalitpur	Lalitpur	Sitapur	Gully plugs/ GS
551	83.575	22.8069	Beljora	Beljora	Sitapur	Gully plugs/ GS
552	83.5422	22.8177	Sureshpur	Beljora	Sitapur	Gully plugs/ GS
553	83.5894	22.8385	Erand	Nawapara	Sitapur	Gully plugs/ GS
554	83.5778	22.8345	Erand	Nawapara	Sitapur	Gully plugs/ GS
555	83.5739	22.8438	Dhekidoli	Dhekidoli	Sitapur	Gully plugs/ GS
556	83.5729	22.8613	Dhekidoli	Dhekidoli	Sitapur	Gully plugs/ GS

Sl No	Longitude	Latitude	Village	Panchayat	Block	Feasible AR Structure
557	83.5734	22.8558	Dhekidoli	Dhekidoli	Sitapur	Gully plugs/ GS
558	83.5612	22.8623	Bagdoli	Dhekidoli	Sitapur	Gully plugs/ GS
559	83.5313	22.853	Parsa	Bhusu	Sitapur	Gully plugs/ GS
560	83.6188	22.8187	Girhuldih	Girhuldih	Sitapur	Gully plugs/ GS
561	83.628	22.8109	Girhuldih	Girhuldih	Sitapur	Gully plugs/ GS
562	83.6275	22.8227	Girhuldih	Girhuldih	Sitapur	Gully plugs/ GS
563	83.6272	22.7987	Bharatpur	Bharatpur	Sitapur	Gully plugs/ GS
564	83.628	22.7899	Gersa	Gersa	Sitapur	Gully plugs/ GS
565	83.6489	22.7724	Gersa	Gersa	Sitapur	Gully plugs/ GS
566	83.6193	22.7736	Gersa	Gersa	Sitapur	Gully plugs/ GS
567	83.6003	22.7942	Bharatpur	Bharatpur	Sitapur	Gully plugs/ GS
568	83.5479	22.8087	Khadadorna	Khadadorna	Sitapur	Gully plugs/ GS
569	83.5786	22.8019	Beljora	Beljora	Sitapur	Gully plugs/ GS
570	83.5859	22.7944	Lalitpur	Lalitpur	Sitapur	Gully plugs/ GS
571	82.8905	22.8608	Chakeri	Chakeri	Udaipur	Check Dam
572	82.8192	22.8632	Parsa	Parsa	Udaipur	Check Dam
573	82.8539	22.8487	Basen	Parsa	Udaipur	Check Dam
574	82.9166	22.8152	Pendarkhi	Pendarkhi	Udaipur	Check Dam
575	82.9271	22.8047	Pendarkhi	Pendarkhi	Udaipur	Check Dam
576	82.8493	22.7827	Parogia	Ghatbarra	Udaipur	Check Dam
577	82.7901	22.7719	Suskam	Ghatbarra	Udaipur	Check Dam
578	82.7714	22.7849	Suskam	Ghatbarra	Udaipur	Check Dam
579	82.7874	22.8615	Salhi	Salhi	Udaipur	Check Dam
580	82.8362	22.7589	Parogia	Ghatbarra	Udaipur	Check Dam
581	82.8561	22.9621	Kharsura	Kharsura	Udaipur	Check Dam
582	82.9429	22.9511	Khodri	Palka	Udaipur	Check Dam
583	82.9396	22.9399	Jarhadih	Keshgawan	Udaipur	Check Dam
584	82.9535	22.9411	Jarhadih	Keshgawan	Udaipur	Check Dam
585	82.8555	22.9154	Dandgaon	Dandgaon	Udaipur	Check Dam
586	82.839	22.8902	Dandgaon	Dandgaon	Udaipur	Check Dam
587	82.8145	22.8884	Mudgaon	Mudgaon	Udaipur	Check Dam
588	82.8392	22.9269	Pandridand	Pandridand	Udaipur	Check Dam
589	82.8097	22.9191	Mudgaon	Mudgaon	Udaipur	Check Dam
590	82.8523	22.8872	Gumga	Gumga	Udaipur	Check Dam
591	82.8818	22.9186	Kotmi	Dawa	Udaipur	Check Dam
592	82.9746	22.7929	Pahadkorja	Pendarkhi	Udaipur	Check Dam
593	82.9526	22.7974	Pahadkorja	Pendarkhi	Udaipur	Check Dam
594	83.0018	22.737	Bhakurma	Bhakurma	Udaipur	Check Dam
595	82.8919	22.7395	Khujhi	Pendarkhi	Udaipur	Check Dam
596	82.89	22.7627	Khujhi	Pendarkhi	Udaipur	Check Dam

Sl No	Longitude	Latitude	Village	Panchayat	Block	Feasible AR Structure
597	83.0042	22.6961	Pangoti	Bhakurma	Udaipur	Check Dam
598	82.9019	23.0086	Namna kalan	Shankarpur	Udaipur	Check Dam
599	82.8875	23.0171	Shankarpur	Shankarpur	Udaipur	Check Dam
600	82.8867	22.9955	Ghuchapur	Lalati	Udaipur	Check Dam
601	82.9863	22.9374	Jajga	Jajga	Udaipur	Check Dam
602	82.9697	22.9584	Kawalgiri	Chainpur	Udaipur	Check Dam
603	82.9643	22.9054	Jhirmiti	Udaipur	Udaipur	Check Dam
604	83.0768	22.7045	Sitkalo	Mareya	Udaipur	Check Dam
605	83.0297	22.7139	Badegaon	Kedma	Udaipur	Check Dam
606	83.0319	22.7574	Bule	Bhakurma	Udaipur	Check Dam
607	83.0359	22.7679	Bule	Bhakurma	Udaipur	Check Dam
608	83.0164	22.7061	Pangoti	Bhakurma	Udaipur	Check Dam
609	83.0427	22.7231	Badegaon	Kedma	Udaipur	Check Dam
610	83.0514	22.7349	Badegaon	Kedma	Udaipur	Check Dam
611	83.0642	22.7574	Keshma	Kedma	Udaipur	Check Dam
612	83.0769	22.7266	Mareya	Mareya	Udaipur	Check Dam
613	83.0578	22.674	Matringa	Mareya	Udaipur	Check Dam
614	83.049	22.7547	Kedma	Kedma	Udaipur	Percolation Tank
615	83.0749	22.7535	Kundeli	Mareya	Udaipur	Percolation Tank
616	82.9337	22.8149	Pendarkhi	Pendarkhi	Udaipur	Percolation Tank
617	82.8201	22.8711	Dandgaon	Dandgaon	Udaipur	Percolation Tank
618	82.7916	22.8558	Salhi	Salhi	Udaipur	Percolation Tank
619	82.892	23.0203	Shankarpur	Shankarpur	Udaipur	Percolation Tank
620	82.8661	22.9835	Lalati	Lalati	Udaipur	Percolation Tank
621	82.8499	22.9593	Doi	Fulchuhi	Udaipur	Percolation Tank
622	82.8034	22.9265	Kathmunda	Mudgaon	Udaipur	Percolation Tank
623	82.9345	22.9338	Jarhadih	Keshgawan	Udaipur	Percolation Tank
624	82.9367	22.969	Salka	Salka	Udaipur	Percolation Tank
625	82.8486	22.8566	Basen	Parsa	Udaipur	Percolation Tank
626	82.8249	22.8954	Mudgaon	Mudgaon	Udaipur	Percolation Tank
627	82.8424	22.781	Parogia	Ghatbarra	Udaipur	Percolation Tank
628	82.9126	23.0296	Tolanga	Tolanga	Udaipur	Percolation Tank
629	82.8403	22.9047	Dandgaon	Dandgaon	Udaipur	Percolation Tank
630	82.7903	22.7765	Suskam	Ghatbarra	Udaipur	Percolation Tank
631	82.8679	22.8449	Basen	Parsa	Udaipur	Percolation Tank
632	82.9442	22.9484	Khodri	Palka	Udaipur	Percolation Tank
633	83.0301	22.7624	Bule	Bhakurma	Udaipur	Percolation Tank
634	82.8749	22.7596	Khujhi	Pendarkhi	Udaipur	Percolation Tank
635	82.9018	22.7842	Pendarkhi	Pendarkhi	Udaipur	Gully plugs/ GS
636	82.898	22.8123	Chakeri	Chakeri	Udaipur	Gully plugs/ GS

Sl No	Longitude	Latitude	Village	Panchayat	Block	Feasible AR Structure
637	82.8363	22.8073	Parogia	Ghatbarra	Udaipur	Gully plugs/ GS
638	82.8263	22.7972	Parogia	Ghatbarra	Udaipur	Gully plugs/ GS
639	82.8083	22.7847	Saidu	Ghatbarra	Udaipur	Gully plugs/ GS
640	82.8488	22.8027	Parogia	Ghatbarra	Udaipur	Gully plugs/ GS
641	82.7934	22.7892	Suskam	Ghatbarra	Udaipur	Gully plugs/ GS
642	82.8279	22.7742	Parogia	Ghatbarra	Udaipur	Gully plugs/ GS
643	82.8735	22.8356	Basen	Parsa	Udaipur	Gully plugs/ GS
644	82.8901	22.8982	Bangru	Gumga	Udaipur	Gully plugs/ GS
645	82.8776	22.8849	Salba	Gumga	Udaipur	Gully plugs/ GS
646	82.9045	22.8766	Chakeri	Chakeri	Udaipur	Gully plugs/ GS
647	82.8124	22.8571	Parsa	Parsa	Udaipur	Gully plugs/ GS
648	82.8246	22.9343	Narayanpur	Mudgaon	Udaipur	Gully plugs/ GS
649	82.8061	22.9318	Kathmunda	Mudgaon	Udaipur	Gully plugs/ GS
650	82.8303	22.8997	Mudgaon	Mudgaon	Udaipur	Gully plugs/ GS
651	82.8385	22.905	Dandgaon	Dandgaon	Udaipur	Gully plugs/ GS
652	82.8485	22.9105	Dandgaon	Dandgaon	Udaipur	Gully plugs/ GS
653	82.7947	22.8418	Hariharpur	Salhi	Udaipur	Gully plugs/ GS
654	82.8086	22.8313	Ghatbarra	Ghatbarra	Udaipur	Gully plugs/ GS
655	82.7798	22.801	Ghatbarra	Ghatbarra	Udaipur	Gully plugs/ GS
656	82.9436	22.8794	Puta	Ramnagar	Udaipur	Gully plugs/ GS
657	82.9705	22.8491	Tendu Tikra	Chakeri	Udaipur	Gully plugs/ GS
658	82.9586	22.8501	Tendu Tikra	Chakeri	Udaipur	Gully plugs/ GS
659	82.9638	22.8584	Tendu Tikra	Chakeri	Udaipur	Gully plugs/ GS
660	82.951	22.8619	Tendu Tikra	Chakeri	Udaipur	Gully plugs/ GS
661	82.9396	22.8516	Tendu Tikra	Chakeri	Udaipur	Gully plugs/ GS
662	82.9119	22.8557	Chakeri	Chakeri	Udaipur	Gully plugs/ GS
663	82.9292	22.8892	Puta	Ramnagar	Udaipur	Gully plugs/ GS
664	82.9203	22.8857	Puta	Ramnagar	Udaipur	Gully plugs/ GS
665	82.9113	22.8804	Puta	Ramnagar	Udaipur	Gully plugs/ GS
666	82.9301	22.8646	Puta	Ramnagar	Udaipur	Gully plugs/ GS
667	82.9958	22.8601	Laxmangarh	Laxmangarh	Udaipur	Gully plugs/ GS
668	82.9855	22.8686	Laxmangarh	Laxmangarh	Udaipur	Gully plugs/ GS
669	82.9798	22.8719	Sanibarra	Laxmangarh	Udaipur	Gully plugs/ GS
670	82.9822	22.8794	Phungi	Manpur	Udaipur	Gully plugs/ GS
671	82.9678	22.8832	Phungi	Manpur	Udaipur	Gully plugs/ GS
672	82.9532	22.8997	Ramnagar	Ramnagar	Udaipur	Gully plugs/ GS
673	82.9583	22.9207	Jhirmiti	Udaipur	Udaipur	Gully plugs/ GS
674	82.9369	22.929	Dumardih	Sontarai	Udaipur	Gully plugs/ GS
675	82.9271	22.9307	Sontarai	Sontarai	Udaipur	Gully plugs/ GS
676	82.9186	22.933	Sontarai	Sontarai	Udaipur	Gully plugs/ GS

Sl No	Longitude	Latitude	Village	Panchayat	Block	Feasible AR Structure
677	82.911	22.938	Pandripani	Dawa	Udaipur	Gully plugs/ GS
678	83.0249	22.6797	Matringa	Mareya	Udaipur	Gully plugs/ GS
679	83.0238	22.6614	Matringa	Mareya	Udaipur	Gully plugs/ GS
680	83.0208	22.6488	Matringa	Mareya	Udaipur	Gully plugs/ GS
681	83.02	22.7002	Pangoti	Bhakurma	Udaipur	Gully plugs/ GS
682	83.0151	22.6975	Pangoti	Bhakurma	Udaipur	Gully plugs/ GS
683	83.0129	22.6844	Matringa	Mareya	Udaipur	Gully plugs/ GS
684	82.9792	22.6889			Udaipur	Gully plugs/ GS
685	82.9659	22.7			Udaipur	Gully plugs/ GS
686	82.9695	22.7			Udaipur	Gully plugs/ GS
687	82.9629	22.712			Udaipur	Gully plugs/ GS
688	82.9763	22.721	Bhakurma	Bhakurma	Udaipur	Gully plugs/ GS
689	82.982	22.7215	Bhakurma	Bhakurma	Udaipur	Gully plugs/ GS
690	83.0018	22.7268	Bhakurma	Bhakurma	Udaipur	Gully plugs/ GS
691	82.9502	22.7268			Udaipur	Gully plugs/ GS
692	82.9374	22.7005			Udaipur	Gully plugs/ GS
693	82.9491	22.6834			Udaipur	Gully plugs/ GS
694	82.9072	22.7263	Bakoi	Pendarkhi	Udaipur	Gully plugs/ GS
695	82.9216	22.7268	Bakoi	Pendarkhi	Udaipur	Gully plugs/ GS
696	82.9146	22.7381	Bakoi	Pendarkhi	Udaipur	Gully plugs/ GS
697	82.9303	22.8454	Tendu Tikra	Chakeri	Udaipur	Gully plugs/ GS
698	82.9814	22.7559			Udaipur	Gully plugs/ GS
699	83.0004	22.7649			Udaipur	Gully plugs/ GS
700	82.979	22.7762	Pahadkorja	Pendarkhi	Udaipur	Gully plugs/ GS
701	82.9515	22.7757			Udaipur	Gully plugs/ GS
702	82.9475	22.7596			Udaipur	Gully plugs/ GS
703	82.9428	22.7579			Udaipur	Gully plugs/ GS
704	83.0271	22.7945	Sayar	Sayar	Udaipur	Gully plugs/ GS
705	82.9257	22.7712	Pendarkhi	Pendarkhi	Udaipur	Gully plugs/ GS
706	82.9178	22.7574	Bakoi	Pendarkhi	Udaipur	Gully plugs/ GS
707	82.9176	22.7845	Pendarkhi	Pendarkhi	Udaipur	Gully plugs/ GS
708	82.9292	22.8281	Tendu Tikra	Chakeri	Udaipur	Gully plugs/ GS
709	82.923	22.8248	Tendu Tikra	Chakeri	Udaipur	Gully plugs/ GS
710	83.0409	22.7411	Kedma	Kedma	Udaipur	Gully plugs/ GS
711	83.1162	22.6952	Sitkalo	Mareya	Udaipur	Gully plugs/ GS
712	83.1083	22.698	Sitkalo	Mareya	Udaipur	Gully plugs/ GS
713	83.0972	22.6985	Sitkalo	Mareya	Udaipur	Gully plugs/ GS
714	83.0888	22.702	Sitkalo	Mareya	Udaipur	Gully plugs/ GS
715	83.0926	22.6932	Sitkalo	Mareya	Udaipur	Gully plugs/ GS
716	83.0765	22.691	Sitkalo	Mareya	Udaipur	Gully plugs/ GS

Sl No	Longitude	Latitude	Village	Panchayat	Block	Feasible AR Structure
717	83.076	22.6842	Sitkalo	Mareya	Udaipur	Gully plugs/ GS
718	83.0725	22.6809	Sitkalo	Mareya	Udaipur	Gully plugs/ GS
719	83.0279	22.6809	Matringa	Mareya	Udaipur	Gully plugs/ GS
720	83.0401	22.6724	Matringa	Mareya	Udaipur	Gully plugs/ GS
721	83.0523	22.6917	Matringa	Mareya	Udaipur	Gully plugs/ GS
722	83.035	22.702	Badegaon	Kedma	Udaipur	Gully plugs/ GS
723	83.0371	22.708	Badegaon	Kedma	Udaipur	Gully plugs/ GS
724	83.0298	22.7456	Kedma	Kedma	Udaipur	Gully plugs/ GS
725	83.0787	22.7594	Keshma	Kedma	Udaipur	Gully plugs/ GS
726	83.0972	22.7115	Sitkalo	Mareya	Udaipur	Gully plugs/ GS
727	83.0578	22.7855	Lalpur	Sayar	Udaipur	Gully plugs/ GS
728	83.0385	22.8208	Kumdewa	Sayar	Udaipur	Gully plugs/ GS

AQUIFER MAPPING AND MANAGEMENT PLAN FOR AMBIKAPUR BLOCK (SURGUJA DISTRICT), CHHATTISGARH

CONTENTS

AQUIFER MAP AND MANAGEMENT PLAN: AMBIKAPUR BLOCK

1. Salient Information:

About the area: Ambikapur Block is situated on the northern part of Surguja district of Chhattisgarh and is bounded on the north by Surajpur and Balrampur district, in the west by Lakhanpur Block, in the south by Mainpat block and in the east by Lundra and Batauli Blocks. The block area lies between 22.86 and 23.24 N latitudes and 83.02 and 83.35 E longitudes. The geographical extension of the study area is 676.32 sq. km representing around 13 % of the district's geographical area. Administrative map of the block is shown in Fig. 1. Eastern part mainly comprises of structural plains on Gondwana rocks and denudational plateau on Proterozoic rocks and in southern part region of plateau. Geomorphology map is shown in Figure 2. The major drainage of the block includes Banari Nala and Gungata Nala, which are parts of Son sub basin and Ganga Basin. Drainage map shown in Fig. 3.

Population: The total population of Ambikapur block as per 2011 Census is 279717 out of which rural population is 158646 while the urban population is 121071.The population break up i.e. male- female, rural & urban is given below -

Table- 1: Population Break Up

Block	Total population	Male	Female	Rural population	Urban population
Ambikapur	279717	142833	136884	158646	121071

Source: CG Census, 2011

Growth rate: The decadal growth rate of the block is 19.36 as per 2011 census.

Rainfall: The study area receives rainfall mainly from south-west monsoon. About 87% of the annual rainfall is received during June to September and July and August are the months of maximum precipitation. The area gets some rainfall during winter season also. Average annual rainfall in the study area is (Average of the last five years i.e. 2013 to 2017) 1185.1 mm with 70 to 80 rainy days.

Table-2: Rainfall data in Ambikapur block in mm

Year	2013	2014	2015	2016	2017
Annual rainfall	998.9	1067.9	1081.9	1393.0	1383.7

Source: IMD

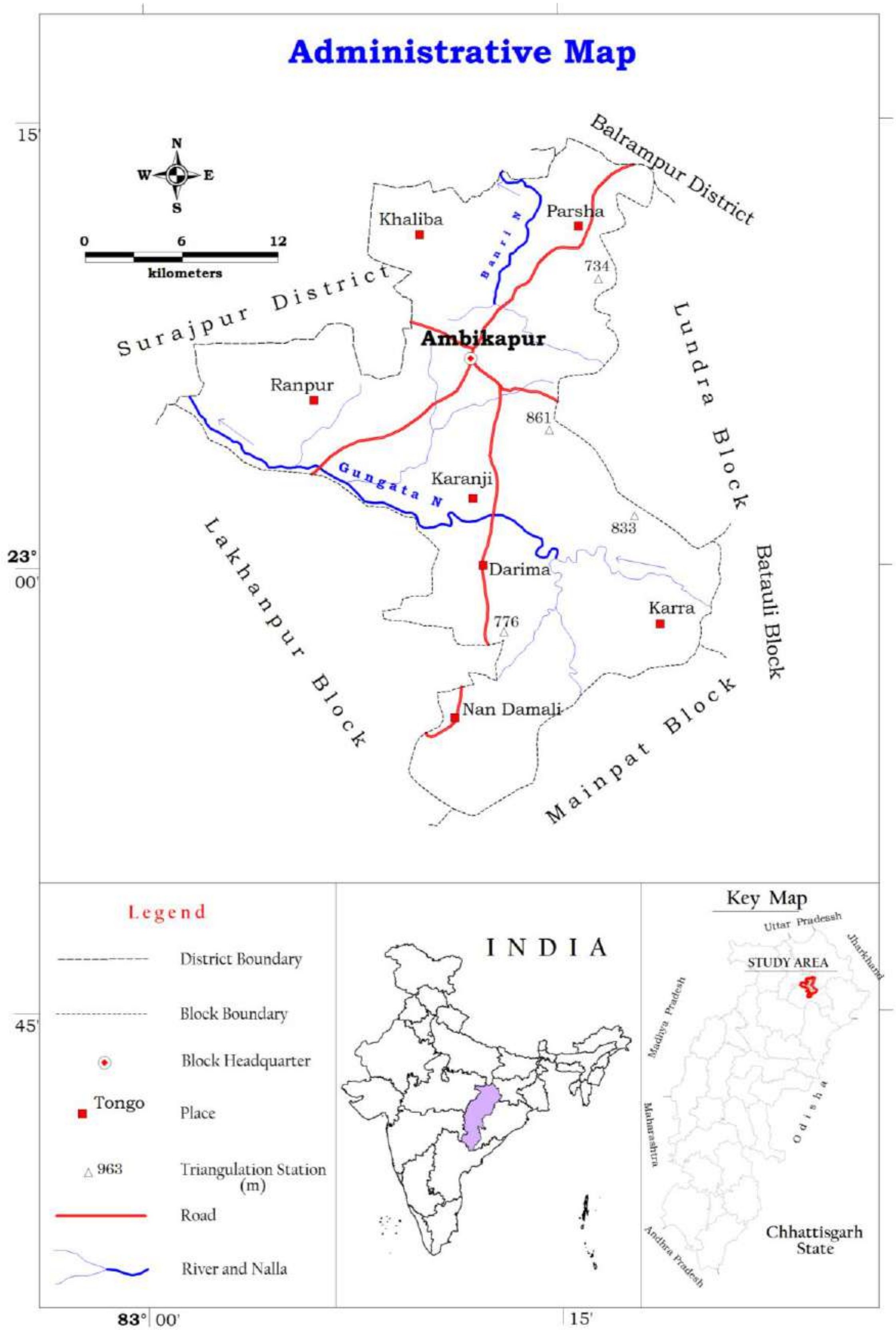

Figure 1 Administrative Map of Ambikapur Block

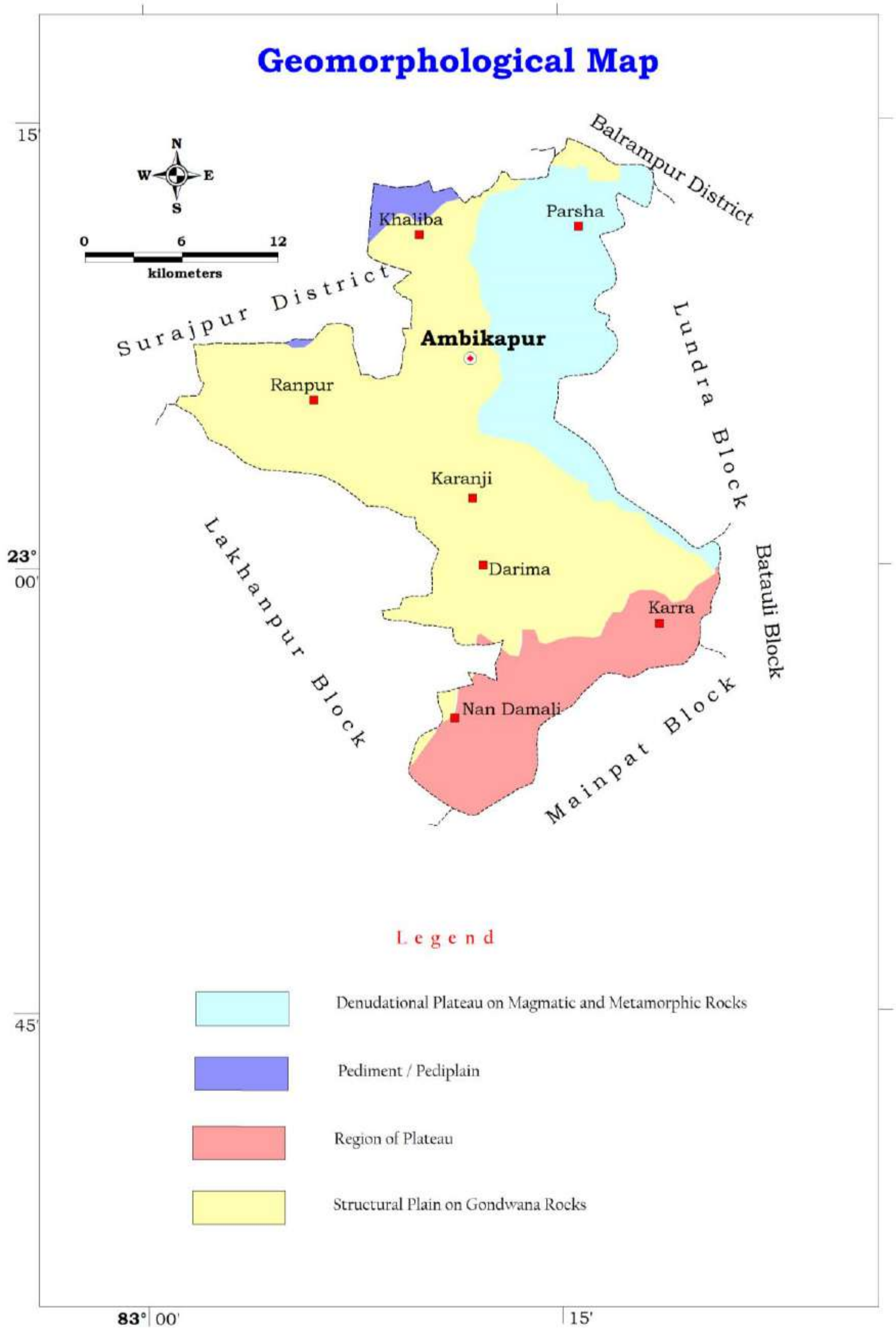

Figure 2 Geomorphology Map of Ambikapur Block

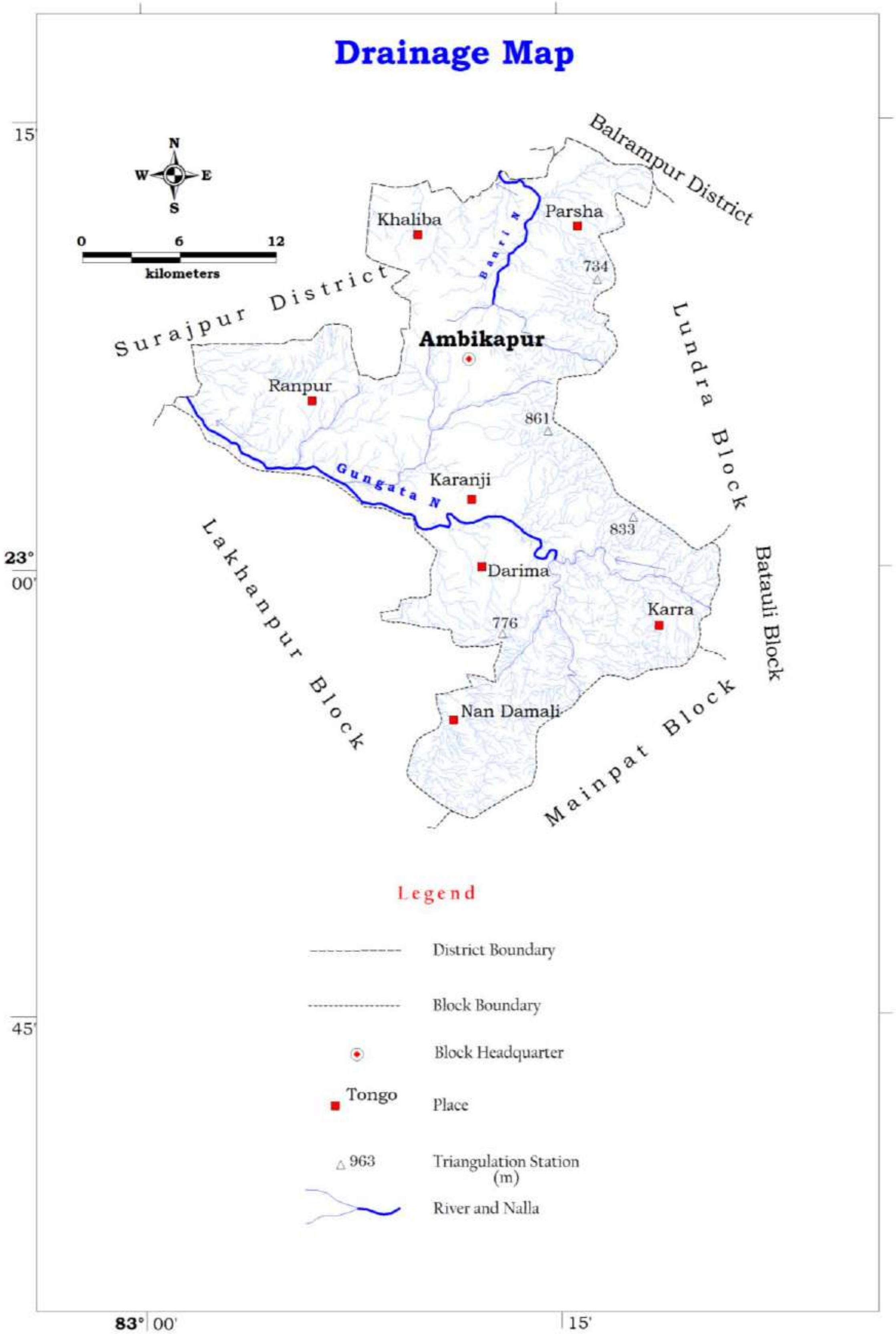

Figure 3 Drainage Map of Ambikapur Block

Agriculture and Irrigation**:** Agriculture is practiced in the area during Kharif and Rabi season every year. During the Kharif, cultivation is done through rainfall while during the Rabi season; it is done through ground water as well as partly through surface water like canals and other sources. The groundwater abstraction structures are generally Dugwells, Borewells /tubewells. The principal crops in the block are Paddy, Wheat, Vegetables and pulses.

In some areas, double cropping is also practiced. The agricultural pattern, cropping pattern and area irrigated data of Ambikapur block is given in Table 3 (A, B, C, D, and E).

Table 3 (A): Land use and Agricultural pattern (in ha)

Total geographical area	Revenue forest area	Area not available for cultivation	Nonagricultural & Fallow land	Agricultural Fallow land	Net sown area	Double cropped area	Gross cropped area
67632	14317.5	6830	6245	5016	28839	6261	35100

Table 3 (C): Cropping pattern (in ha)

Kharif	Rabi	Cereal				Pulses	Tilhan	Fruits and Vegetables	Sugarcane	Mirch Masala
		Wheat	Rice	Jowar & Maize	Others					
20881	804	2000	21983	1372	7	3427	705	2353	223	348

Table 3 (D): Area irrigated by various sources (in ha)

No. of canals (private and Govt.)	Irrigated area	No. of bore wells/ Tube wells	Irrigated area	No. of dug wells	Irrigated area	No. of Talabs	Irrigated area	Irrigated area by other sources	Net Irrigated area	Gross irrigated area	% of irrigated area wrt. Net sown area
30	4311	1320	236	2630	272	215	165	1804	5743	7094	20.21

Table 3 (E): Statistics showing Irrigation by Ground water

Block	Net Irrigated Area	Net Irrigated Area by ground water	Percentage of Area Irrigated by ground water
Ambikapur	5743	498	8.67

Groundwater Resource Availability and Extraction: Based on the resource assessment made, the resource availability in aquifer wise in Ambikapur block is given in the table-4.

Table – 4 (A): Ground Water Budget of Ambikapur block in Ham

Assessment Unit Name	Ground Water Recharge (Ham)				Total Annual Ground Water (Ham) Recharge	Total Natural Discharges (Ham)
	Monsoon Season		Non-monsoon season			
	Recharge from Rainfall	Recharge from Other Sources	Recharge from Rainfall	Recharge from Other Sources		
Ambikapur	5951.74	635.55	477.47	1742.30	8807.06	440.35

Table – 4 (B): Ground Water Dynamic Resource (Unconfined Aquifer) of Ambikapur block in Ham

Annual Extractable Ground Water Recharge (Ham)	Current Annual Ground Water Extraction (Ham)				Annual GW Allocation for Domestic Use as on 2025	Net Ground Water Availability for future use	Stage of Ground Water Extraction (%)	Categorization (OE/Critical/Semicritical/Safe)
	Irrigation Use	Industrial Use	Domestic Use	Total Extraction				
8366.71	3793.42	2.95	733.05	4529.42	834.77	3735.57	54.14	Safe

Table – 4 (C): Ground Water Static Resource (Unconfined Aquifer) and Dynamic Resource (Confined Aquifer) of Ambikapur block in Ham

Static Resources Area (Ha)	Difference Piezometric Head (Pre-post) m	Storativity (S)	Dynamic Ground Water Resource of Confined Aquifer (Ham)	Bottom level of the top confining layer (m)	In storage Ground Water Resource of Unconfined Aquifer (Ham)	Sum of Dynamic GW (Confined Aquifer) and In storage GW (Unconfined Aquifer) resource (Ham)
67632	6.4	0.000246	106.48	200	12459.84	12566.32

Existing and Future Water Demand (2025)*:* The existing draft for irrigation in the area is 3793.42 Ham while the total extraction for all uses is 4529.42 Ham. At present scenario to meet the future demand for water, a total quantity of 3735.57 ham of ground water is available for future use.

Water Level Behavior: (i) Pre- monsoon water level: In the pre-monsoon period, it has been observed that in Ambikapur block, water level in dugwells (phreatic aquifer) varies between 3.7 to 9.9 mbgl with average water level of 7.18 mbgl. In semiconfined aquifer, the maximum water level is 7.0 mbgl; the average water level is 28.50 mbgl.

Table 5A: Phreatic aquifer Depth to Water Level in mbgl (Pre-monsoon)

Block Name	Phreatic Aquifer		
	Min	Max	Avg
Ambikapur	3.7	9.9	7.18

Table 5B: Semiconfined Aquifer Depth to Water Level in mbgl (Pre-monsoon)

Block Name	Semiconfined Aquifer		
	Min	Max	Avg
Ambikapur	7.0	28.50	15.95

(ii) Post- monsoon water level**:** In the post-monsoon period, it has been observed that the water level varies from 1.06 to 6.0 mbgl with an average of 3.61 mbgl in phreatic aquifer. In semiconfined/fractured formation, the post monsoon water level variation range is 2.75 to 20.50 mbgl with average of 8.59 mbgl.

Table 5C: Phreatic Aquifer Depth to Water Level in mbgl (Post-monsoon)

Block Name	Phreatic Aquifer		
	Min	Max	Avg
Ambikapur	1.06	6.0	3.61

Table 5D: Semiconfined Aquifer Depth to Water Level in mbgl (Post-monsoon)

Block Name	Semiconfined Aquifer		
	Min	Max	Avg
Ambikapur	2.75	20.50	8.59

(iii) Seasonal water level fluctuation: The water level fluctuation data indicates that in Ambikapur block, water level fluctuation in phreatic aquifer varies from 0.8 to 6.94 m with an average fluctuation of 3.57 m. Water level fluctuation in semiconfined Aquifer varies from 2.0 to 10.80 m with an average fluctuation of 7.35 m.

Table 5E: Phreatic Aquifer Depth to Water Level Fluctuation (meter)

Block Name	Phreatic Aquifer		
	Min	Max	Avg
Ambikapur	0.8	6.94	3.57

Table 5F: Semiconfined Aquifer Depth to Water Level Fluctuation (meter)

Block Name	Semiconfined Aquifer		
	Min	Max	Avg
Ambikapur	2.0	10.80	7.35

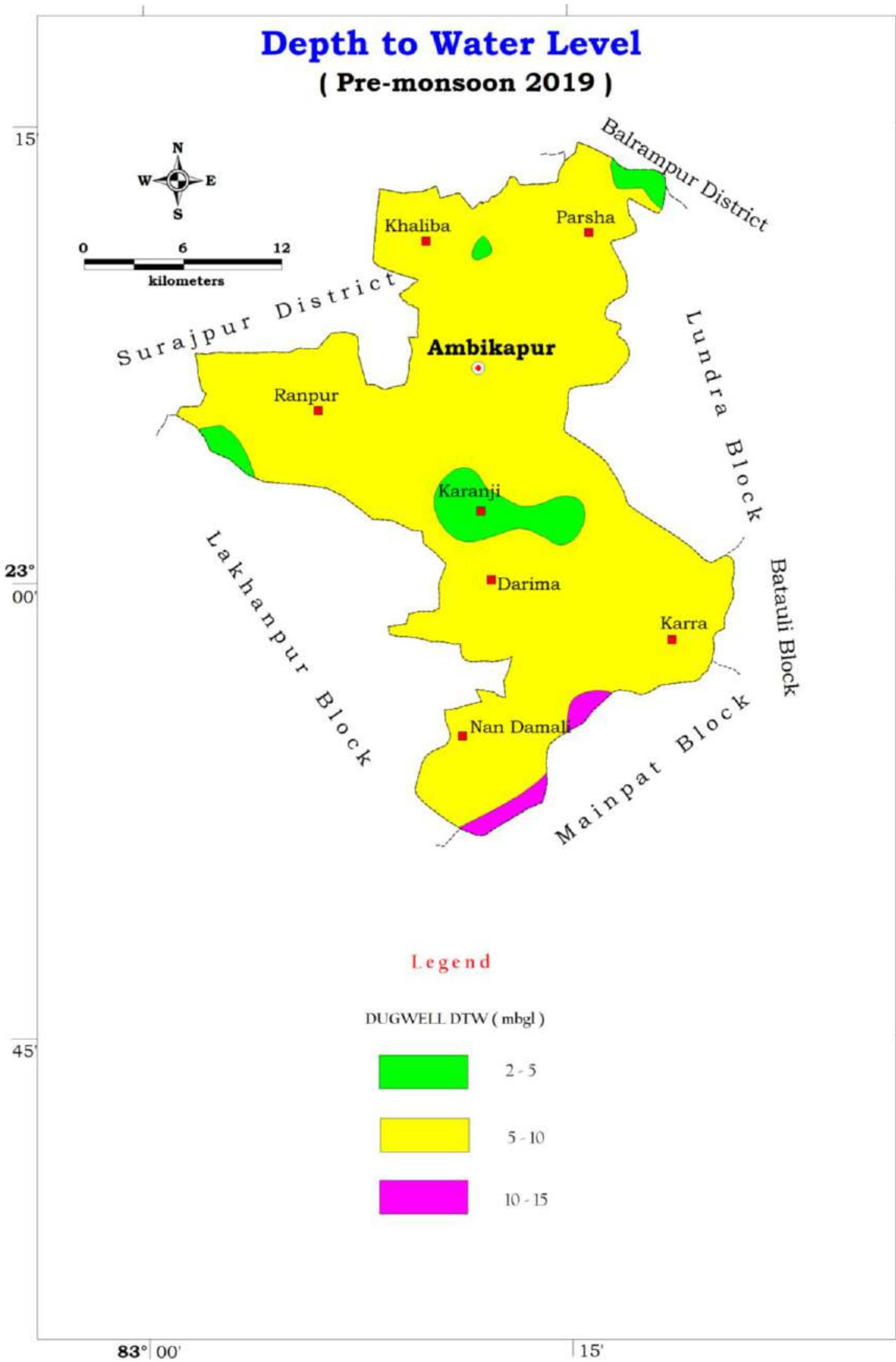

Figure 4 Depth to water level map Phreatic Aquifer (Pre-monsoon)

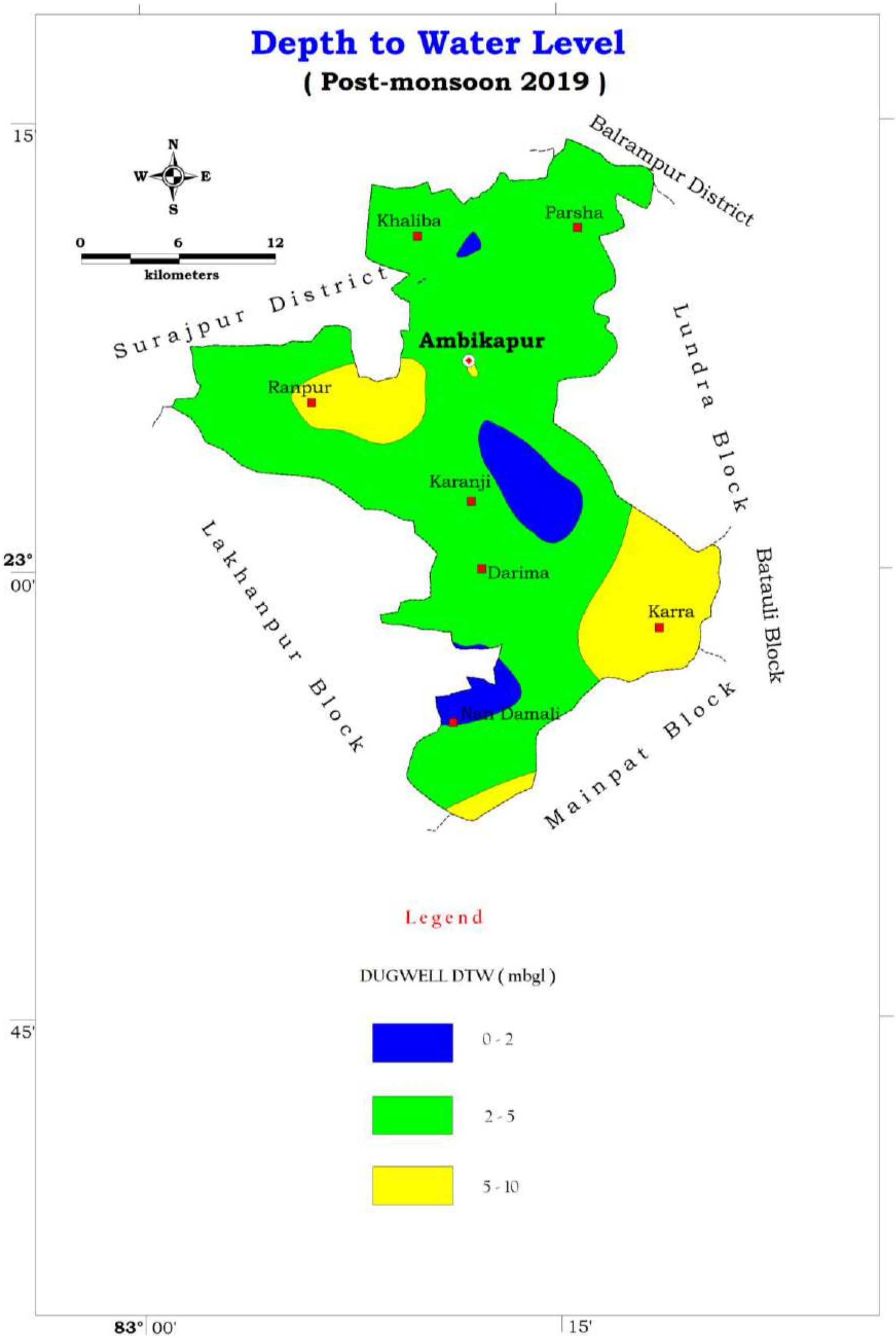

Figure 5 Depth to water level map Phreatic Aquifer (Post-monsoon)

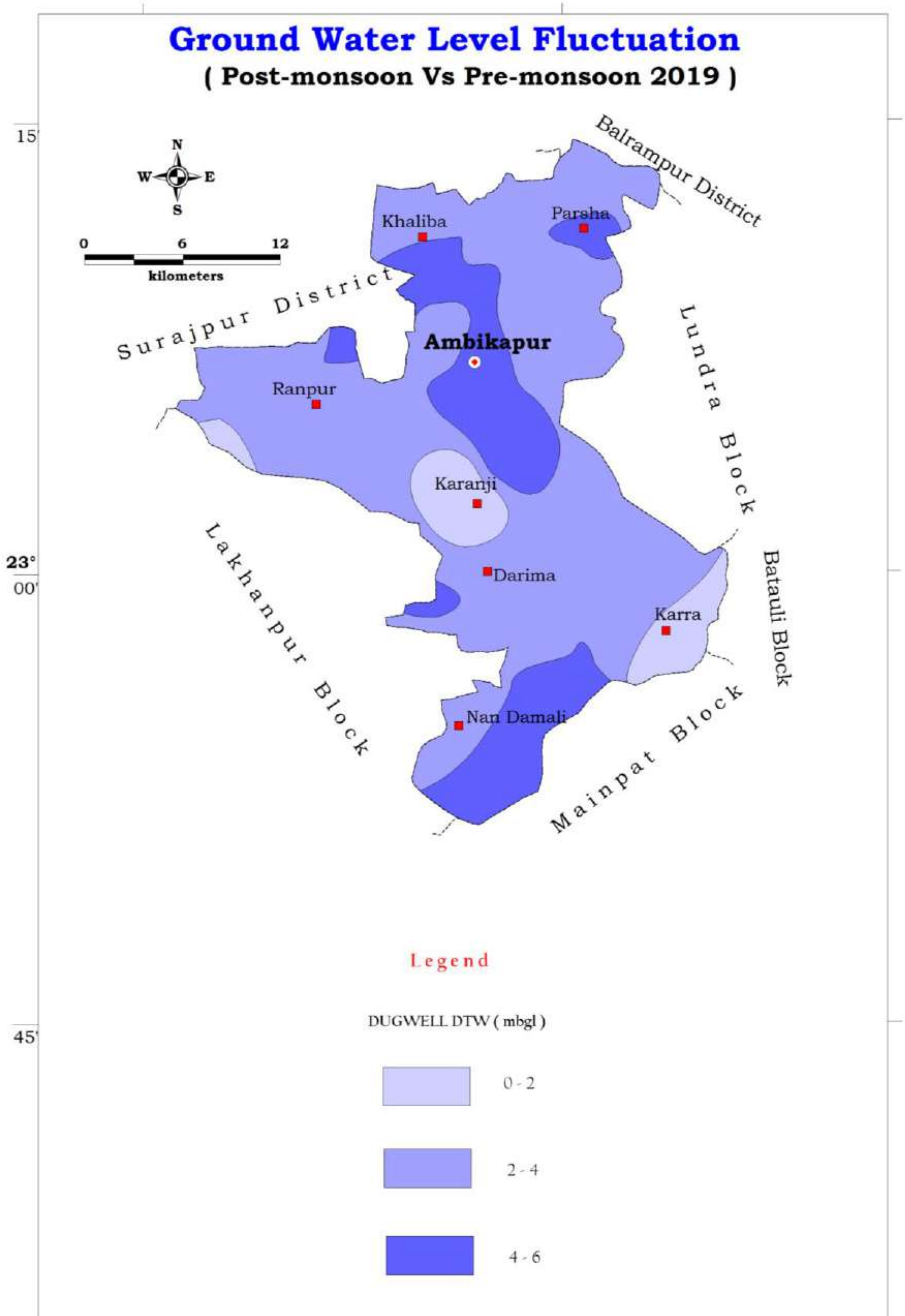

Figure 6 Depth to water level fluctuation map of Phreatic Aquifer

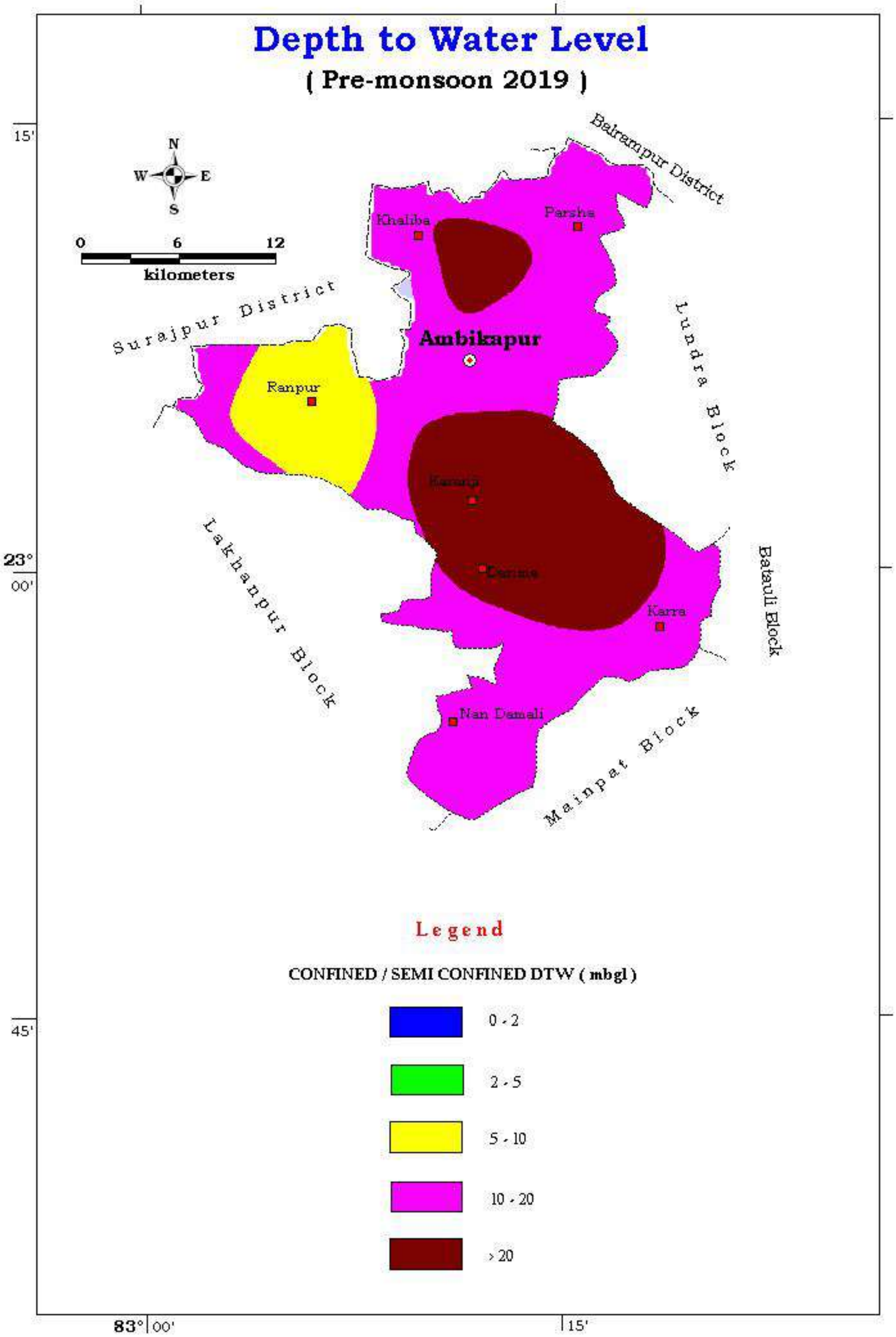

Figure 7 Depth to water level map Semiconfined Aquifer (Pre-monsoon)

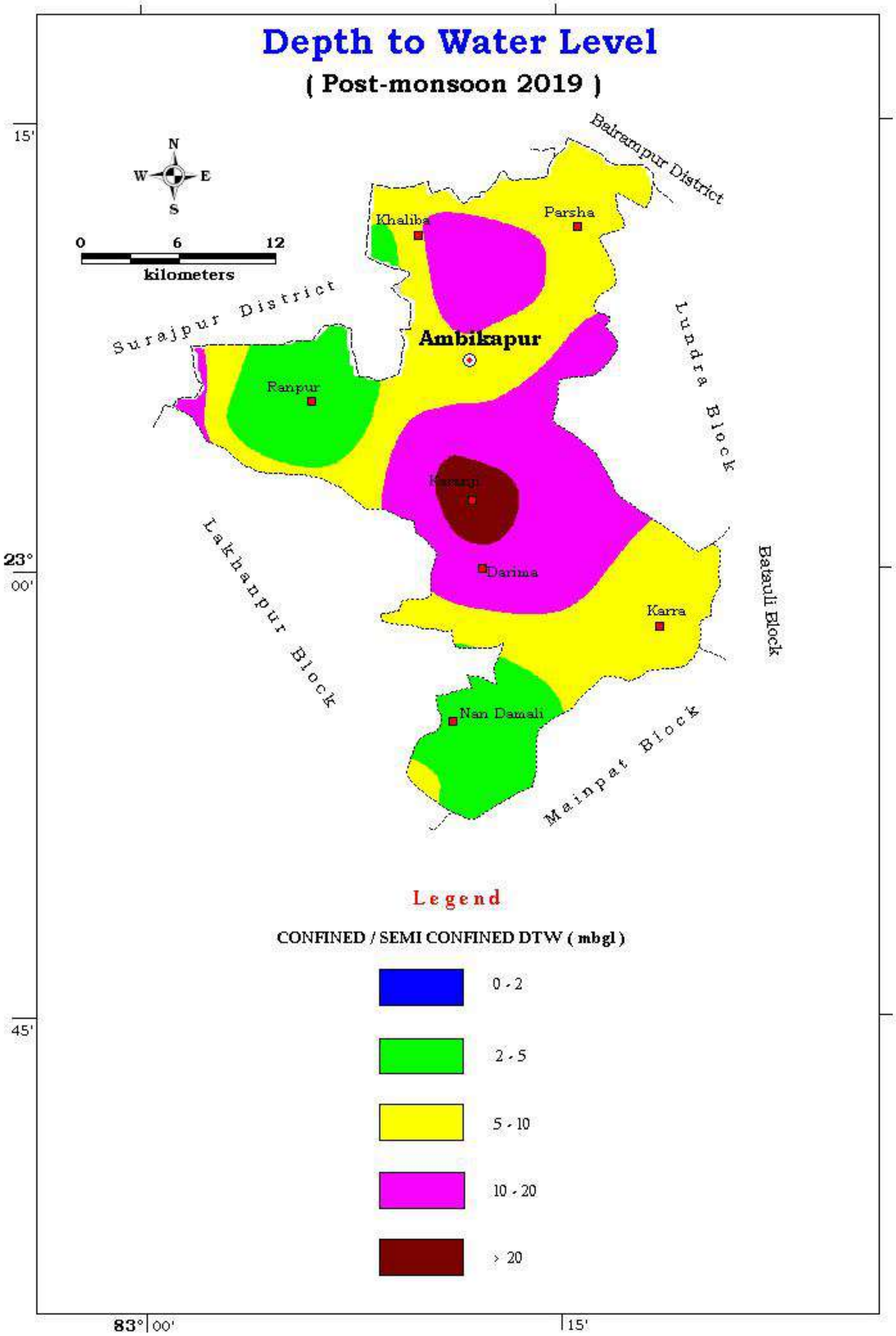

Figure 8 Depth to water level map Semiconfined Aquifer (Post-monsoon)

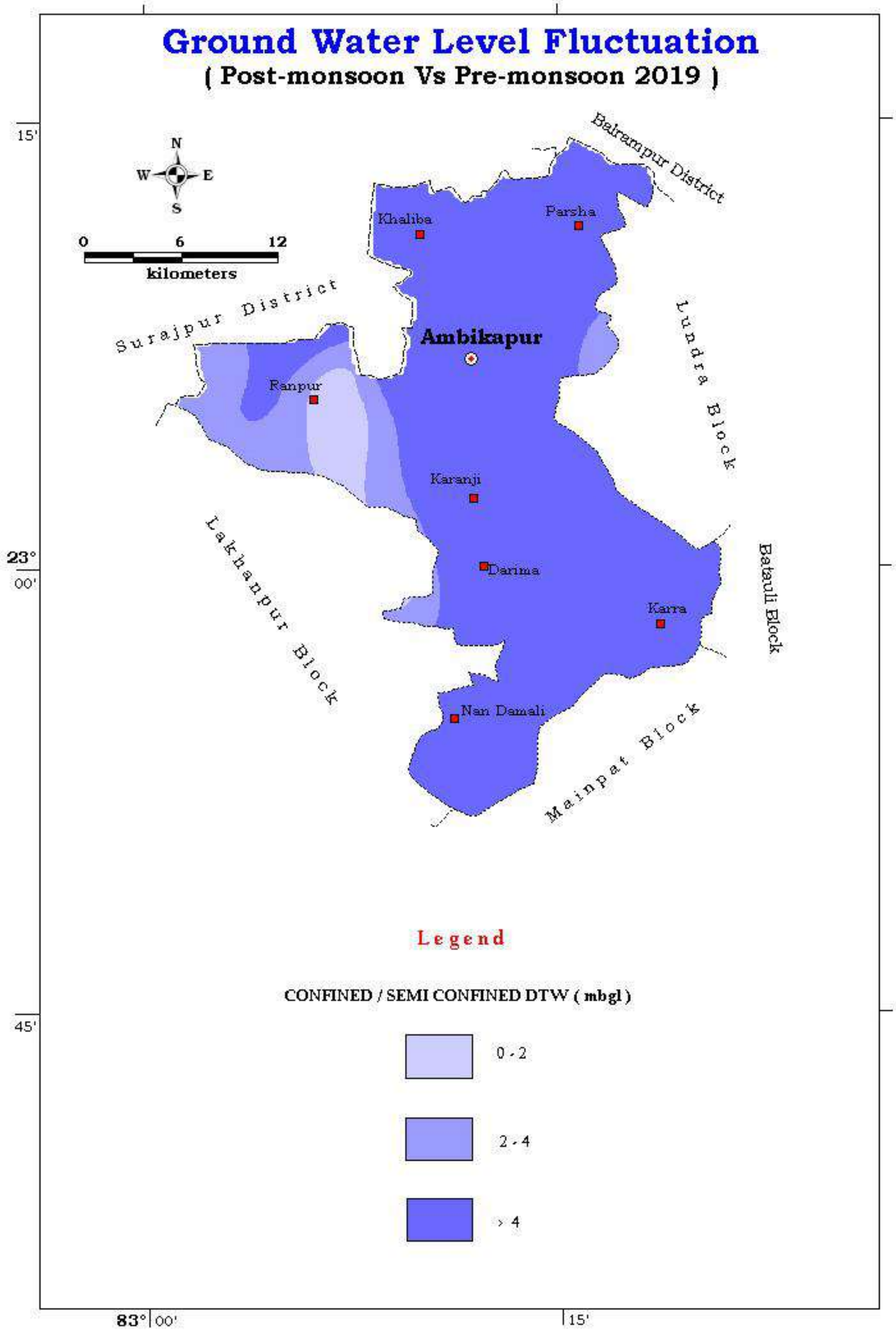

Figure 9 Depth to water level fluctuation map of Semiconfined Aquifer

(iv) The long term water level trend: There is no significant decline in water level in pre and post monsoon period in all observed NHS networks.

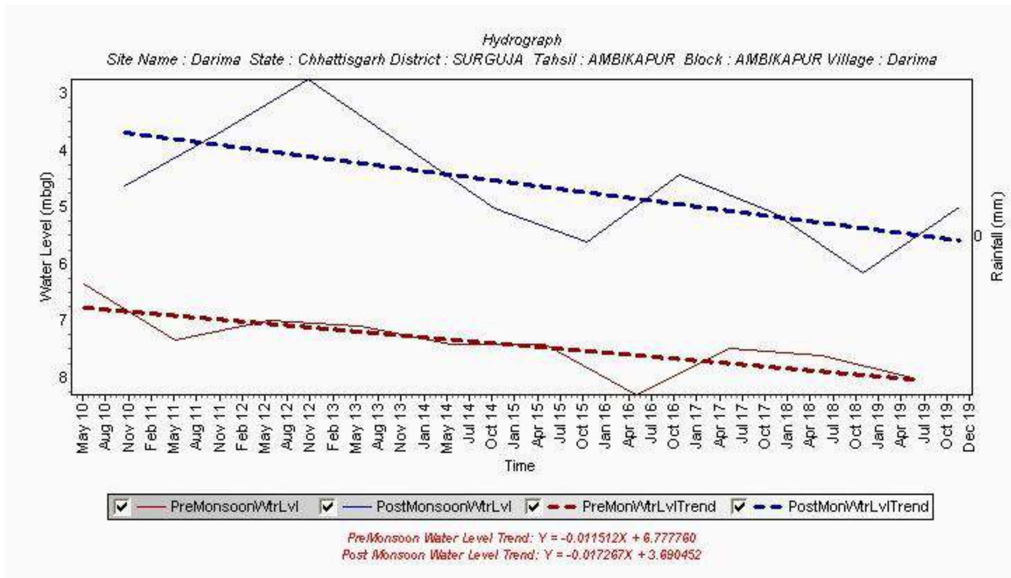

Figure 10 a: Hydrograph of Darima village, Ambikapur block

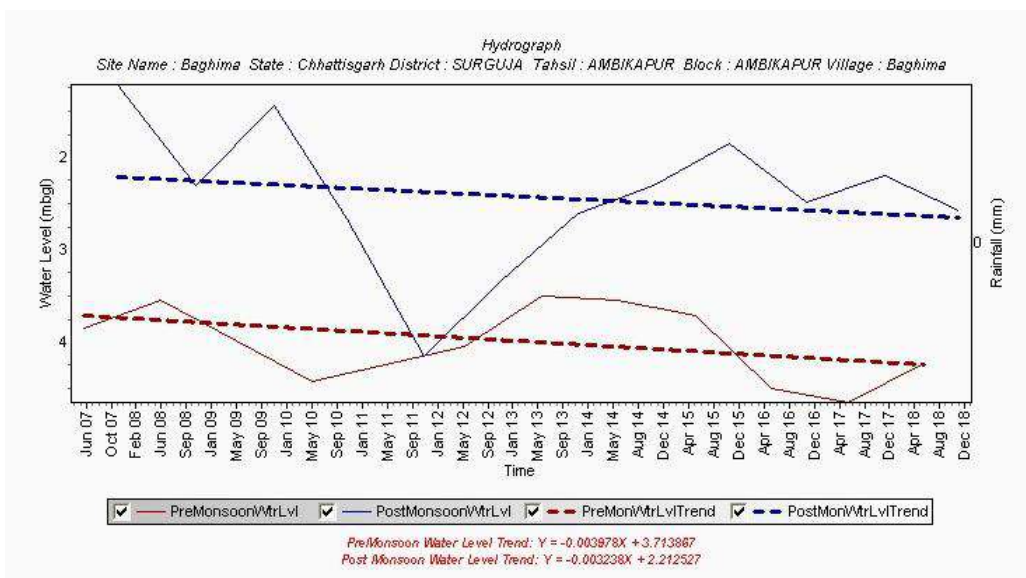

Figure 10 b: Hydrograph of Ambikapur town, Ambikapur block

2. Aquifer Disposition:

Number of Aquifers: There are two major aquifer system viz. Granite Aquifer system and Sandstone Aquifer system. Both the aquifer system has the shallow aquifer and deeper aquifer which occurs in phreatic and semiconfined condition respectively.

3-d aquifer disposition and basic characteristics of each aquifer:

Sandstone Aquifer System:

After studying the exploratory well details in Sandstone aquifer system, it has been envisaged that Gondwanas rock 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. 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.

The average thickness of the weathered portion is around 21 m. In general, the discharge varies from meagre to 12.5 lps with an average yield of 4.33 lps. The average drawdown of the formation is around 26 m. Rotary drilling technique is preferred in sandstone aquifer where well construction is required depending upon the water zone and formation encountered. Water zone has been encountered up to 200 meters. Transmissivity range observed is 3.74 to 159.1 sq. meter/day. Details of the aquifer characteristics and water zone encountered are shown in annexure.

Granite Aquifer System:

Groundwater occurrence is largely limited to secondary permeability, such as weathered zones, joints, fractures or faults. The potential of weathered zones depends on the degree and depth of weathering and associated fracturing, and the saturated thickness. The aquifers are generally discontinuous, and often confined. Higher yields are obtained where thick weathered zones are associated with bedrock fracturing.

The average thickness of the weathered portion in the area is around 20 m. In general, the discharge varies from meagre to 5.5 lps. The average drawdown of the formation is around 29 m. DTH drilling technique is preferred in Granite aquifer where well construction is required depending upon the thickness of weathered zone. Water zone has been encountered up to 158 mbgl in the formation. Transmissivity range observed is upto 18.72 sq meter/day.

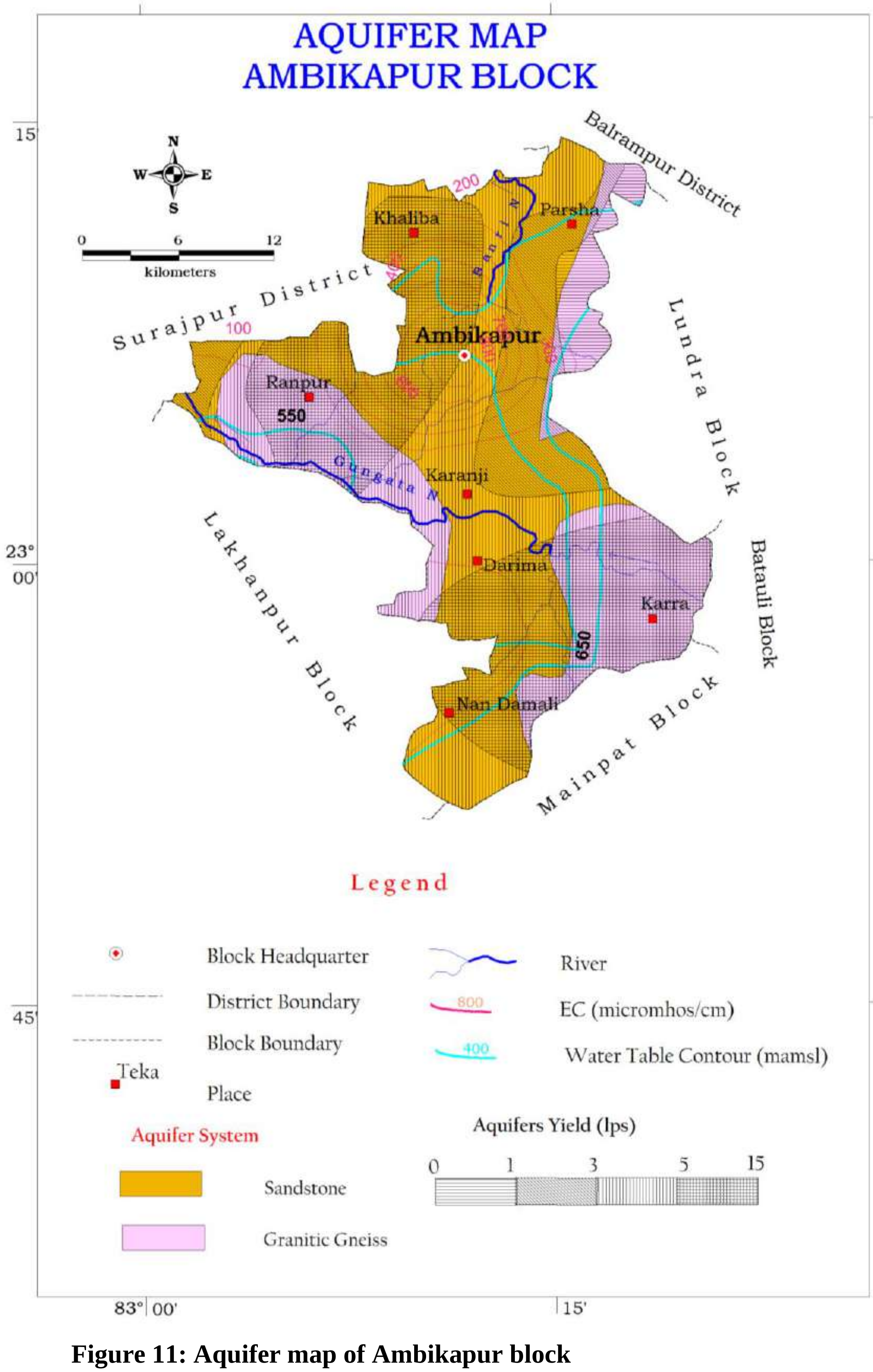

Figure 11: Aquifer map of Ambikapur block

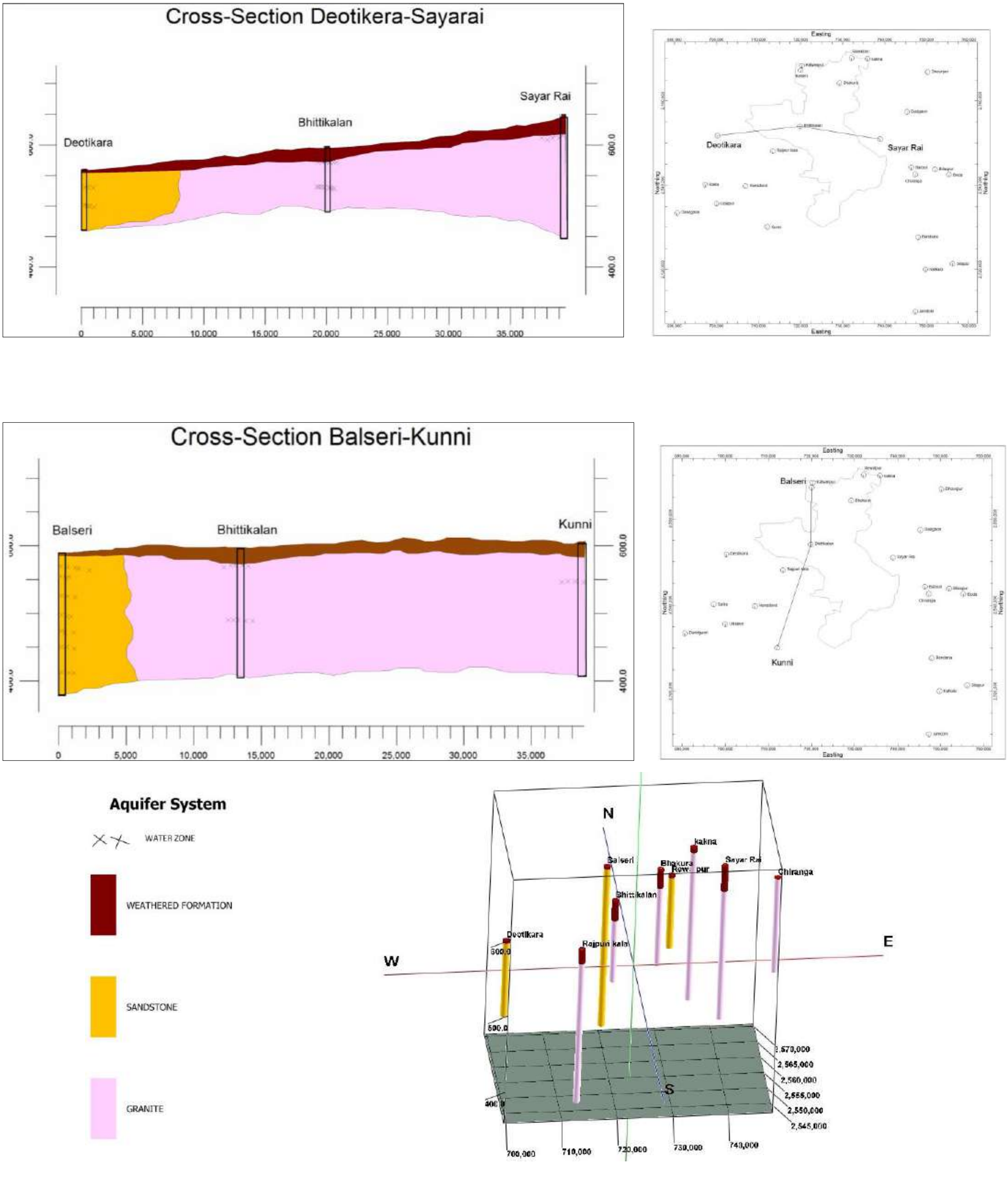

Figure-12, Disposition of Aquifer, Ambikapur Block

3. Ground water Resource, extraction, contamination and other issues:

Aquifer wise resource availability and extraction: Resource availability of Ambikapur block is given in the table -4 where net ground water availability for future use is 3735.57 ham. The extraction details and the future scenario (2025) along with the categorisation are also depicted in the table-4.

Table 7 Categorization of Assessment Unit

District	Block	Stage of Ground water development (%)	Categorisation
Ambikapur	Ambikapur	54.14	Safe

Categorisation: Ambikapur block falls in safe category. The stage of Ground water development is 54.14 %. The Net Ground water availability is 6651.02 ham. The Ground water draft for all uses is 4529.42Ham. The Ground water resource for future uses for Ambikapur Block is 3735.57 Ham.

Chemical Quality of Ground water and Contamination**:** Throughout the study area, the water samples from both dugwell and handpumps were collected and chemical analysis has been completed (Annexure I). Several villages like Katkalo have more Iron concentration.
Overall ground water of the study area is suitable for the drinking, agriculture and industrial purpose. In Ambikapur at 35 villages Fluoride contamination and at 54 villages Iron contamination reported. (Source: https://ejalshakti.gov.in/IMISReports/MIS.html)

4. Ground Water Resource enhancement:

Aquifer wise space available for recharge and proposed interventions:

Table -8: Summarised detail of Volume of porous space available for recharge

Major Aquifer	Area Identified for Artificial Recharge (Sq. Km)	Sp. Yield for the formation	Volume of vadose zone available for recharge(mcm)	Sub surface storage potential (mcm)
Sandstone (Gondwana)	109.30	0.02	492	9.837

5. Issues:

(i) During summer, dugwells in villages becomes dry at many locations. Several handpumps also stop yielding water. The aquifer itself is a low yielding one.

(ii) In Granite aquifer system potential zone for ground water is related with occurrence of fracture, so drilling a high yield well is always a challenge. Proper scientific study coupled with geophysical investigation may minimize the failure of well.

(iii) Problems in Tube well / Bore well construction in Sandstone Aquifer System: In case of filter point wells drilled with hand bores, the depth of penetration is variable and whenever the Shale or any other compact layers are encountered, further drilling becomes difficult. When portable rotary rigs are deployed for drilling, the drilling operations become very slow and the pore spaces in fine grained layers are invaded by drilling fluid as a result the discharges tend to be poor. Proper well development is seldom carried out by private drillers and as a result fine sands get deposited in the bore. Sometimes caving of wells are commonly reported particularly when the top loss sand is cased and the bottom shales are drilled with down the hole hammer rig.

(iv) Problems in ring well construction Sandstone Aquifer System: The common problem is sand filling inside the rings during and after the lowering of rings, thereby practically eliminating the change of deepening of wells to tap more saturated column in summer months. The weep holes provided in the rings allow water with fine sands and gets filled up as and when sand removal is in progress thereby making it difficult for lowering of rings is highly saturated sands.

(v) High value of Fluoride and Iron has been reported from several locations.

6. Management Plan:

(i) It has been observed during fieldwork, there is colossal wastage of groundwater through private well and public water supply system. So, Information, Education and Communication (IEC) activities need to be organized to sensitize people on the issues of depleting groundwater resource. Massive awareness campaigns are essential to aware people about the importance of community participation in saving water.

(ii) Desiltation of existing Tanks and Talabs to be carried out for efficient storage of rainwater. Also Rain water harvesting structures may be constructed in villages to reduce stress on groundwater.

(iii) It has been observed that the demand of ground water is increasing for irrigation, industrial and domestic uses. At locations where water level is declining, we have to go for artificial recharge on a long-term sustainability basis. Artificial Recharge structures may be constructed at suitable locations especially in the areas where the water level remains more than 3m in the post-monsoon period in this block to arrest the huge non-committed run-off and augment the ground water storage in the area. The different types of artificial structures feasible in the block are described in table-9.

Table-9: Types of Artificial Recharge structures feasible

Name of Block	Area Feasible for recharge (sq.km)	Volume of Sub Surface Potential for Artificial recharge (MCM)	Types of Structures Feasible and their Numbers			
			Percolation tank	Nalas bunding cement plug/ check dam	Gravity head /Dug well/ tube well/Recharge shaft	Gully plugs Gabion structures
Ambikapur	109.30	6.518	19	28	121	62
	Recharge Capacity (MCM)/structure		0.2192	0.0326	0.00816	0.0073

(iv) Fluoride and Iron filter plant may be installed in the villages having higher value of contaminants.

(v) In urban areas STP may be installed for the treatment of sewage water in proper numbers to avoid contamination of ground water. Treatment of sewage water in village through soak pit for the individual houses and Seechewal model or similar model for community level may be adopted to avoid contamination of ground water. Treated water may also be reused for irrigation and other industrial purposes.

(vi) Since the stage of development in the block is 54.14 %. There is scope of utilizing more ground water for future irrigation purpose. Additional number of Ground water abstraction structure may be developed for the effective utilization of ground water resources in the block. The ground water is presently developed through dug wells and tube wells. Yield potential for the block has been shown in Aquifer map (fig 11). Sites for wells need to be selected only after proper scientific investigation. The ground water quality also needs to be ascertained and the wells used for water supply should be first checked for Iron, Fluoride and other pollutants.

Table 10: Potential of Additional GW abstraction structure creation

Net Groundwater availability (ham)	Stage of ground water Development (%)	Present ground water draft (Ham)	Ground water draft at 70% stage of development (ham)	Surplus ground water at present Stage of Development (ham)	Number of TW Recommended in each block (Assuming unit draft as 1.6 ham/structure/year)	Number of DW Recommended in each block (Assuming unit draft as 0.72 ham/structure/year)
8366.71	54.14	4529.42	5856.70	1327.28	498	737

7. Conclusion:

For effective utilization of Ground water existing draft for irrigation may be coupled with micro irrigation system. Change in irrigation pattern, optimum use of available resource, use of ground water potential created after artificial recharge can lead to groundwater savings and increase in gross cropped area of the block (Table: 11).

Table 11: Detail of groundwater saved through change in cropping pattern and other interventions

Block	Existing Gross Ground Water Draft for Irrigation in Ham	Additional Saving of GW after using Micro Irrigation methods in Ham (Assuming 30 % saving)	GW Potential created after Artificial recharge structure in Ham	Development by new GW abstraction structure	Additional GW irrigation Potential created in Ham	Additional Irrigation potential creation for Maize/ wheat in winter season in Ha (Assuming 500 mm water requirement)	Percent increase in Crop area compare to Gross cropped area
Ambikapur	3793.42	1138.03	651.76	1327.28	3449.01	6898.012	19.65%

AQUIFER MAPPING AND MANAGEMENT PLAN FOR BATAULI BLOCK (SURGUJA DISTRICT), CHHATTISGARH

CONTENTS

AQUIFER MAP AND MANAGEMENT PLAN: BATAULI BLOCK

1. Salient Information:

About the area: Batauli Block is situated on the eastern part of Surguja district of Chhattisgarh and is bounded in the west by Mainpat block and Ambikapur Block, in the north by Lundra block, in the south by Sitapur block and in the east by Jashpur district. The block area lies between 22.83 and 23.06 N latitudes and 83.33 and 83.55 E longitudes. The geographical extension of the study area is 401.73 sq. km representing around 7.74 % of the district's geographical area. Administrative map of the block is shown in Fig. 1. Geomorphologically northern part comprises of denudational plateau, eastern and southern part comprises pediment and western part comprises region of plateau. Geomorphology map is shown in Figure 2. The major drainage of the block includes Mand river and part of Mahanadi Basin. Drainage map shown in Fig. 3.

Population: The total population of Batauli block as per 2011 Census is 70244. The population break up i.e. male- female and rural- urban is given below -

Table- 1: Population Break Up

Block	Total population	Male	Female	Rural population	Urban population
Batauli	70244	35094	35150	70244	0

Source: CG Census, 2011

Growth rate: The decadal growth rate of the block is 16.40 as per 2011 census.

Rainfall: The study area receives rainfall mainly from south-west monsoon. About 87% of the annual rainfall is received during June to September and July and August are the months of maximum precipitation. The area gets some rainfall during winter season also. Average annual rainfall in the study area is (Average of the last five years i.e. 2013 to 2017) 762.74 mm with 70 to 80 rainy days.

Table-2: Rainfall data in Batauli block in mm

Year	2013	2014	2015	2016	2017
Annual rainfall	740.1	615.4	735.8	757.4	965.0

Source: IMD

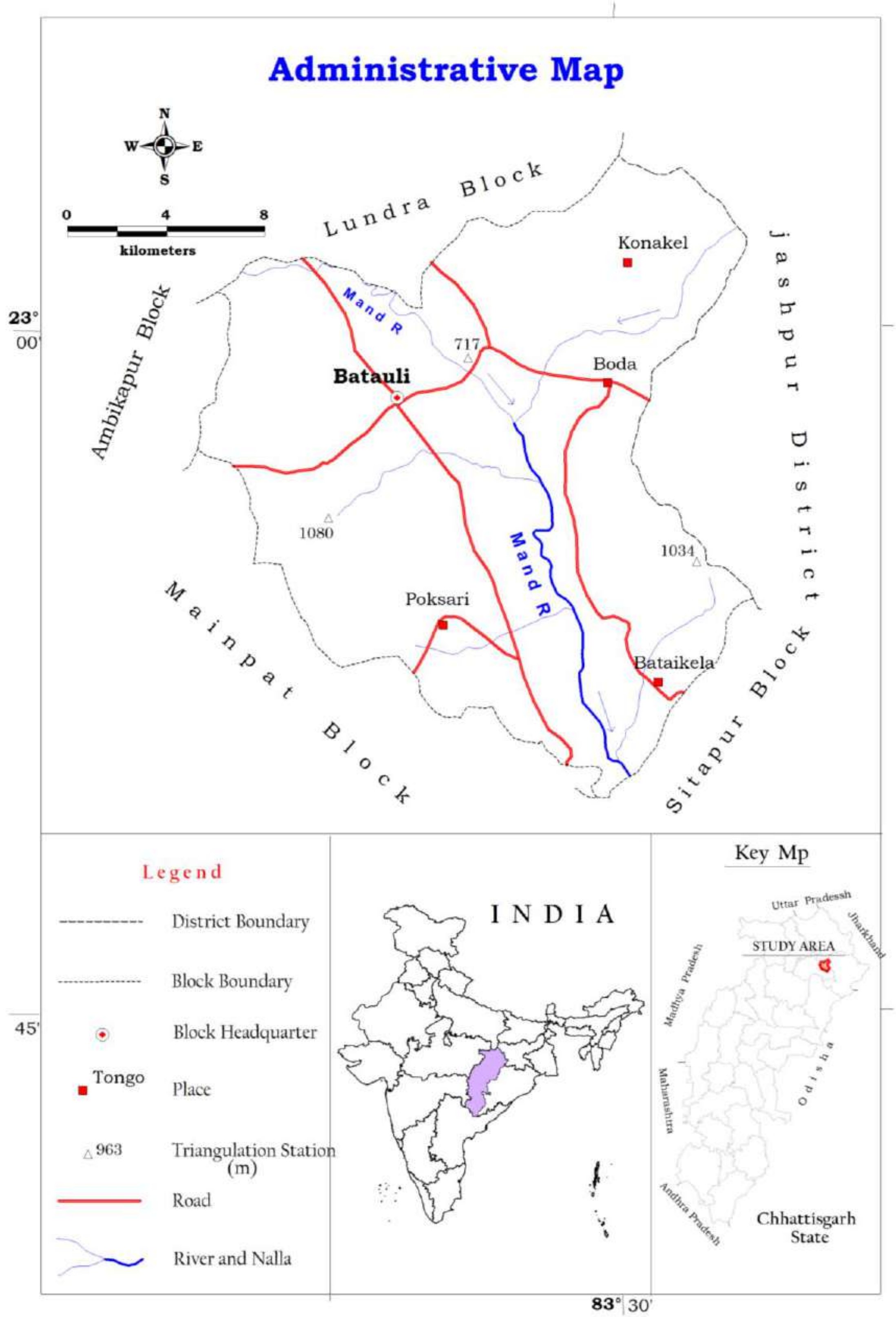

Figure 1 Administrative Map of Batauli Block

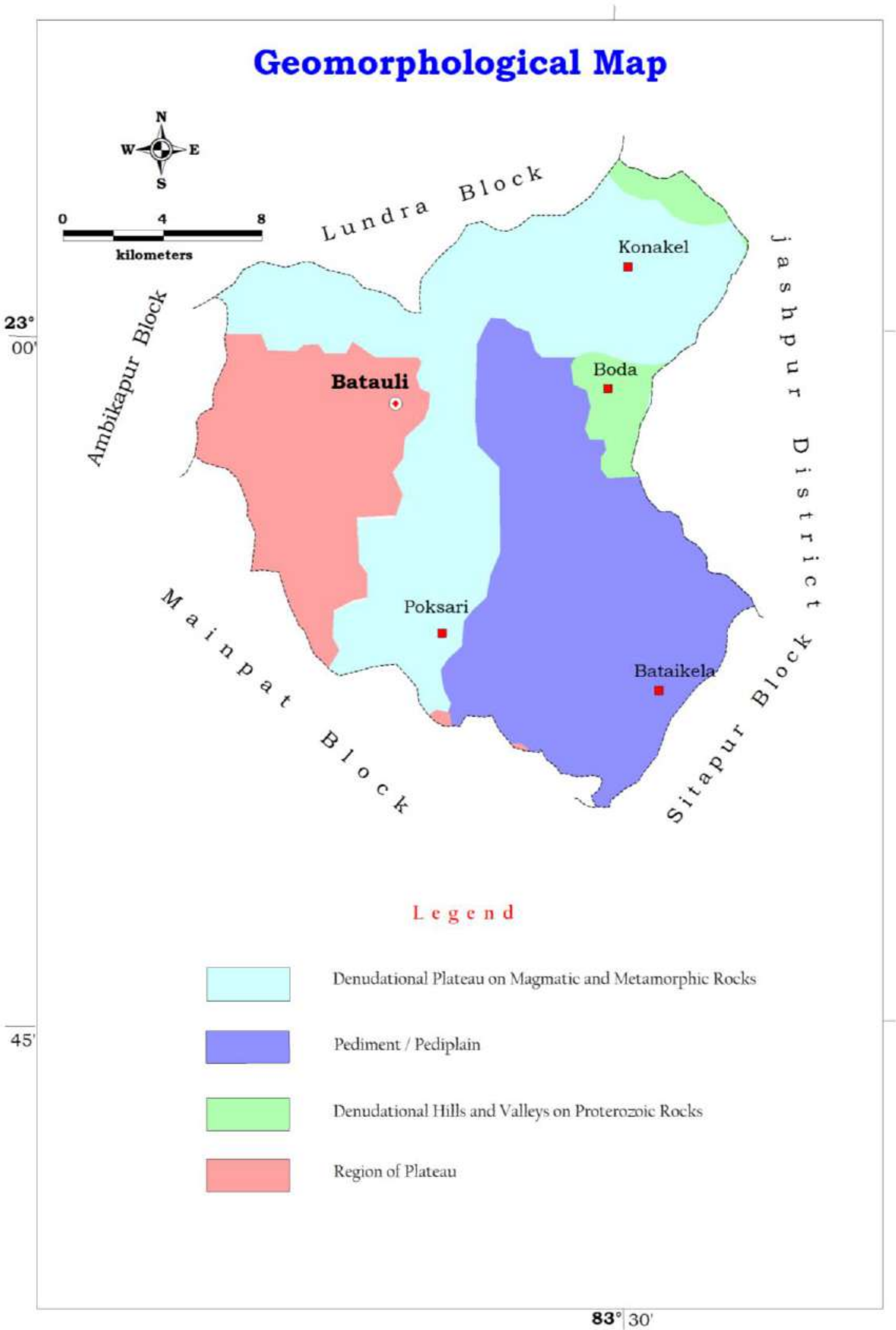

Figure 2 Geomorphology Map of Batauli Block

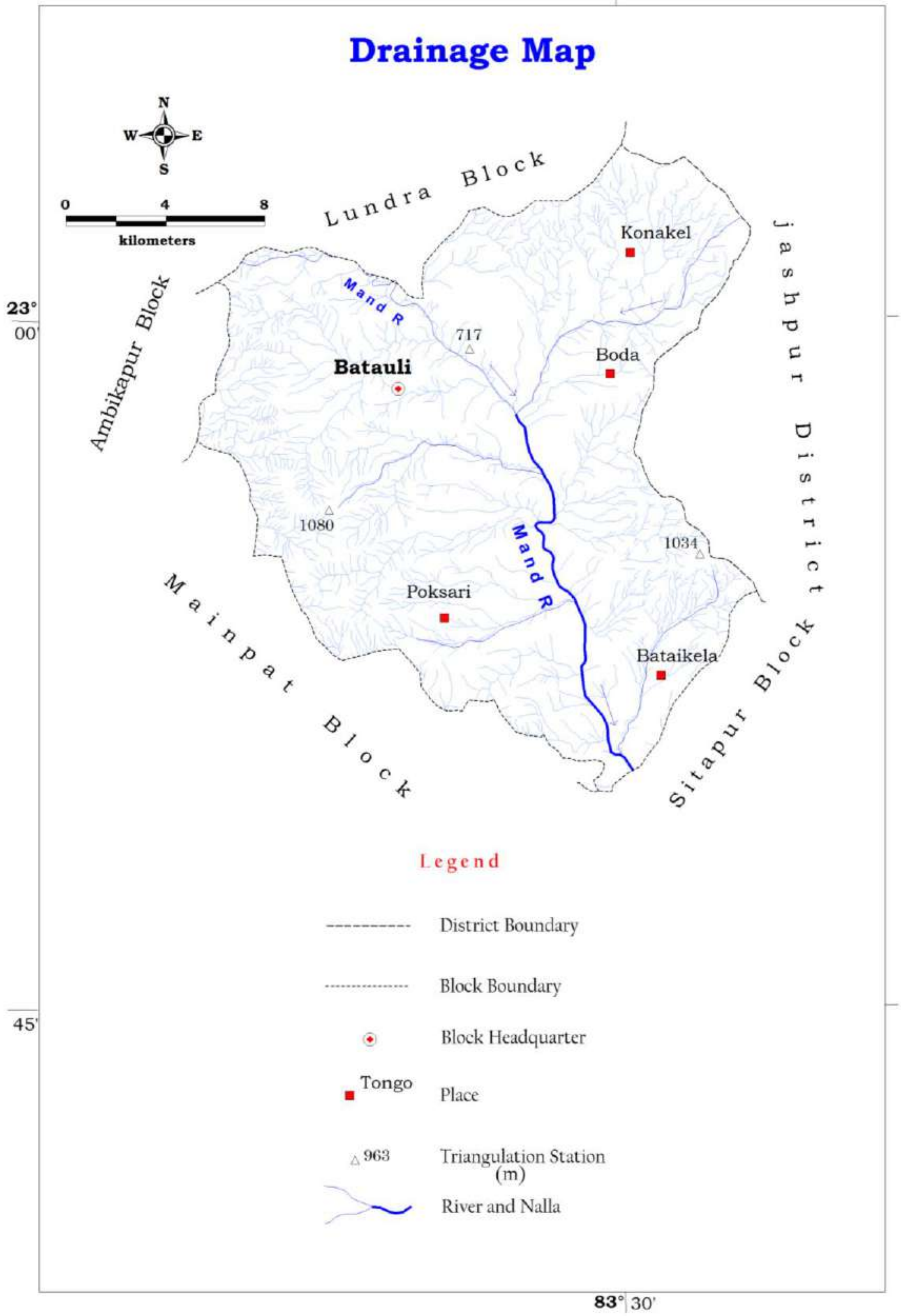

Figure 3 Drainage Map of Batauli Block

Agriculture and Irrigation: Agriculture is practiced in the area during Kharif and Rabi season every year. During the Kharif, cultivation is done through rainfall while during the Rabi season; it is done through ground water as well as partly through surface water like canals and other sources. The groundwater abstraction structures are generally Dugwells, Borewells /tubewells. The principal crops in the block are Paddy, Wheat, Vegetables and pulses.

In some areas, double cropping is also practiced. The agricultural pattern, cropping pattern and area irrigated data of Batauli block is given in Table 3 (A, B, C, D, and E).

Table 3 (A): Land use and Agricultural pattern (in ha)

Total geographical area	Forest area	Area not available for cultivation	Nonagricultural & Fallow land	Agricultural Fallow land	Net sown area	Double cropped area	Gross cropped area
40173	7021.0	1857	3141	3684	18316	1384	19700

Table 3 (C): Cropping pattern (in ha)

Kharif	Rabi	Cereal				Pulses	Tilhan	Fruits and Vegetables	Sugarcane	Mirch Masala	Others
		Wheat	Rice	Jowar & Maize	Medo						
17892	1808	474	14466	643	170	1071	1585	732	418	115	27

Table 3 (D): Area irrigated by various sources (in ha)

No. of canals (private and Govt.)	Irrigated area	No. of bore wells/ Tube wells	Irrigated area	No. of dug wells	Irrigated area	No. of Talabs	Irrigated area	Irrigated area by other sources	Net Irrigated area	Gross irrigated area	% of irrigated area wrt. Net sown area
6	76	114	28	22	43	61	10	1163	1320	1377	7.08

Table 3 (E): Statistics showing Irrigation by Ground water

Block	Net Irrigated Area	Net Irrigated Area by ground water	Percentage of Area Irrigated by ground water wrt Net Irrigated Area
Batauli	1320	71	5.37

<u>Groundwater Resource Availability and Extraction</u>: Based on the resource assessment made, the resource availability in aquifer wise in Batauli block is given in the table-4.

Table – 4 (A): Ground Water Budget of Batauli block in Ham

Assessment Unit Name	Ground Water Recharge(Ham)				Total Annual Ground Water (Ham) Recharge	Total Natural Discharges (Ham)
	Monsoon Season		Non-monsoon season			
	Recharge from Rainfall	Recharge from Other Sources	Recharge from Rainfall	Recharge from Other Sources		
Batauli	3694.17	121.86	268.77	598.98	4683.78	457.82

Table – 4 (B): Ground Water Dynamic Resource (Unconfined Aquifer) of Batauli block in Ham

Annual Extractable Ground Water Recharge (Ham)	Current Annual Ground Water Extraction(Ham)				Annual GW Allocation for Domestic Use as on 2025	Net Ground Water Availability for future use	Stage of Ground Water Extraction (%)	Categorization (OE/Critical/ Semicritical/ Safe)
	Irrigation Use	Industrial Use	Domestic Use	Total Extraction				
4225.96	1410.50	0.00	168.97	1579.47	189.14	2626.32	37.38	Safe

Table – 4 (C): Ground Water Static Resource (Unconfined Aquifer) and Dynamic Resource (Confined Aquifer) of Batauli block in Ham

Static Resources Area (Ha)	Difference Piezometric Head (Pre-post) m	Storativity (S)	Dynamic Ground Water Resource of Confined Aquifer (Ham)	Bottom level of the top confining layer (m)	In storage Ground Water Resource of Unconfined Aquifer (Ham)	Sum of Dynamic GW (Confined Aquifer) and In storage GW (Unconfined Aquifer) resource (Ham)
40173	8.03	0.00025	79.4	200	7479.41	7558.81

<u>Existing and Future Water Demand (2025)</u>*:* The existing draft for irrigation in the area is 1410.50 Ham while the total extraction for all uses is 1579.47 Ham. At present scenario to meet the future demand for water, a total quantity of 2626.32 ham of ground water is available for future use.

Water Level Behavior: (i) Pre- monsoon water level: In the pre-monsoon period, it has been observed that in Batauli block, water level in dugwells (phreatic aquifer) varies between 4.90 to 8.90 mbgl with average water level of 6.38 mbgl. In semiconfined aquifer, the maximum water level is 20.70 mbgl; the average water level is 15.18 mbgl.

Table 5A: Phreatic aquifer Depth to Water Level in mbgl (Pre-monsoon)

Block Name	Phreatic Aquifer		
	Min	Max	Avg
Batauli	4.90	8.90	6.38

Table 5B: Semiconfined Aquifer Depth to Water Level in mbgl (Pre-monsoon)

Block Name	Semiconfined Aquifer		
	Min	Max	Avg
Batauli	11.75	20.70	15.18

(ii) Post- monsoon water level**:** In the post-monsoon period, it has been observed that the water level varies from 2.00 to 6.50 mbgl with an average of 3.49 mbgl in phreatic aquifer. In semiconfined/fractured formation, the post monsoon water level variation range is 3.85 to 11.93 mbgl with average of 7.15 mbgl.

Table 5C: Phreatic Aquifer Depth to Water Level in mbgl (Post-monsoon)

Block Name	Phreatic Aquifer		
	Min	Max	Avg
Batauli	2.00	6.50	3.49

Table 5D: Semiconfined Aquifer Depth to Water Level in mbgl (Post-monsoon)

Block Name	Semiconfined Aquifer		
	Min	Max	Avg
Batauli	3.85	11.93	7.15

(iii) Seasonal water level fluctuation: The water level fluctuation data indicates that in Batauli block, water level fluctuation in phreatic aquifer varies from 0.50 to 3.85 m with an average fluctuation of 2.90 m. Water level fluctuation in semiconfined Aquifer varies from 6.88 to 8.86 m with an average fluctuation of 8.03 m.

Table 5E: Phreatic Aquifer Depth to Water Level Fluctuation (meter)

Block Name	Phreatic Aquifer		
	Min	Max	Avg
Batauli	0.50	3.85	2.90

Table 5F: Semiconfined Aquifer Depth to Water Level Fluctuation (meter)

Block Name	Semiconfined Aquifer		
	Min	Max	Avg
Batauli	6.88	8.86	8.03

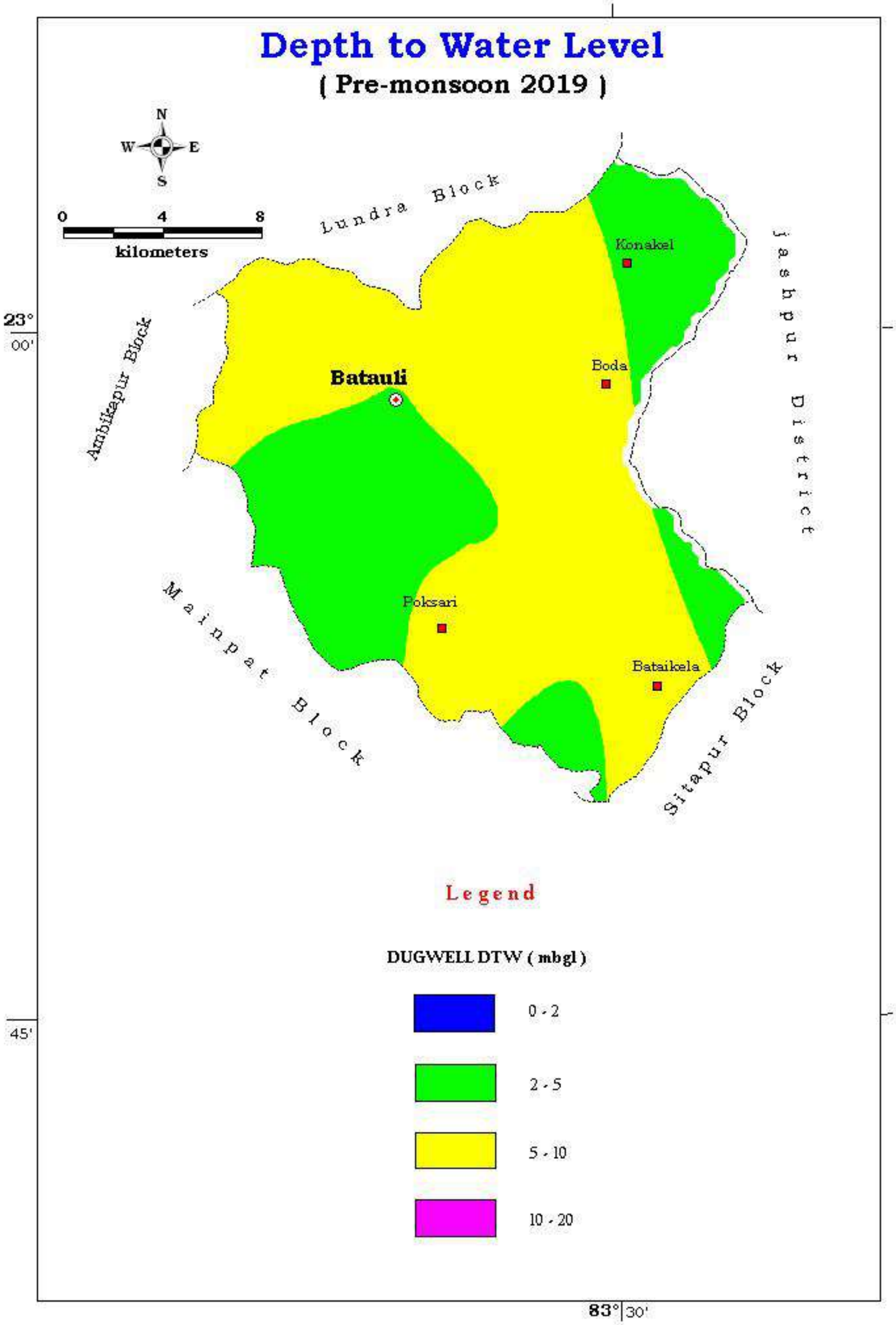

Figure 4 Depth to water level map Phreatic Aquifer (Pre-monsoon)

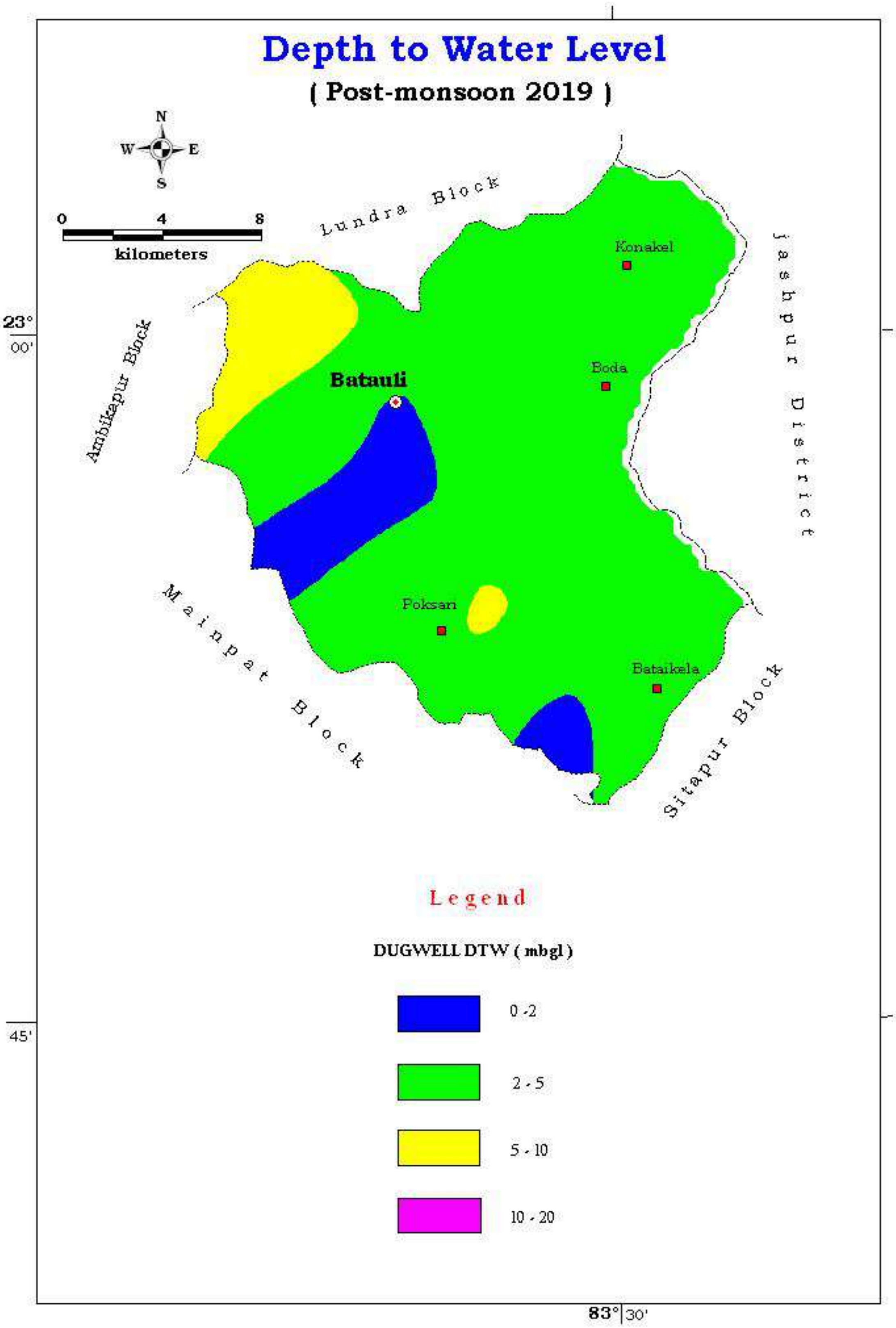

Figure 5 Depth to water level map Phreatic Aquifer (Post-monsoon)

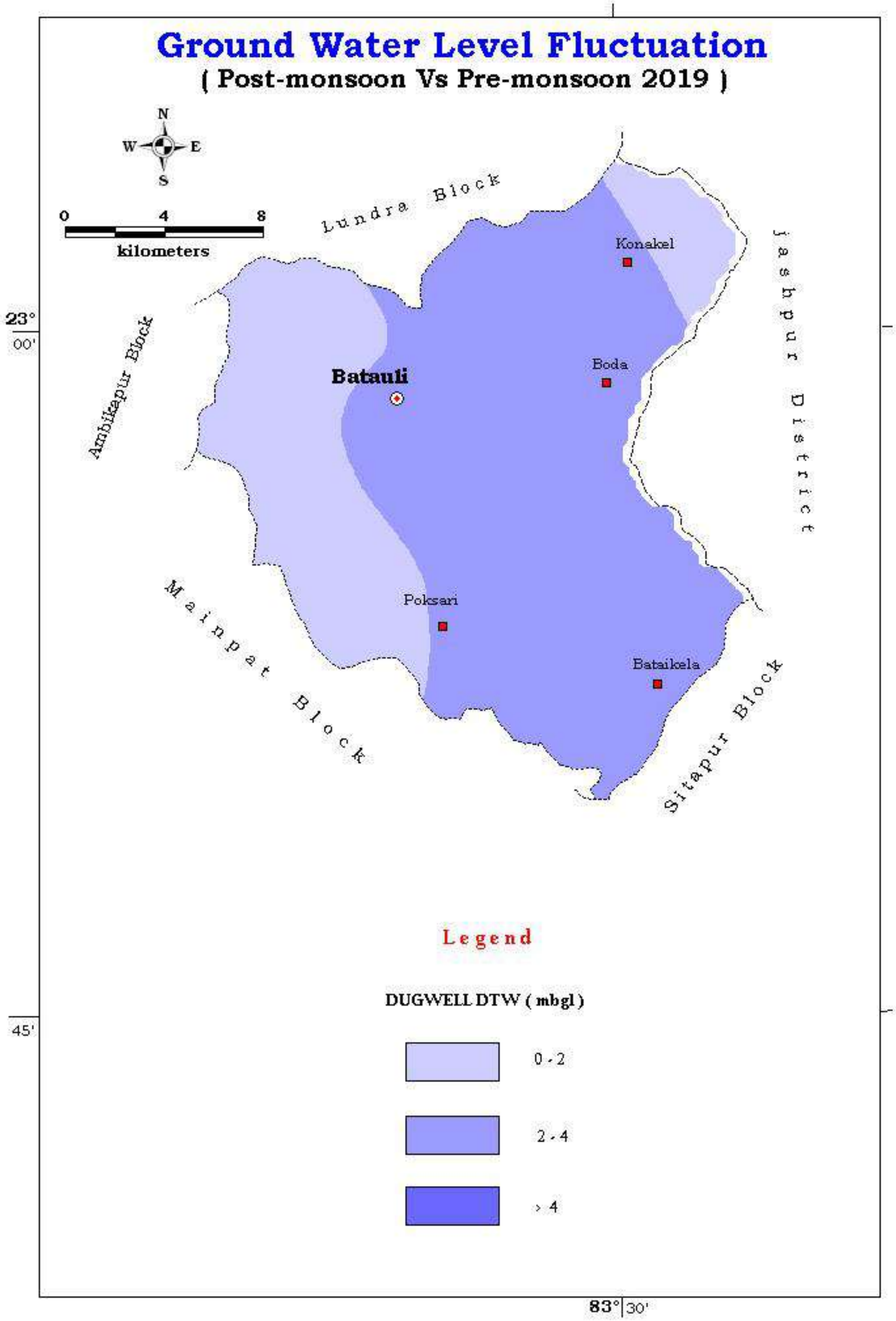

Figure 6 Depth to water level fluctuation map of Phreatic Aquifer

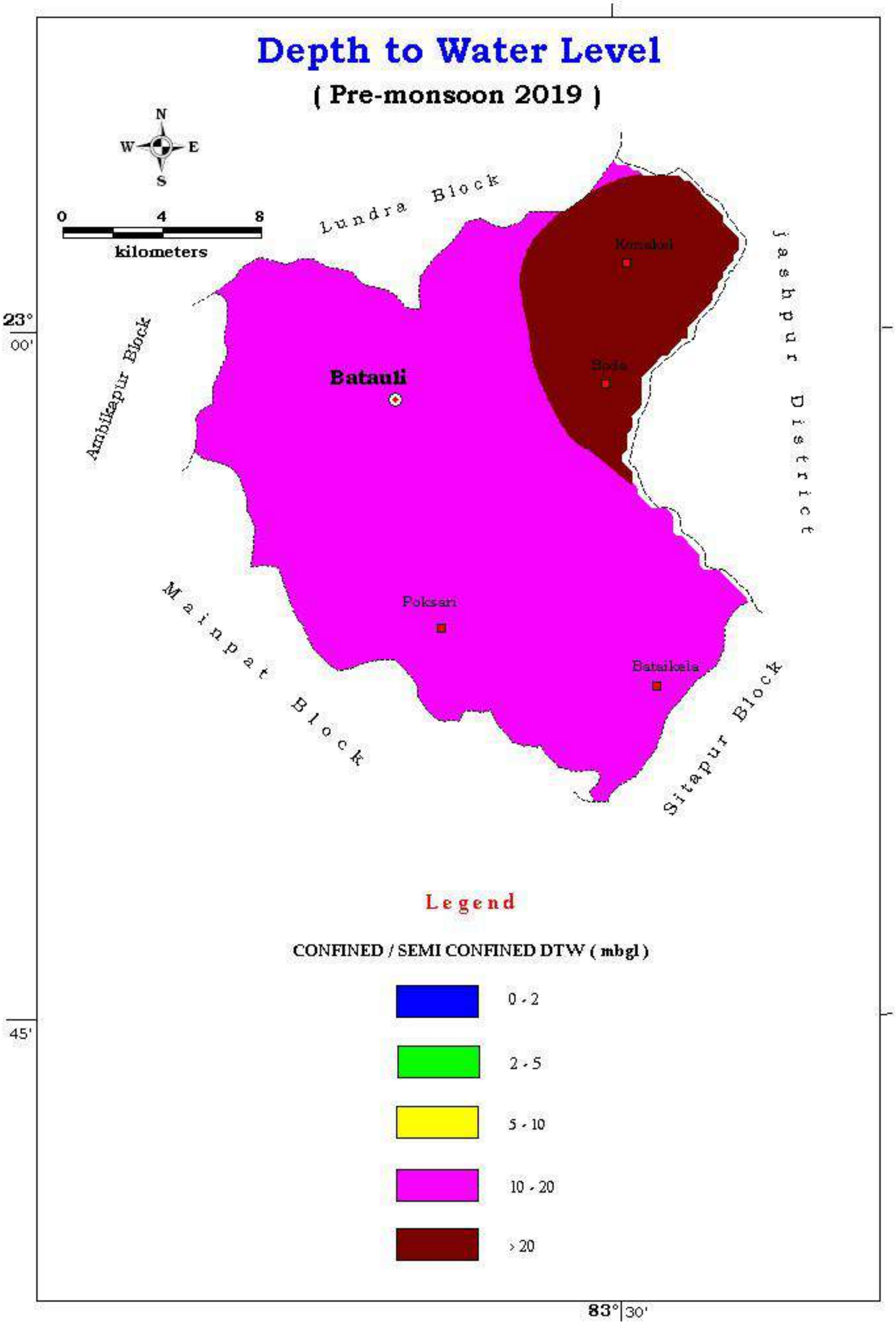

Figure 7 Depth to water level map Semiconfined Aquifer (Pre-monsoon)

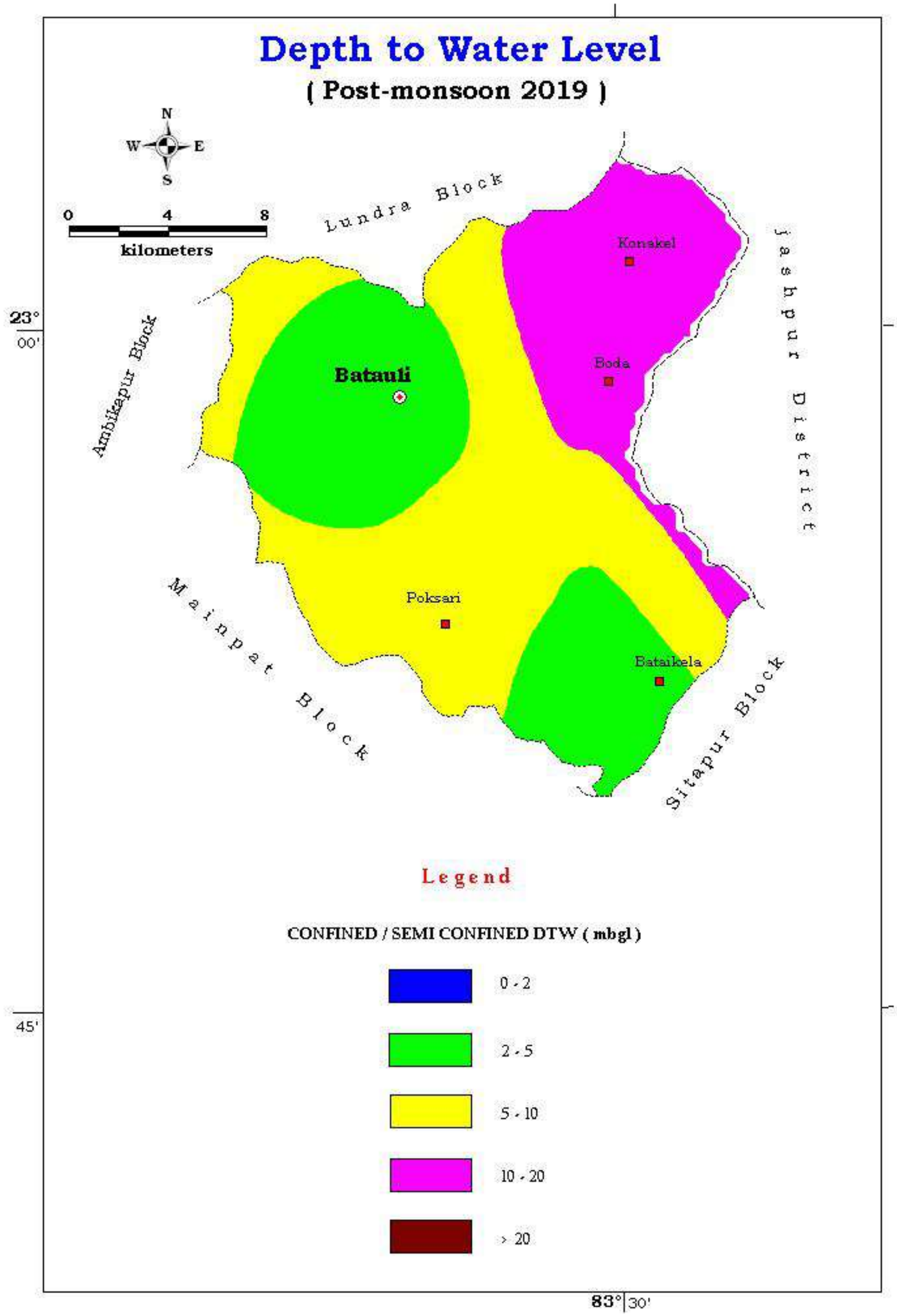

Figure 8 Depth to water level map Semiconfined Aquifer (Post-monsoon)

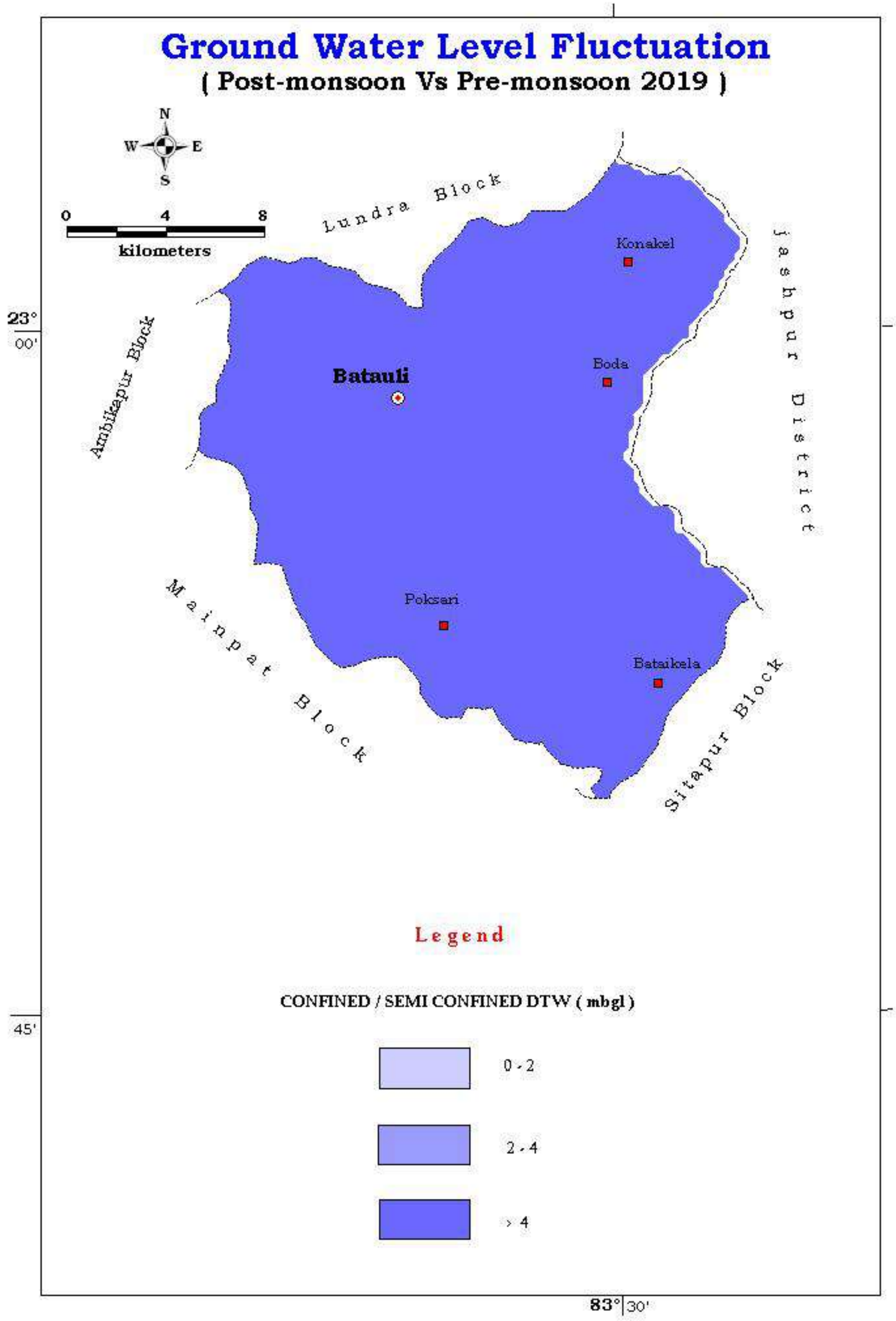

Figure 9 Depth to water level fluctuation map of Semiconfined Aquifer

(iv) The long term water level trend: There is no significant decline in water level in pre and post monsoon period in all observed NHS networks.

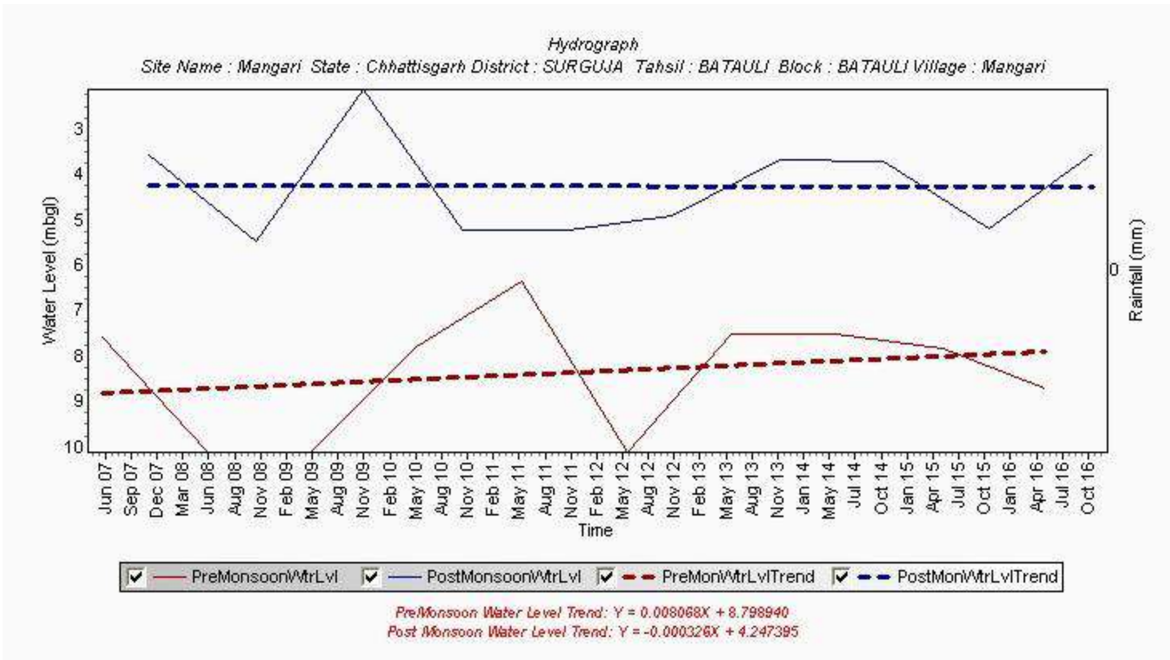

Figure 10 a: Hydrograph of Mangari Village, Batauli block

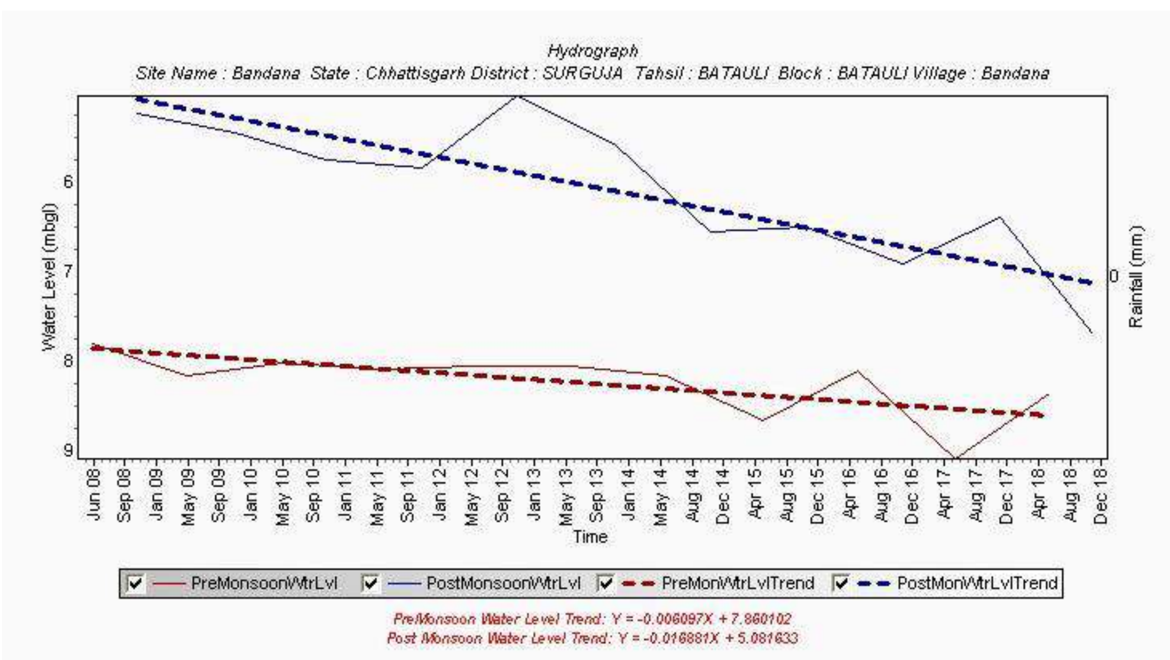

Figure 10 b: Hydrograph of Bandana Village, Batauli block

2. Aquifer Disposition:

Number of Aquifers: There is one major aquifer system viz. Granite Aquifer system and. Granite aquifer system has the shallow aquifer and deeper aquifer which occurs in phreatic and semiconfined condition respectively. Although there are few patches of unclassified metamorphic, biotite schist and other rocks.

3-d aquifer disposition and basic characteristics of each aquifer:

Granite Aquifer System: Groundwater occurrence is largely limited to secondary permeability, such as weathered zones, joints, fractures or faults. The potential of weathered zones depends on the degree and depth of weathering and associated fracturing, and the saturated thickness. The aquifers are generally discontinuous, and often confined. Higher yields are obtained where thick weathered zones are associated with bedrock fracturing.

The average thickness of the weathered portion in the area is around 20 m. In general, the discharge varies from meagre to 12.7 lps. In block maximum discharge was at Chiranga village where total 04 set of fracture zone identified having the cumulative discharge of 12.7 lps. At 104 mbgl last water zone encountered. The average drawdown of the formation is around 29 m. DTH drilling technique is preferred in Granite aquifer where well construction is required depending upon the thickness of weathered zone. Water zone has been encountered up to 158 mbgl in the formation. Transmissivity range observed is upto 43.72 sq meter/day.

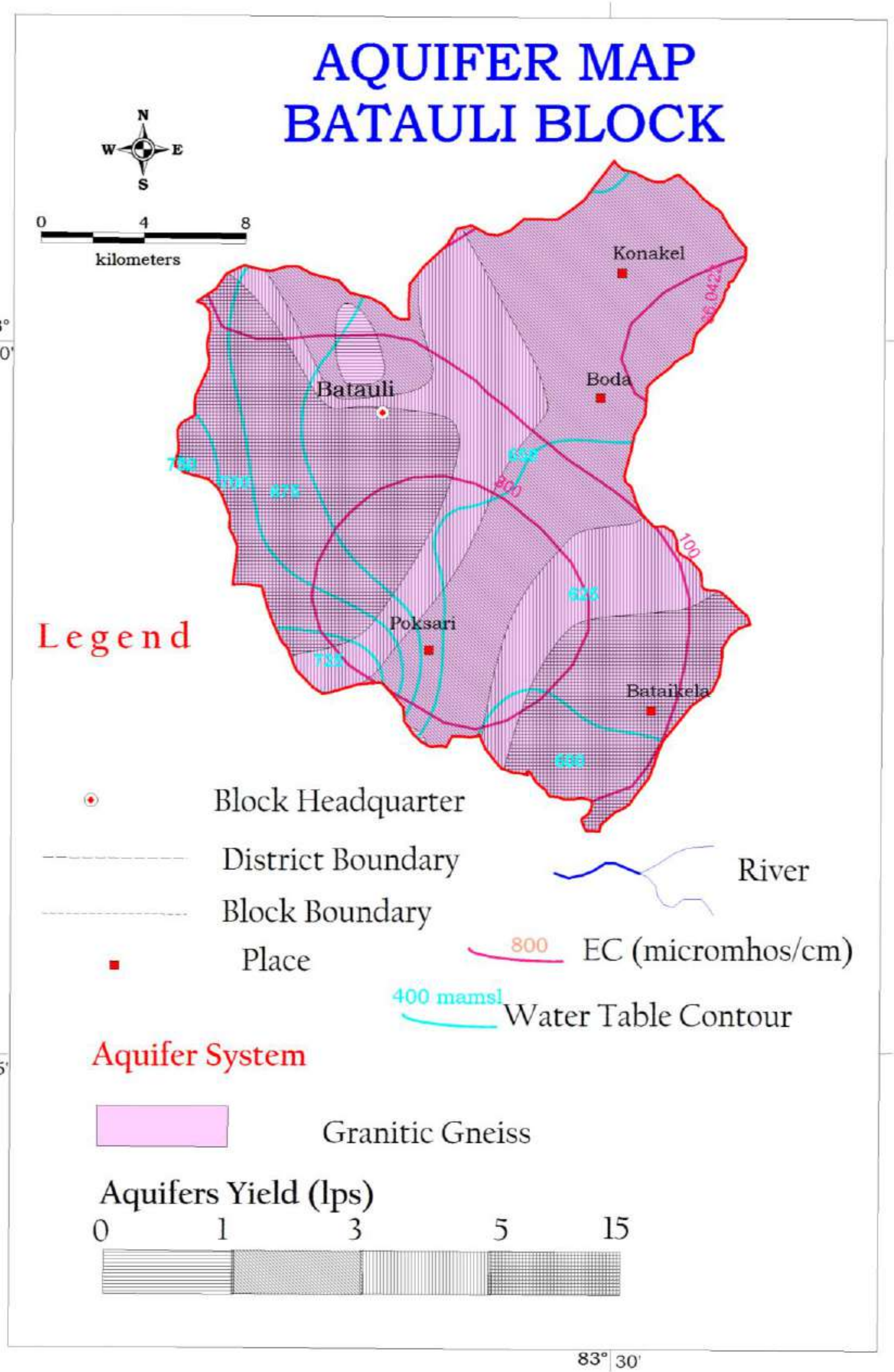

Figure 11: Aquifer map of Batauli block

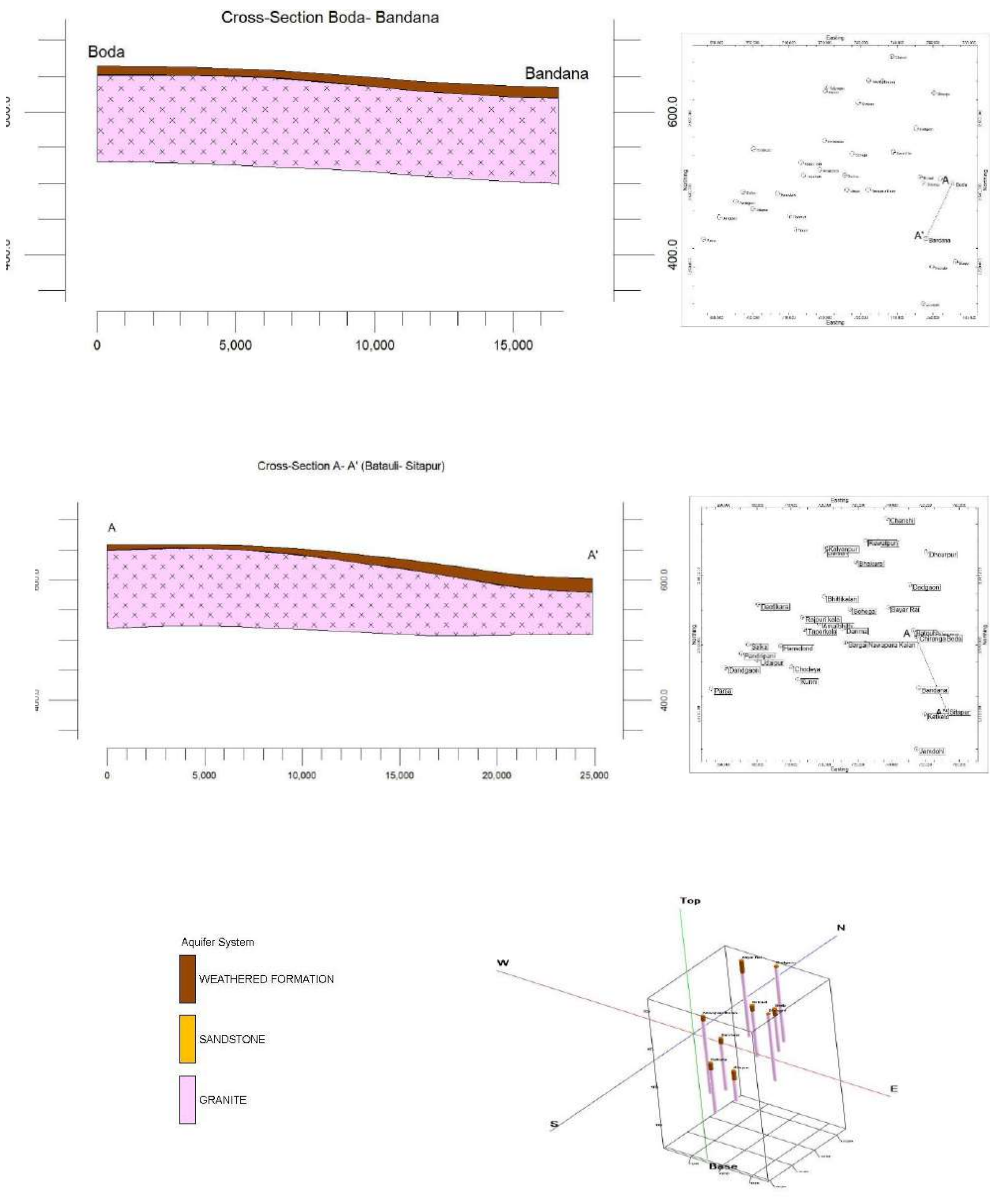

Figure-12, Disposition of Aquifer, Batauli Block

3. Ground water Resource, extraction, contamination and other issues:

Resource availability of Batauli block is given in the table -4 where net ground water availability for future use is 2626.32 ham. The extraction details and the future scenario (2025) along with the categorisation are also depicted in the table-4.

Table 7 Categorization of Assessment Unit

District	Block	Stage of Ground water development (%)	Categorisation
Batauli	Batauli	37.38	Safe

Categorisation: Batauli block falls in safe category. The stage of Ground water development is 37.38 %. The Annual Extractable Ground Water Recharge is 4225.96 ham. The Ground water draft for all uses is 1579.47 Ham.

Chemical Quality of Ground water and Contamination**:** Throughout the study area, the water samples from both dugwell and handpumps were collected and chemical analysis has been completed (Annexure I). Several villages have Iron and Flouride concentration more than permissible limit. Overall ground water of the study area is suitable for the drinking, agriculture and industrial purpose. In Batauli at 9 villages Fluoride contamination and at 23 villages Iron contamination reported. (Source: https://ejalshakti.gov.in/IMISReports/MIS.html)

4. Ground Water Resource enhancement:

Aquifer wise space available for recharge and proposed interventions:

Table -8: Summarised detail of Volume of porous space available for recharge (Aquifer wise)

Major Aquifer	Area Identified for Artificial Recharge (Sq. Km)	Sp. Yield for the formation	Volume of vadose zone available for recharge(mcm)	Sub surface storage potential (mcm)
Granite gneiss	204.02	0.02	322	6.436

5. Issues:

(i) During summer, dugwells in villages becomes dry at many locations. Several handpumps also stop yielding water. The aquifer itself is a low yielding one.

(ii) In Granite aquifer system potential zone for ground water is related with occurrence of fracture, so drilling a high yield well is always a challenge. Proper scientific study coupled with geophysical investigation may minimize the failure of well.

(iii) Fluoride and Iron filter plant may be installed in the villages having higher value of contaminants.

6. Management Plan:

(i) It has been observed during fieldwork, there is colossal wastage of groundwater through private well and public water supply system. So, Information, Education and Communication (IEC) activities need to be organized to sensitize people on the issues of depleting groundwater resource. Massive awareness campaigns are essential to aware people about the importance of community participation in saving water.

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(iii) It has been observed that the demand of ground water is increasing for irrigation, industrial and domestic uses. At locations where water level is declining, we have to go for artificial recharge on a long-term sustainability basis. Artificial Recharge structures may be constructed at suitable locations especially in the areas where the water level remains more than 3m in the post-monsoon period in this block to arrest the huge non-committed run-off and augment the ground water storage in the area. The different types of artificial structures feasible in the block are described in table-9.

Table-9: Types of Artificial Recharge structures feasible

Name of Block	**Area Feasible for recharge (sq.km)**	**Volume of Sub Surface Potential for Artificial recharge (MCM)**	**Types of Structures Feasible and their Numbers**			
			Percolation tank	**Nalas bunding cement plug/ check dam**	**Gravity head /Dug well/ tube well/Recharge shaft**	**Gully plugs Gabion structures**
Batauli	204.02	1.924	4	14	33	44
	Recharge Capacity (MCM)/structure		0.2192	0.0326	0.00816	0.0073

(iv) Fluoride and Iron filter plant may be installed in the villages having higher value of contaminants.

(v) In urban areas STP may be installed for the treatment of sewage water in proper numbers to avoid contamination of ground water. Treatment of sewage water in village through soak pit for the individual houses and Seechewal model or similar model for community level may be adopted to avoid contamination of ground water. Treated water may also be reused for irrigation and other industrial purposes.

(vi) Since the stage of development in the block is 37.38 %. There is scope of utilizing more ground water for future irrigation purpose. Additional number of Ground water abstraction structure may be developed for the effective utilization of ground water resources in the block. The ground water is presently developed through dug wells and tube wells. Yield potential for the block has been shown in Aquifer map (fig 11). Sites for wells need to be selected only after proper scientific investigation. The ground water quality also needs to be ascertained and the wells used for water supply should be first checked for Iron, Fluoride and other pollutants.

Table 10: Potential of Additional GW abstraction structure creation

Net Groundwater availability (ham)	Stage of ground water Development (%)	Present ground water draft (Ham)	Ground water draft at 70% stage of development (ham)	Surplus ground water at present Stage of Development (ham)	Number of TW Recommended in each block (Assuming unit draft as 1.6 ham/structure/year)	Number of DW Recommended in each block (Assuming unit draft as 0.72 ham/structure/year)
4225.96	37.38	1579.47	2958.17	1378.70	517	766

7. Conclusion:

For effective utilization of Ground water existing draft for irrigation may be coupled with micro irrigation system. Change in irrigation pattern, optimum use of available resource, use of ground water potential created after artificial recharge can lead to groundwater savings and increase in gross cropped area of the block (Table: 11).

Table 11: Detail of groundwater saved through change in cropping pattern and other interventions

Block	Existing Gross Ground Water Draft for Irrigation in Ham	Additional Saving of GW after using Micro Irrigation methods in Ham (Assuming 30 % saving)	GW Potential created after Artificial recharge structure in Ham	Development by new GW abstraction structure	Additional GW irrigation Potential created in Ham	Additional Irrigation potential creation for Maize/ wheat in winter season in Ha (Assuming 500 mm water requirement)	Percent increase in Crop area compare to Gross cropped area
Batauli	1410.50	423.15	192.37	1378.70	1937.79	3875.58	19.67%

AQUIFER MAPPING AND MANAGEMENT PLAN FOR LAKHANPUR BLOCK (SURGUJA DISTRICT), CHHATTISGARH

CONTENTS

AQUIFER MAP AND MANAGEMENT PLAN - LAKHANPUR BLOCK

1. Salient Information:

About the area: Lakhanpur Block is situated on the central part of Surguja district of Chhattisgarh and is bounded in the west by Udaipur Block, in the east by Mainpat block and Ambikapur Block. The block area lies between 22.73 and 23.11 N latitudes and 82.85 and 83.22 E longitudes. The geographical extension of the study area is 780.08 sq. km representing around 15 % of the district's geographical area. Administrative map of the block is shown in Fig. 1. Geomorphologically blocks northern half comprises of structural plains on Gondwana rocks and area adjacent to Mainpat block in southern and western part comprises of region of plateau. Geomorphology map is shown in Figure 2. The major drainage of the block includes Khurkhuri Nala and Chandani Nala and Rehar river all of which are parts of Son sub basin and Lower Ganga Basin. Drainage map shown in Fig. 3.

Population: The total population of Lakhanpur block as per 2011 Census is 118969 out of which rural population is 112699 while the urban population is 6270.The population break up i.e. male- female and rural- urban is given below -

Table- 1: Population Break Up

Block	Total population	Male	Female	Rural population	Urban population
Lakhanpur	118969	59782	59187	112699	6270

Source: CG Census, 2011

Growth rate: The decadal growth rate of the block is 18.77 as per 2011 census.

Rainfall: The study area receives rainfall mainly from south-west monsoon. About 87% of the annual rainfall is received during June to September and July and August are the months of maximum precipitation. The area gets some rainfall during winter season also. Average annual rainfall in the study area is (Average of the last five years i.e. 2013 to 2017) 863.3 mm with 70 to 80 rainy days.

Table-2: Rainfall data in Lakhanpur block in mm

Year	2013	2014	2015	2016	2017
Annual rainfall	659.5	465.2	883.3	1017.3	1294.0

Source: IMD

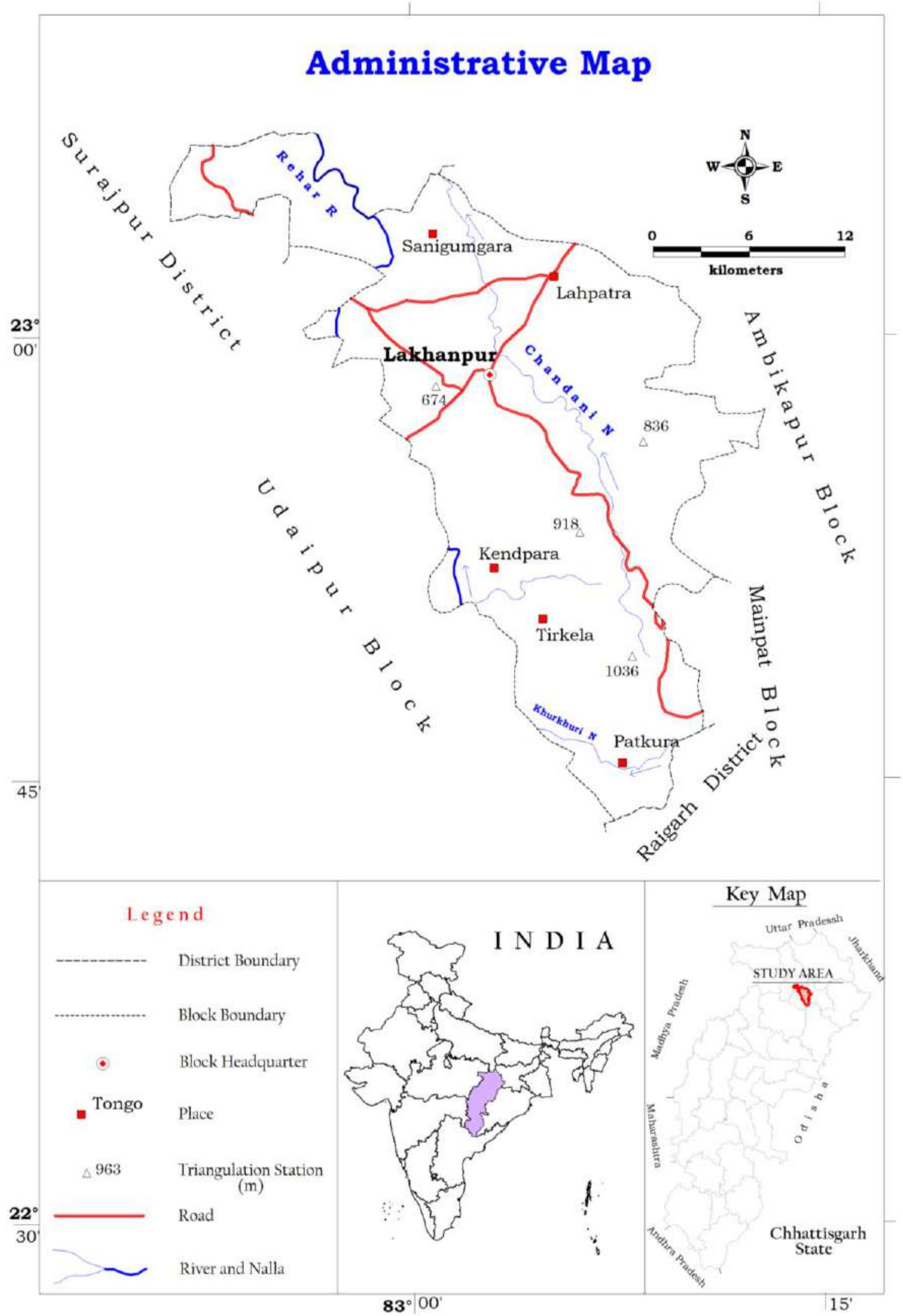


Figure 1 Administrative Map of Lakhanpur Block

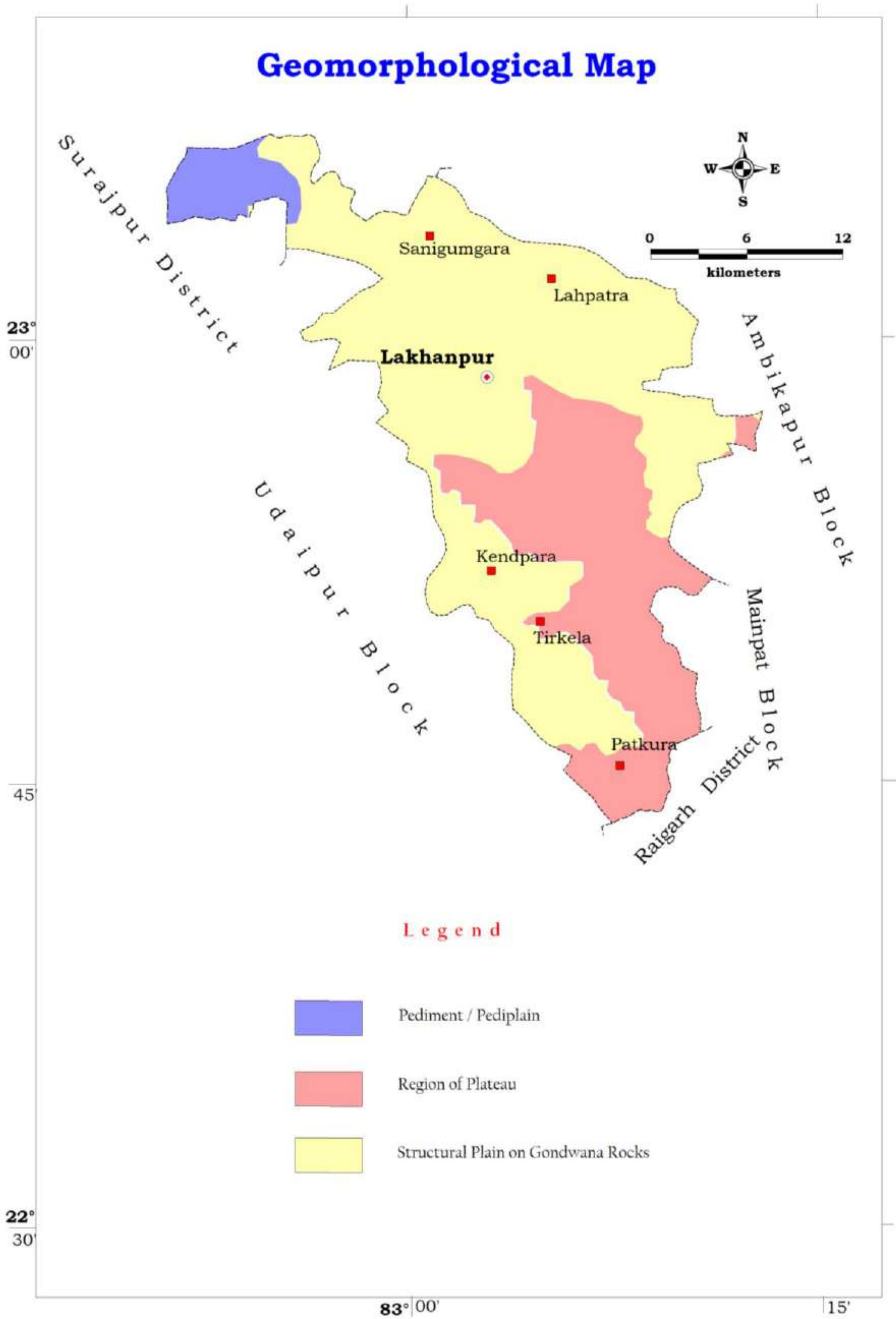


Figure 2 Geomorphology Map of Lakhanpur Block

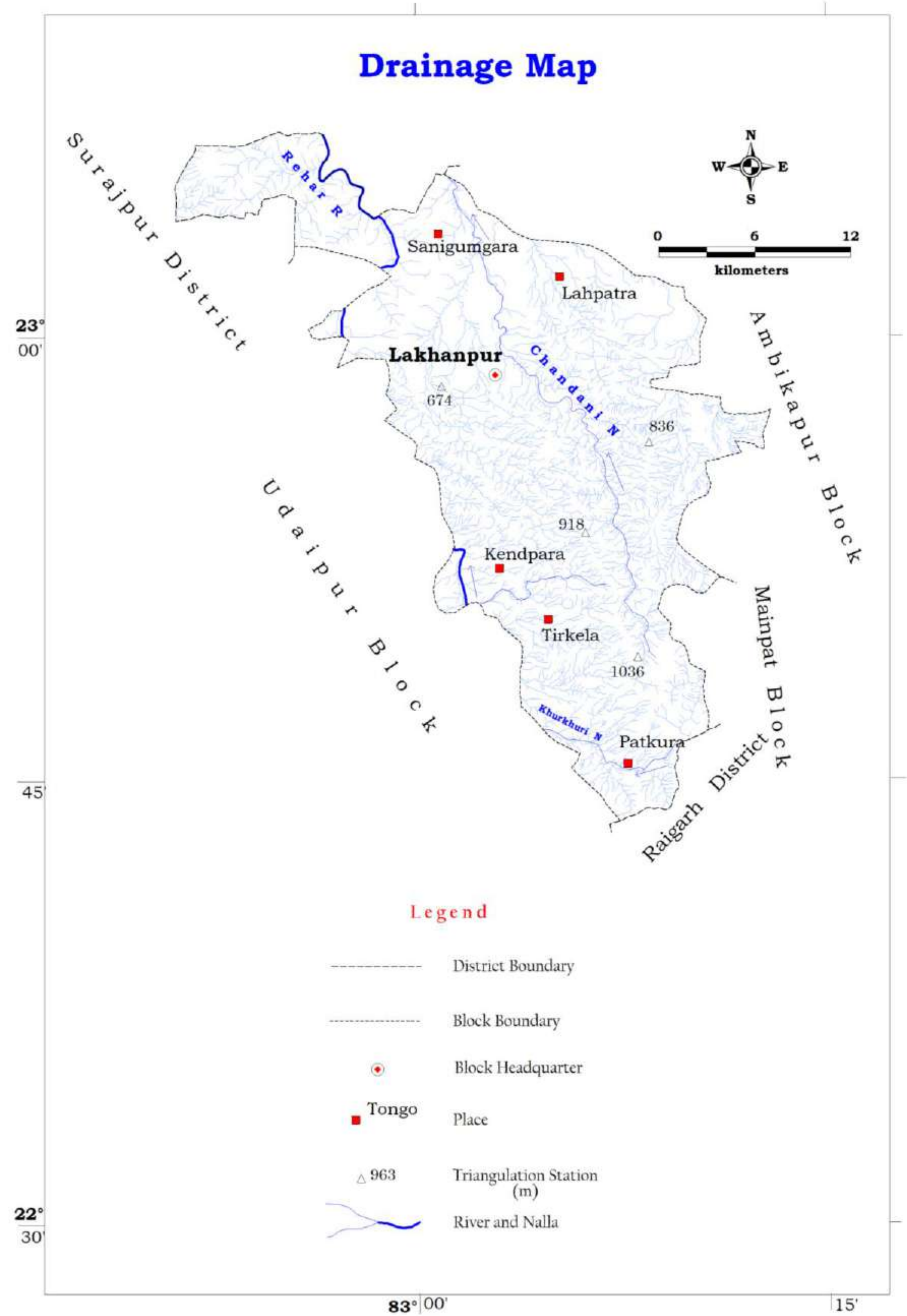


Figure 3 Drainage Map of Lakhanpur Block

<u>Agriculture and Irrigation</u>**:** Agriculture is practiced in the area during Kharif and Rabi season every year. During the Kharif, cultivation is done through rainfall while during the Rabi season; it is done through ground water as well as partly through surface water like canals and other sources. The groundwater abstraction structures are generally Dugwells, Borewells /tubewells. The principal crops in the block are Paddy, Wheat, Vegetables and pulses.

In some areas, double cropping is also practiced. The agricultural pattern, cropping pattern and area irrigated data of Lakhanpur block is given in Table 3 (A, B, C, D, and E).

Table 3 (A): Land use and Agricultural pattern (in ha)

Total geographical area	Forest area	Area not available for cultivation	Nonagricultural & Fallow land	Agricultural Fallow land	Net sown area	Double cropped area	Gross cropped area
78008	18680	4030	7875	4666	24588	3373	27961

Table 3 (C): Cropping pattern (in ha)

Kharif	Rabi	Cereal				Pulses	Tilhan	Fruits and Vegetables	Sugarcane	Mirch Masala
		Wheat	Rice	Jowar & Maize	Others					
23761	4200	640	19841	866	117	2289	2284	1527	69	264

Table 3 (D): Area irrigated by various sources (in ha)

No. of canals (private and Govt.)	Irrigated area	No. of bore wells/ Tube wells	Irrigated area	No. of dug wells	Irrigated area	No. of Talabs	Irrigated area	Irrigated area by other sources	Net Irrigated area	Gross irrigated area	% of irrigated area wrt. Net sown area
2	2150	589	53	1033	561	118	140	1221	3582	3960	14.16

Table 3 (E): Statistics showing Irrigation by Ground water

Block	Net Irrigated Area	Net Irrigated Area by ground water	Percentage of Area Irrigated by ground water
Lakhanpur	3582	614	17.14

Groundwater Resource Availability and Extraction: Based on the resource assessment made, the resource availability in aquifer wise in Lakhanpur block is given in the table-4.

Table – 4 (A): Ground Water Budget of Lakhanpur block in Ham

Assessment Unit Name	Ground Water Recharge(Ham)				Total Annual Ground Water (Ham) Recharge	Total Natural Discharges (Ham)
	Monsoon Season		Non-monsoon season			
	Recharge from Rainfall	Recharge from Other Sources	Recharge from Rainfall	Recharge from Other Sources		
Lakhanpur	4942.96	151.83	535.71	748.28	6378.78	637.88

Table – 4 (B): Ground Water Dynamic Resource (Unconfined Aquifer) of Lakhanpur block in Ham

Annual Extractable Ground Water Recharge (Ham)	Current Annual Ground Water Extraction(Ham)				Annual GW Allocation for Domestic Use as on 2025	Net Ground Water Availability for future use	Stage of Ground Water Extraction (%)	Categorization (OE/Critical/ Semicritical/ Safe)
	Irrigation Use	Industrial Use	Domestic Use	Total Extraction				
5740.90	1999.66	1.82	292.44	2293.92	331.89	3407.53	39.96	Safe

Table – 4 (C): Ground Water Static Resource (Unconfined Aquifer) and Dynamic Resource (Confined Aquifer) of Lakhanpur block in Ham

Static Resources Area (Ha)	Difference Piezometric Head (Pre-post) m	Storativity (S)	Dynamic Ground Water Resource of Confined Aquifer (Ham)	Bottom level of the top confining layer (m)	In storage Ground Water Resource of Unconfined Aquifer (Ham)	Sum of Dynamic GW (Confined Aquifer) and In storage GW (Unconfined Aquifer) resource (Ham)
67632	5.17	0.00025	99.21	200	14394.82	14494.03

Existing and Future Water Demand (2025)*:* The existing draft for irrigation in the area is 1999.66 Ham while the total extraction for all uses is 2293.92 Ham. At present scenario to meet the future demand for water, a total quantity of 3407.53 ham of ground water is available for future use.

<u>Water Level Behavior</u>: (i) Pre- monsoon water level: In the pre-monsoon period, it has been observed that in Lakhanpur block, water level in dugwells (phreatic aquifer) varies between 3.85 to 10.0 mbgl with average water level of 7.14 mbgl. In semiconfined aquifer, the maximum water level is 8.76 mbgl; the average water level is 16.17 mbgl.

Table 5A: Phreatic aquifer Depth to Water Level in mbgl (Pre-monsoon)

Block Name	Phreatic Aquifer		
	Min	Max	Avg
Lakhanpur	3.85	10.00	7.14

Table 5B: Semiconfined Aquifer Depth to Water Level in mbgl (Pre-monsoon)

Block Name	Semiconfined Aquifer		
	Min	Max	Avg
Lakhanpur	8.76	26.96	16.17

(ii) Post- monsoon water level**:** In the post-monsoon period, it has been observed that the water level varies from 1.00 to 7.00 mbgl with an average of 3.64 mbgl in phreatic aquifer. In semiconfined/fractured formation, the post monsoon water level variation range is 4.62 to 18.45 mbgl with average of 11.00 mbgl.

Table 5C: Phreatic Aquifer Depth to Water Level in mbgl (Post-monsoon)

Block Name	Phreatic Aquifer		
	Min	Max	Avg
Lakhanpur	1.00	7.00	3.64

Table 5D: Semiconfined Aquifer Depth to Water Level in mbgl (Post-monsoon)

Block Name	Semiconfined Aquifer		
	Min	Max	Avg
Lakhanpur	4.62	18.45	11.00

(iii) Seasonal water level fluctuation: The water level fluctuation data indicates that in Lakhanpur block, water level fluctuation in phreatic aquifer varies from 1.40 to 5.10 m with an average fluctuation of 3.51 m. Water level fluctuation in semiconfined Aquifer varies from 2.44 to 8.51 m with an average fluctuation of 5.17 m.

Table 5E: Phreatic Aquifer Depth to Water Level Fluctuation (meter)

Block Name	Phreatic Aquifer		
	Min	Max	Avg
Lakhanpur	1.40	5.10	3.51

Table 5F: Semiconfined Aquifer Depth to Water Level Fluctuation (meter)

Block Name	Semiconfined Aquifer		
	Min	Max	Avg
Lakhanpur	2.44	8.51	5.17

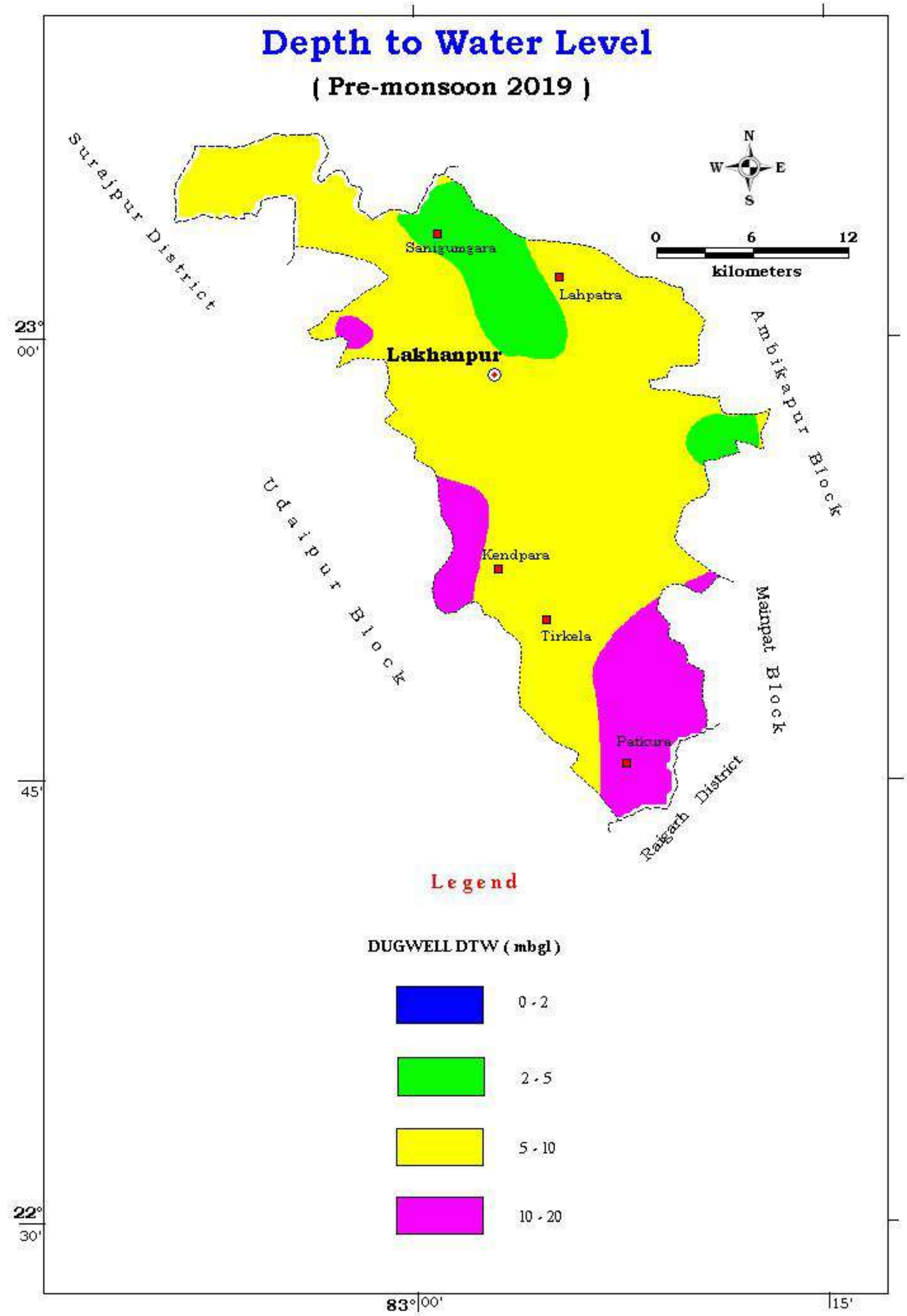


Figure 4 Depth to water level map Phreatic Aquifer (Pre-monsoon)

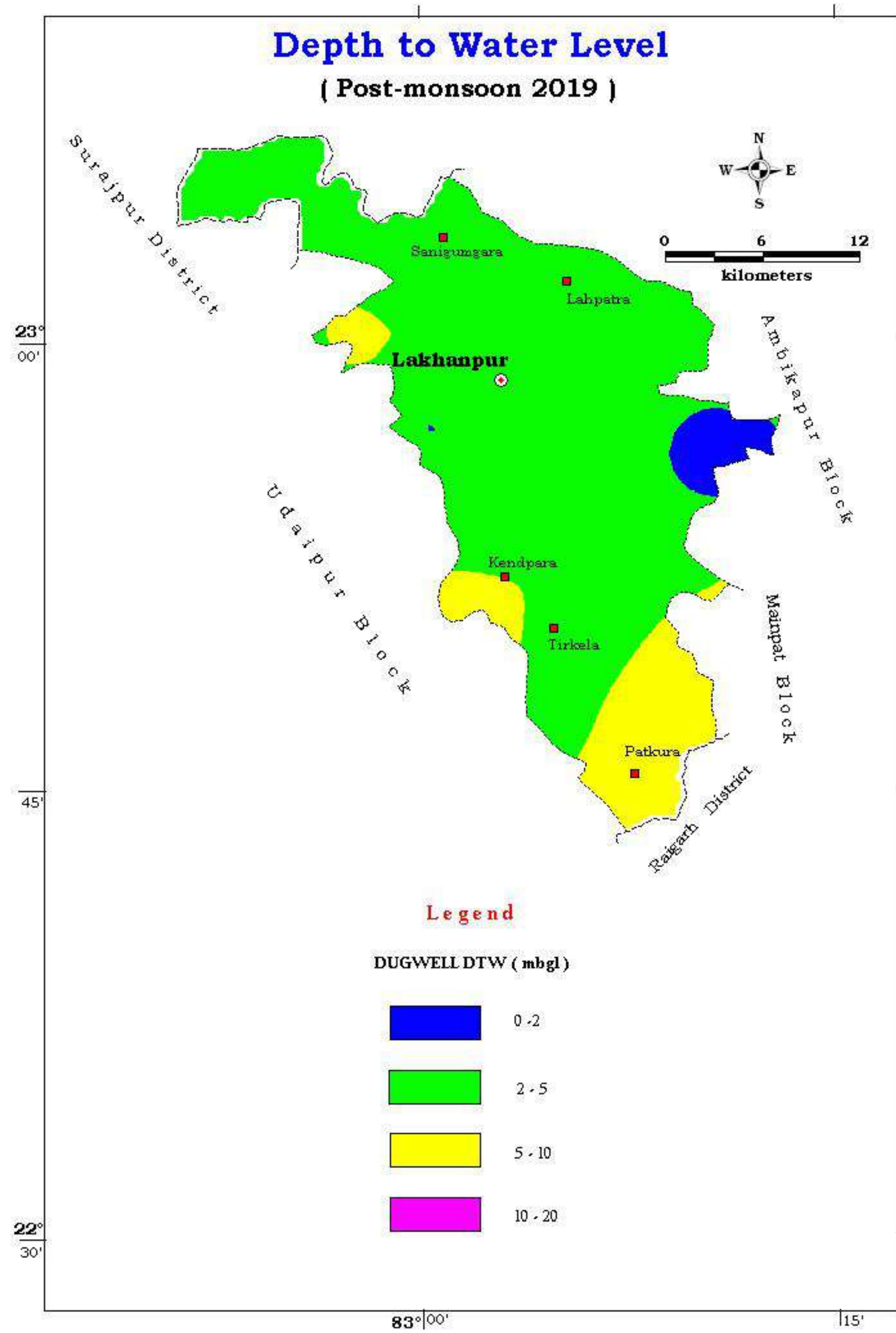


Figure 5 Depth to water level map Phreatic Aquifer (Post-monsoon)

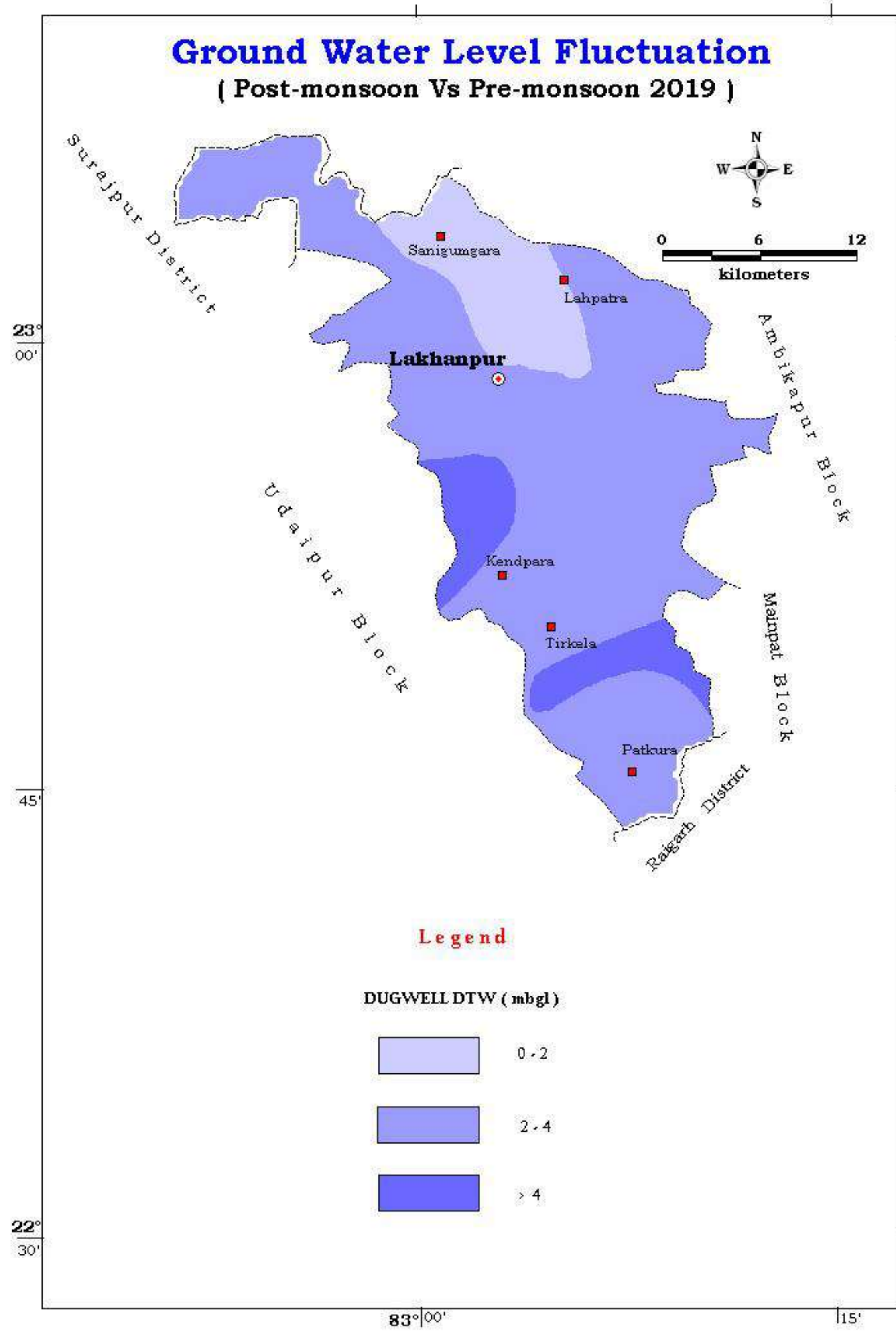


Figure 6 Depth to water level fluctuation map of Phreatic Aquifer

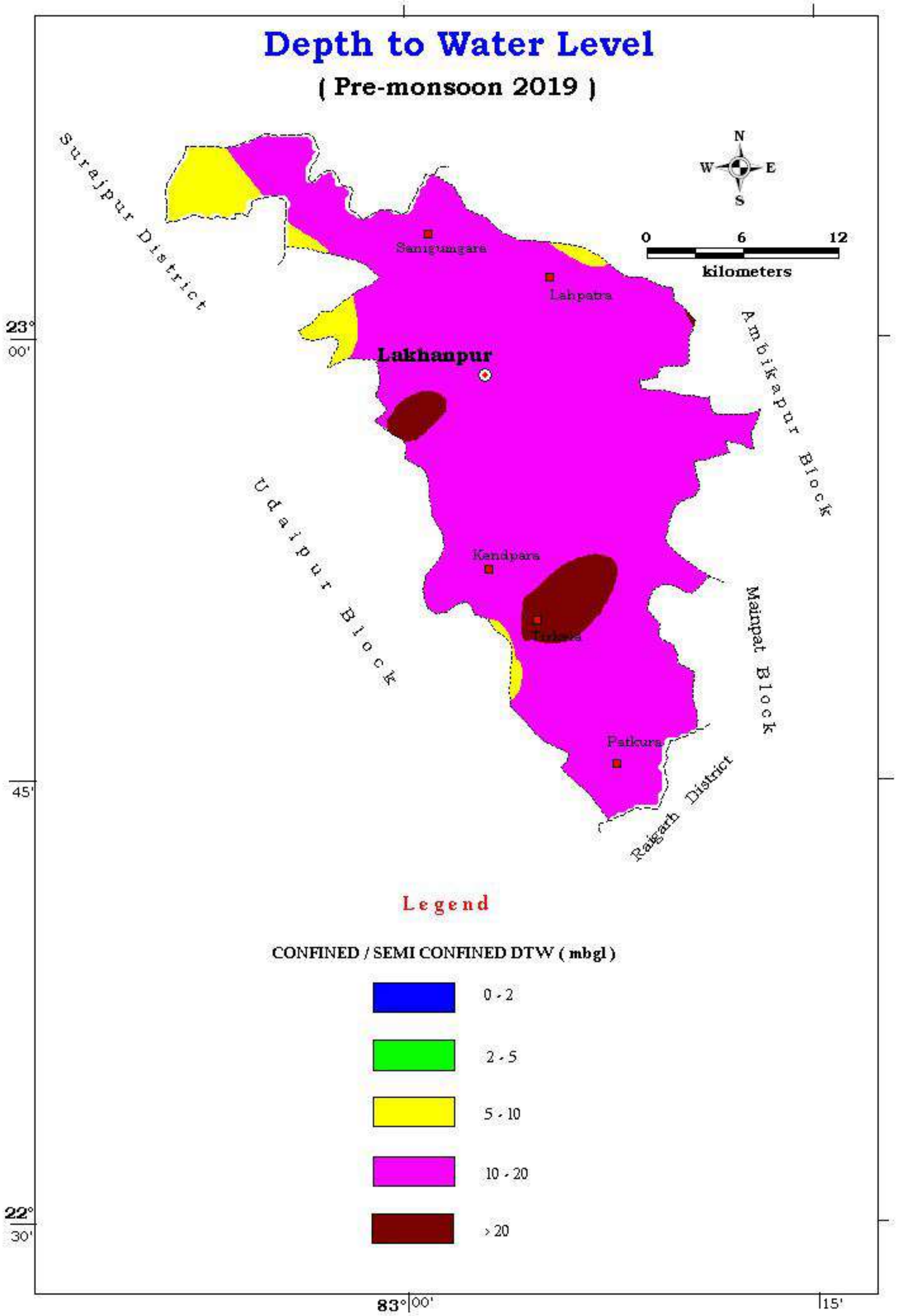


Figure 7 Depth to water level map Semiconfined Aquifer (Pre-monsoon)

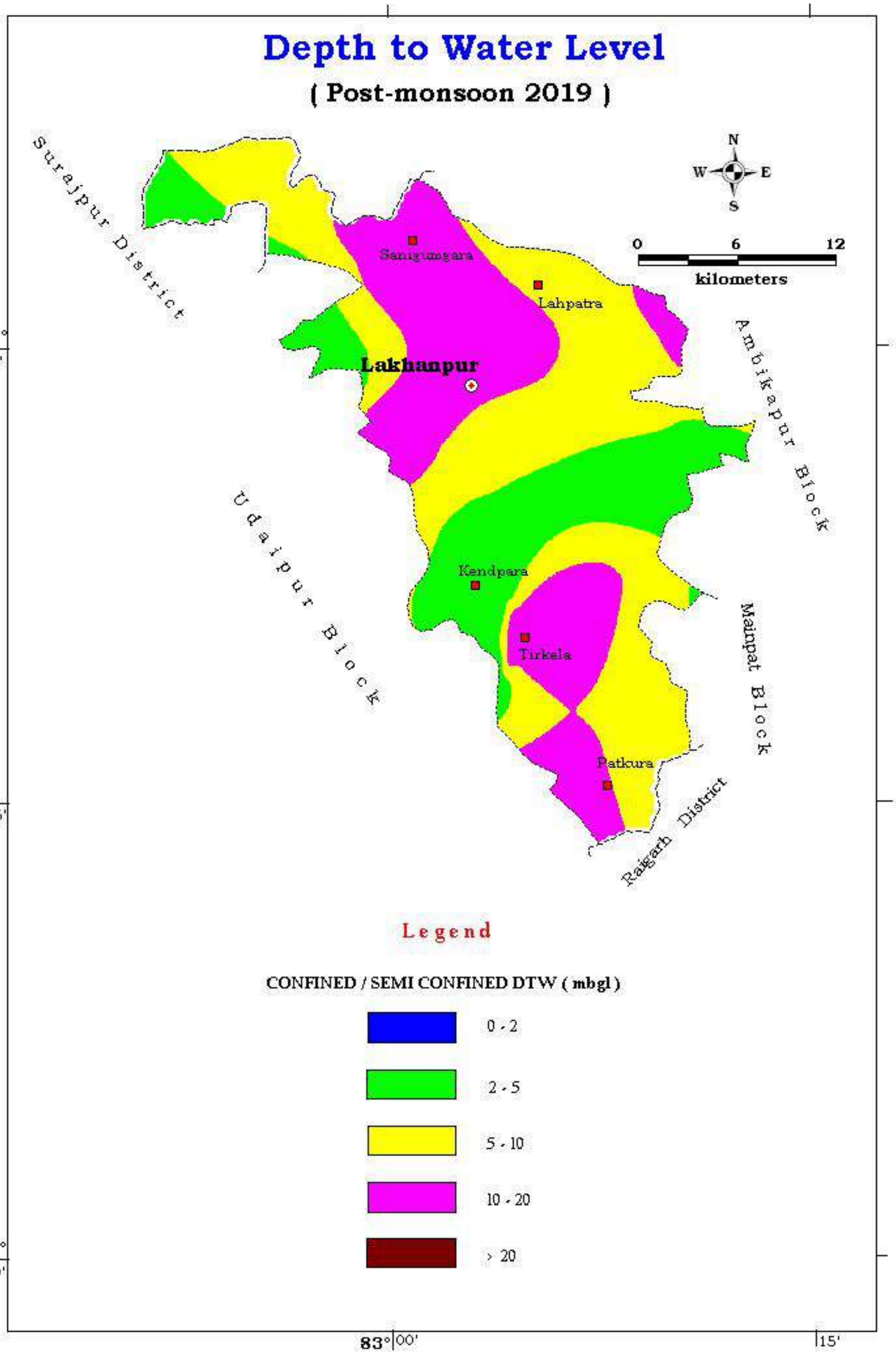


Figure 8 Depth to water level map Semiconfined Aquifer (Post-monsoon)

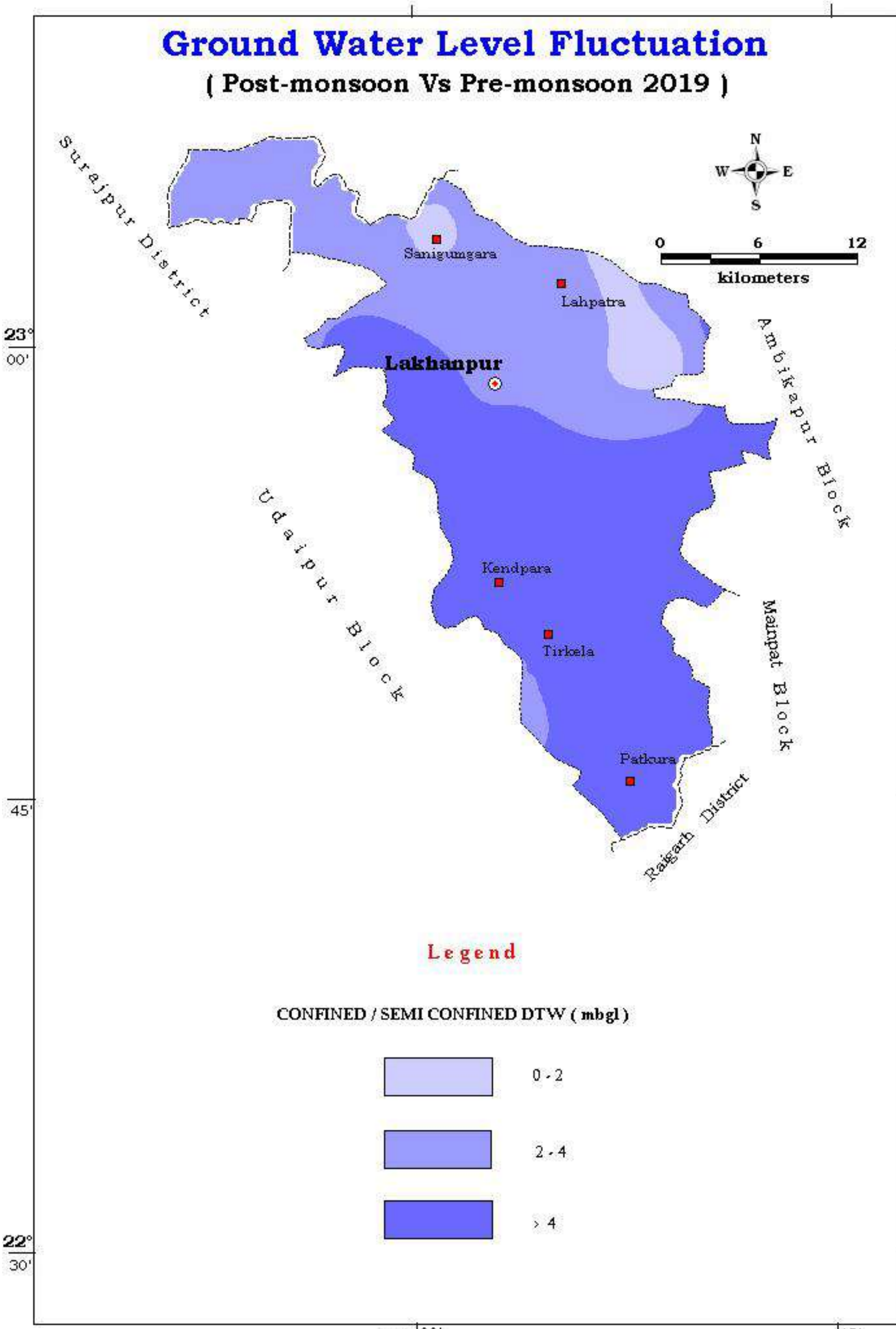


Figure 9 Depth to water level fluctuation map of Semiconfined Aquifer

(iv) <u>The long term water level trend</u>: There is no significant decline in water level in pre and post monsoon period in all observed NHS networks.

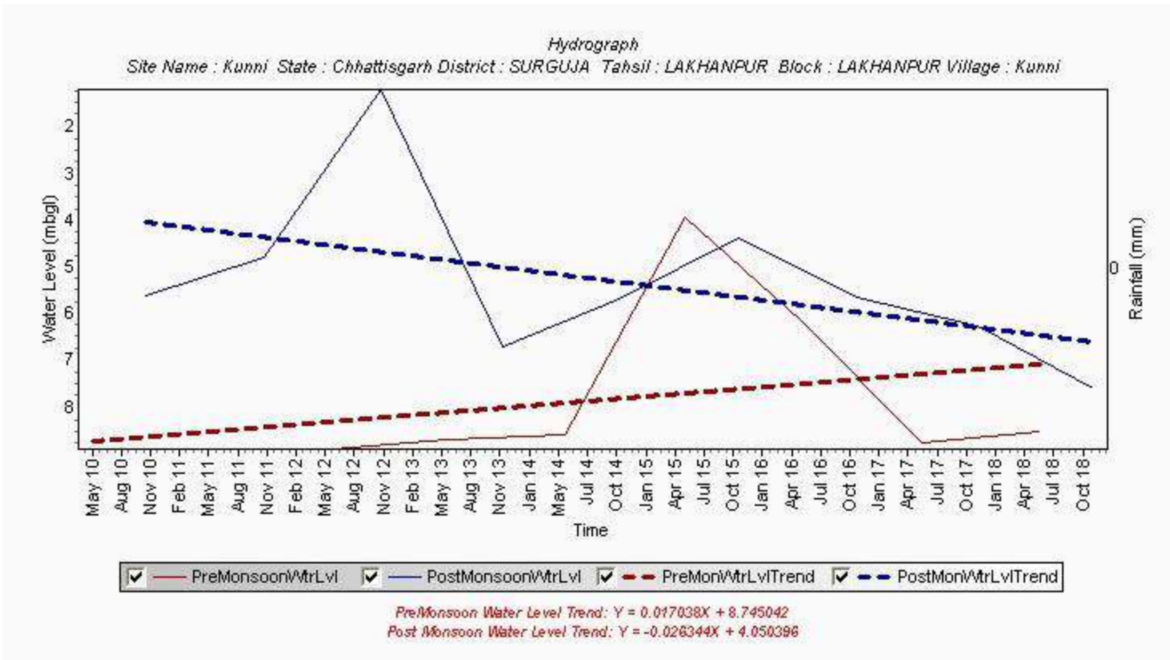


Figure 10 a: Hydrograph of Kunni Village, Lakhanpur block

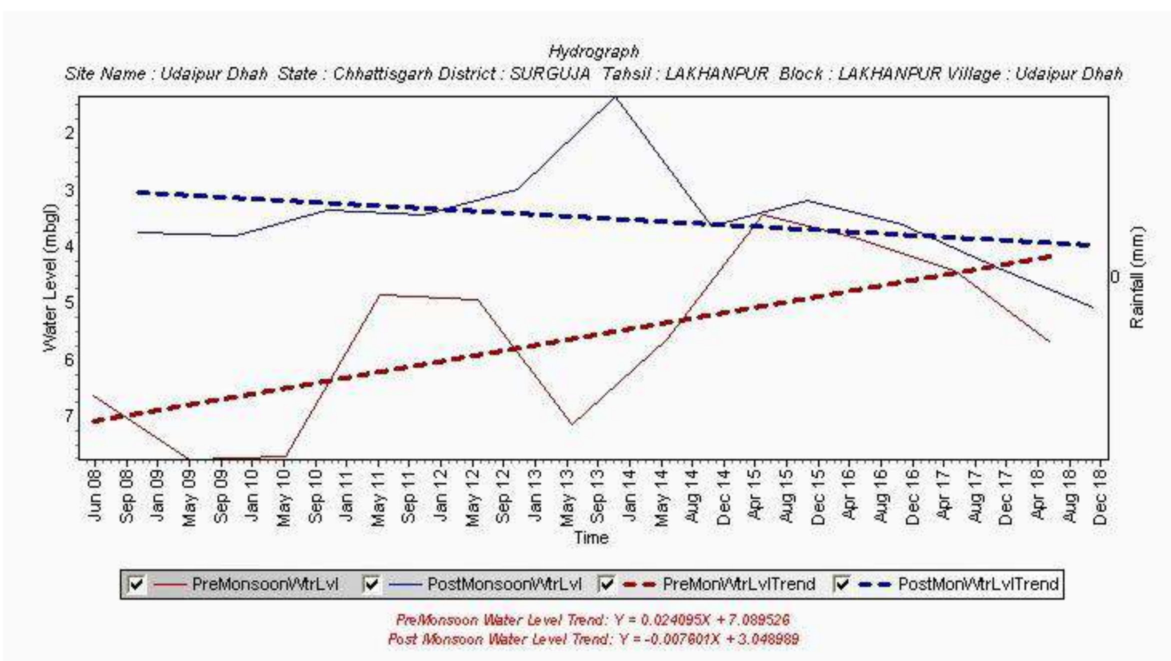


Figure 10 b: Hydrograph of Udaipur Dhah, Lakhanpur block

2. Aquifer Disposition:

Number of Aquifers: There are two major aquifer system viz. Granite Aquifer system and Sandstone Aquifer system. Both the aquifer system has the shallow aquifer and deeper aquifer which occurs in phreatic and semiconfined condition respectively.

3-d aquifer disposition and basic characteristics of each aquifer:

Sandstone Aquifer System:

After studying the exploratory well details in Sandstone aquifer system, it has been envisaged that Gondwanas rock 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. 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.

The average thickness of the weathered portion is around 21 m. In general, the discharge varies from meagre to 12.5 lps with an average yield of 4.33 lps. The average drawdown of the formation is around 26 m. Rotary drilling technique is preferred in sandstone aquifer where well construction is required depending upon the water zone and formation encountered. Water zone has been encountered up to 200 meter. Transmissivity range observed is 3.74 to 159.1 sq. meter/day. Details of the aquifer characteristics and water zone encountered are shown in annexure.

Granite Aquifer System:

Groundwater occurrence is largely limited to secondary permeability, such as weathered zones, joints, fractures or faults. The potential of weathered zones depends on the degree and depth of weathering and associated fracturing, and the saturated thickness. The aquifers are generally discontinuous, and often confined. Higher yields are obtained where thick weathered zones are associated with bedrock fracturing.

The average thickness of the weathered portion in the area is around 20 m. In general, the discharge varies from meagre to 5.5 lps. The average drawdown of the formation is around 29 m. DTH drilling technique is preferred in Granite aquifer where well construction is required depending upon the thickness of weathered zone. Water zone has been encountered up to 158 mbgl in the formation. Transmissivity range observed is upto 18.72 sq meter/day.

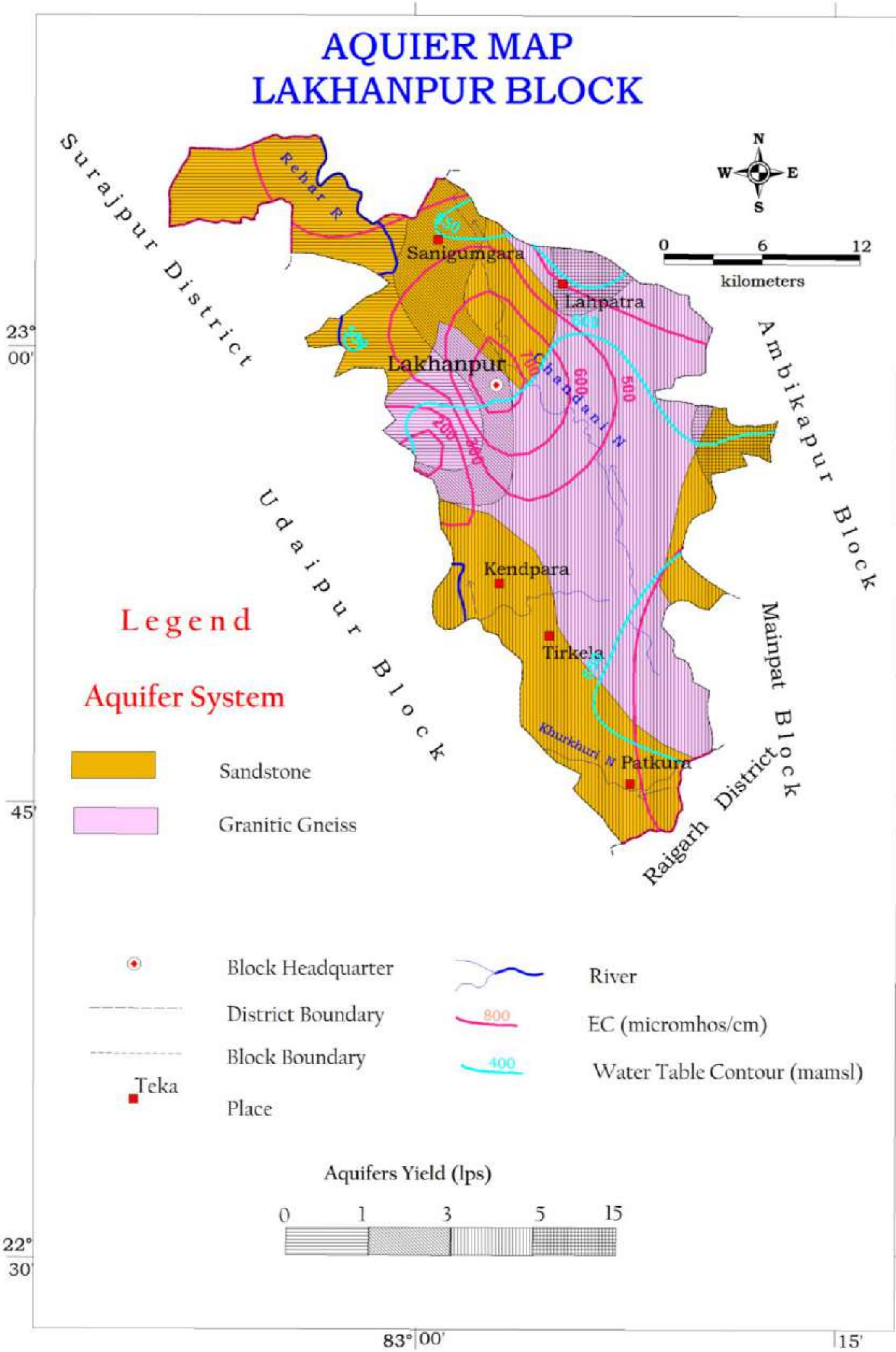


Figure 11: Aquifer map of Lakhanpur block

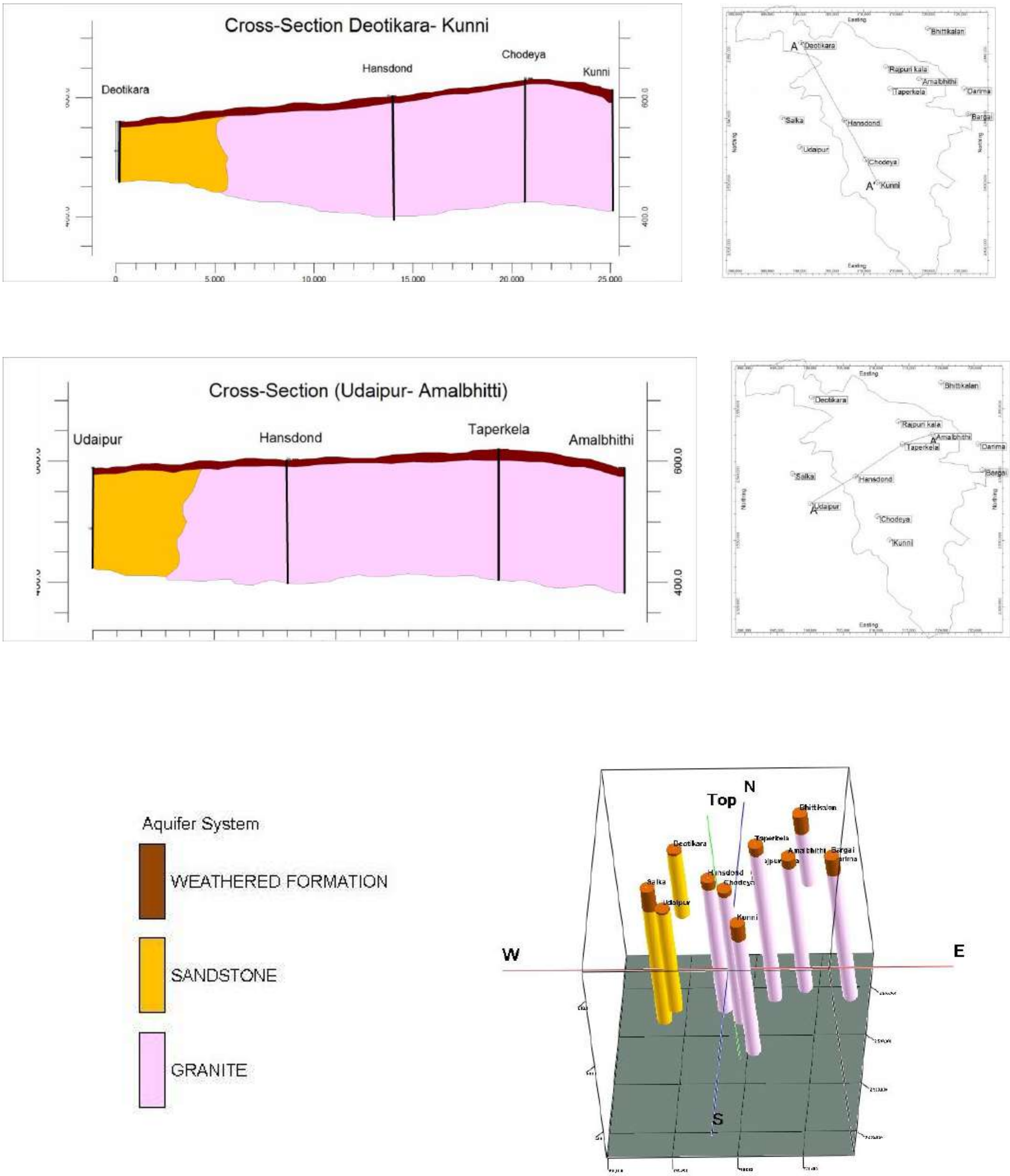


Figure-12, Disposition of Aquifer, Lakhanpur Block

3. Ground water Resource, extraction, contamination and other issues:

Resource availability of Lakhanpur block is given in the table -4 where net ground water availability for future use is 3407.53 ham. The extraction details and the future scenario (2025) along with the categorisation are also depicted in the table-4.

Table 7 Categorization of Assessment Unit

District	Block	Stage of Ground water development (%)	Categorisation
Lakhanpur	Lakhanpur	39.96	Safe

Categorisation: Lakhanpur block falls in safe category. The stage of Ground water development is 39.96 %. The Annual Extractable Ground Water Recharge is 5740.90 ham. The Ground water draft for all uses is 2293.92 Ham. The Ground water resource for future uses for Lakhanpur Block is 3407.53 Ham.

Chemical Quality of Ground water and Contamination**:** Throughout the study area, the water samples from both dugwell and handpumps were collected and chemical analysis has been completed (Annexure I). Several villages like Kunni have more Iron concentration.
Overall ground water of the study area is suitable for the drinking, agriculture and industrial purpose.
In Lakhanpur at 29 villages Fluoride contamination and at 54 villages Iron contamination reported.
(Source: https://ejalshakti.gov.in/IMISReports/MIS.html)

4. Ground Water Resource enhancement:

Aquifer wise space available for recharge and proposed interventions:

Table -8: Summarised detail of Volume of porous space available for recharge (Aquifer wise)

Major Aquifer	Area Identified for Artificial Recharge (Sq. Km)	Sp. Yield for the formation	Volume of vadose zone available for recharge(mcm)	Sub surface storage potential (mcm)
Sandstone (Gondwana)	204.02	0.02	322	6.436

5. Issues:

(i) During summer, dugwells in villages becomes dry at many locations. Several handpumps also stop yielding water. The aquifer itself is a low yielding one.

(ii) In Granite aquifer system potential zone for ground water is related with occurrence of fracture, so drilling a high yield well is always a challenge. Proper scientific study coupled with geophysical investigation may minimize the failure of well.

(iii) Problems in Tube well / Bore well construction in Sandstone Aquifer System: In case of filter point wells drilled with hand bores, the depth of penetration is variable and whenever the Shale or any other compact layers are encountered, further drilling becomes difficult. When portable rotary rigs are deployed for drilling, the drilling operations become very slow and the pore spaces in fine grained layers are invaded by drilling fluid as a result the discharges tend to be poor. Proper well development is seldom carried out by private drillers and as a result fine sands get deposited in the bore. Sometimes caving of wells are commonly reported particularly when the top loss sand is cased and the bottom shales are drilled with down the hole hammer rig.

(iv) Problems in ring well construction Sandstone Aquifer System: The common problem is sand filling inside the rings during and after the lowering of rings, thereby practically eliminating the change of deepening of wells to tap more saturated column in summer months. The weep holes provided in the rings allow water with fine sands and gets filled up as and when sand removal is in progress thereby making it difficult for lowering of rings is highly saturated sands.

(v) High value of Fluoride and Iron has been reported from several locations.

6. Management Plan:

(i) It has been observed during fieldwork, there is colossal wastage of groundwater through private well and public water supply system. So, Information, Education and Communication (IEC) activities need to be organized to sensitize people on the issues of depleting groundwater resource. Massive awareness campaigns are essential to aware people about the importance of community participation in saving water.

(ii) Desiltation of existing Tanks and Talabs to be carried out for efficient storage of rainwater. Also Rain water harvesting structures may be constructed in villages to reduce stress on groundwater.

(iii) It has been observed that the demand of ground water is increasing for irrigation, industrial and domestic uses. At locations where water level is declining, we have to go for artificial recharge on a long-term sustainability basis. Artificial Recharge structures may be constructed at suitable locations especially in the areas where the water level remains more than 3m in the post-monsoon period in this block to arrest the huge non-committed run-off and augment the ground water storage in the area. The different types of artificial structures feasible in the block are described in table-9.

Table-9: Types of Artificial Recharge structures feasible

Name of Block	Area Feasible for recharge (sq.km)	Volume of Sub Surface Potential for Artificial recharge (MCM)	Types of Structures Feasible and their Numbers			
			Percolation tank	Nalas bunding cement plug/ check dam	Gravity head /Dug well/ tube well/Recharge shaft	Gully plugs Gabion structures
Lakhanpur	204.02	7.200	20	30	159	74
	Recharge Capacity (MCM)/structure		0.2192	0.0326	0.00816	0.0073

(iv) Fluoride and Iron filter plant may be installed in the villages having higher value of contaminants.

(v) Treatment of sewage water in village through soak pit for the individual houses and Seechewal model or similar model for community level may be adopted to avoid contamination of ground water. Treated water may also be reused for irrigation and other industrial purposes.

(vi) Since the stage of development in the block is 39.96 %. There is scope of utilizing more ground water for future irrigation purpose. Additional number of Ground water abstraction structure may be developed for the effective utilization of ground water resources in the block. The ground water is presently developed through dug wells and tube wells. Yield potential for the block has been shown in Aquifer map (fig 11). Sites for wells need to be selected only after proper scientific investigation. The ground water quality also needs to be ascertained and the wells used for water supply should be first checked for Iron, Fluoride and other pollutants

Table 10: Potential of Additional GW abstraction structure creation

Net Groundwater availability (ham)	Stage of ground water Developm ent (%)	Present ground water draft (Ham)	Ground water draft at 70% stage of developmen t (ham)	Surplus ground water at present Stage of Development (ham)	Number of TW Recommended in each block (Assuming unit draft as 1.6 ham/structure/year)	Number of DW Recommended in each block (Assuming unit draft as 0.72 ham/structure/year)
5740.90	39.96	2293.92	4018.63	1724.71	647	958

6. **Conclusion:**
For effective utilization of Ground water existing draft for irrigation may be coupled with micro irrigation system. Change in irrigation pattern, optimum use of available resource, use of ground water potential created after artificial recharge can lead to groundwater savings and increase in gross cropped area of the block (Table: 11).

Table 11: Detail of groundwater saved through change in cropping pattern and other interventions

Block	Existing Gross Ground Water Draft for Irrigation in Ham	Additional Saving of GW after using Micro Irrigation methods in Ham(Assuming 30 % saving)	GW Potential created after Artificial recharge structure in Ham	Development by new GW abstraction structure	Additional GW irrigation Potential created in Ham	Additional Irrigation potential creation for Maize/ wheat in winter season in Ha (Assuming 500 mm water requirement)	Percent increase in Crop area compare to Gross cropped area
Lakhanpur	1999.66	599.90	719.96	1724.71	2968.21	5936.41	21.23%

AQUIFER MAPPING AND MANAGEMENT PLAN FOR LUNDRA BLOCK (SURGUJA DISTRICT), CHHATTISGARH

CONTENTS

AQUIFER MAPS AND MANAGEMENT PLANS: LUNDRA BLOCK

1. Salient Information:

About the area: Lundra Block is situated on the north eastern part of Surguja district of Chhattisgarh and is bounded in the west by Ambikapur Block, in the south by Batauli block, in the north by Balrampur District and in the east by Jashpur district. The block area lies between 23.01 and 23.28 N latitudes and 83.25 and 83.57 E longitudes. The geographical extension of the study area is 742.94 sq. km representing around 14.3 % of the district's geographical area. Administrative map of the block is shown in Fig. 1. Geomorphologically blocks comprises of denudational plateau. Geomorphology map is shown in Figure 2. The major drainage of the block includes Gagar Nala and Biechri Nala all of which are parts of Son sub basin and Lower Ganga Basin. Drainage map shown in Fig. 3.

Population: The total population of Lundra block as per 2011 Census is 119800.The population break up i.e. male- female and rural- urban is given below -

Table- 1: Population Break Up

Block	Total population	Male	Female	Rural population	Urban population
Lundra	119800	60457	59343	119800	0

Source: CG Census, 2011

Growth rate: The decadal growth rate of the block is 18.26 as per 2011 census.

Rainfall: The study area receives rainfall mainly from south-west monsoon. About 87% of the annual rainfall is received during June to September and July and August are the months of maximum precipitation. The area gets some rainfall during winter season also. Average annual rainfall in the study area is (Average of the last five years i.e. 2013 to 2017) 1252.2 mm with 70 to 80 rainy days.

Table-2: Rainfall data in Lundra block in mm

Year	2013	2014	2015	2016	2017
Annual rainfall	1322.4	1035.1	1157.5	1493.6	NA

Source: IMD

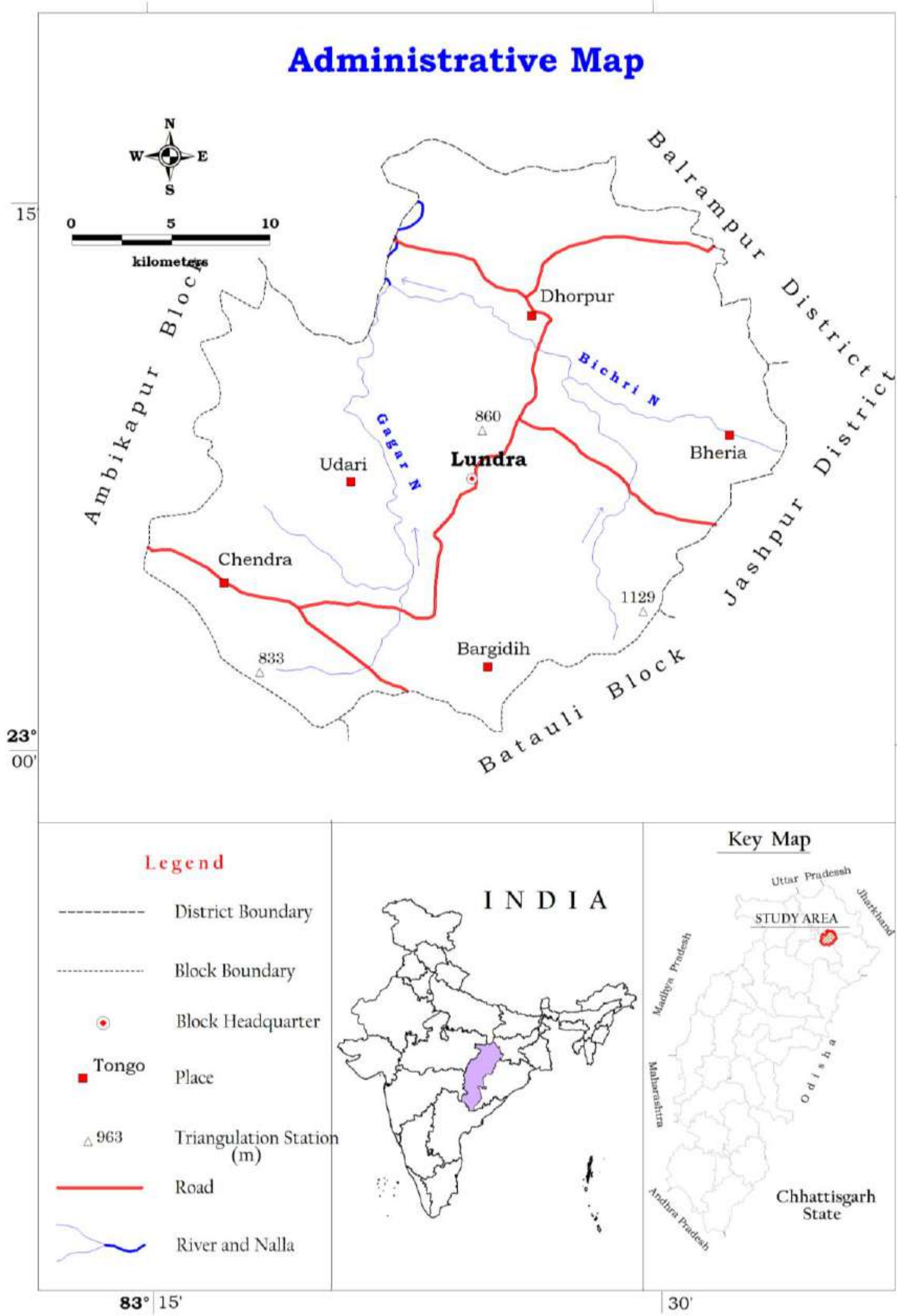


Figure 1 Administrative Map of Lundra Block

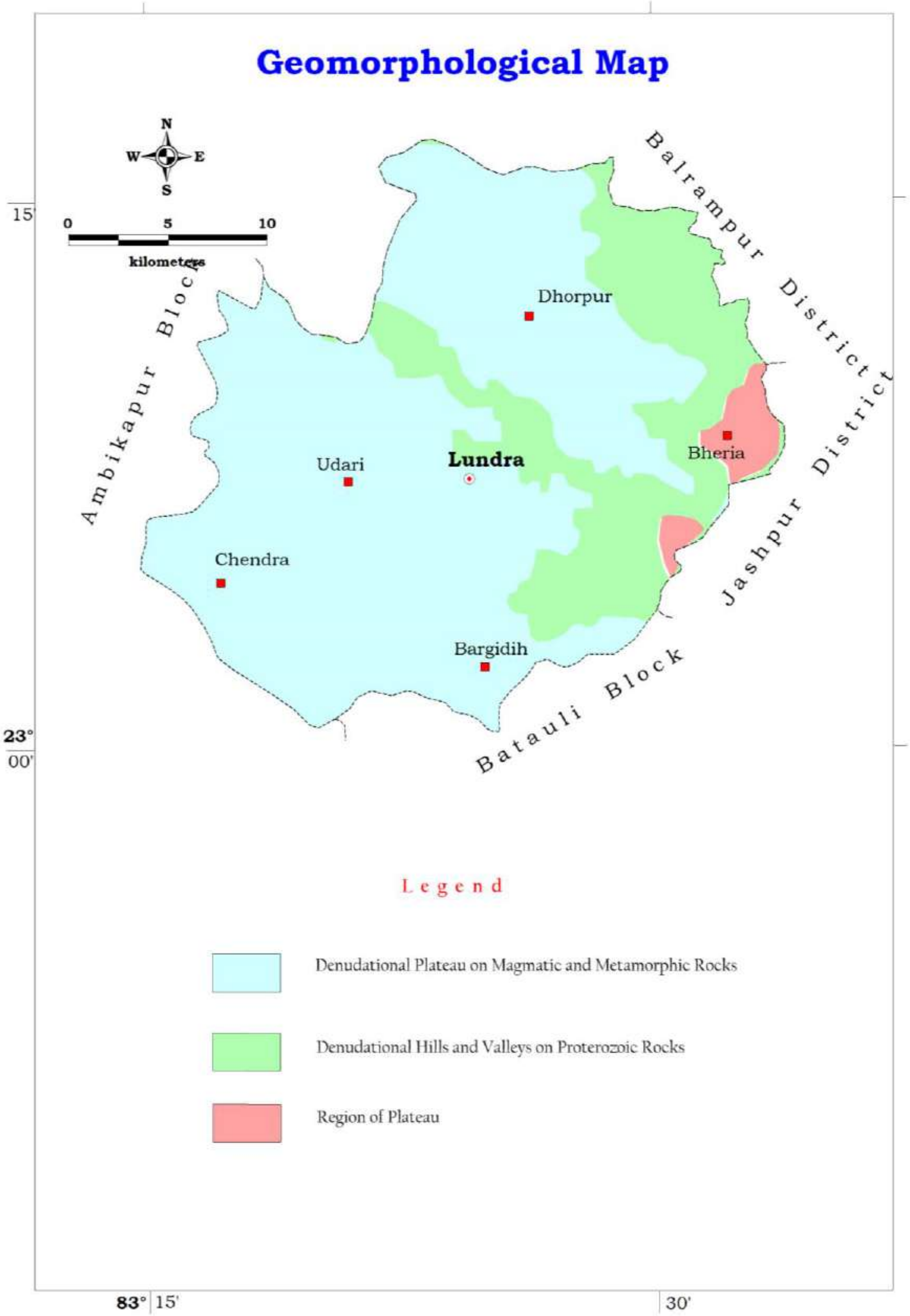


Figure 2 Geomorphology Map of Lundra Block

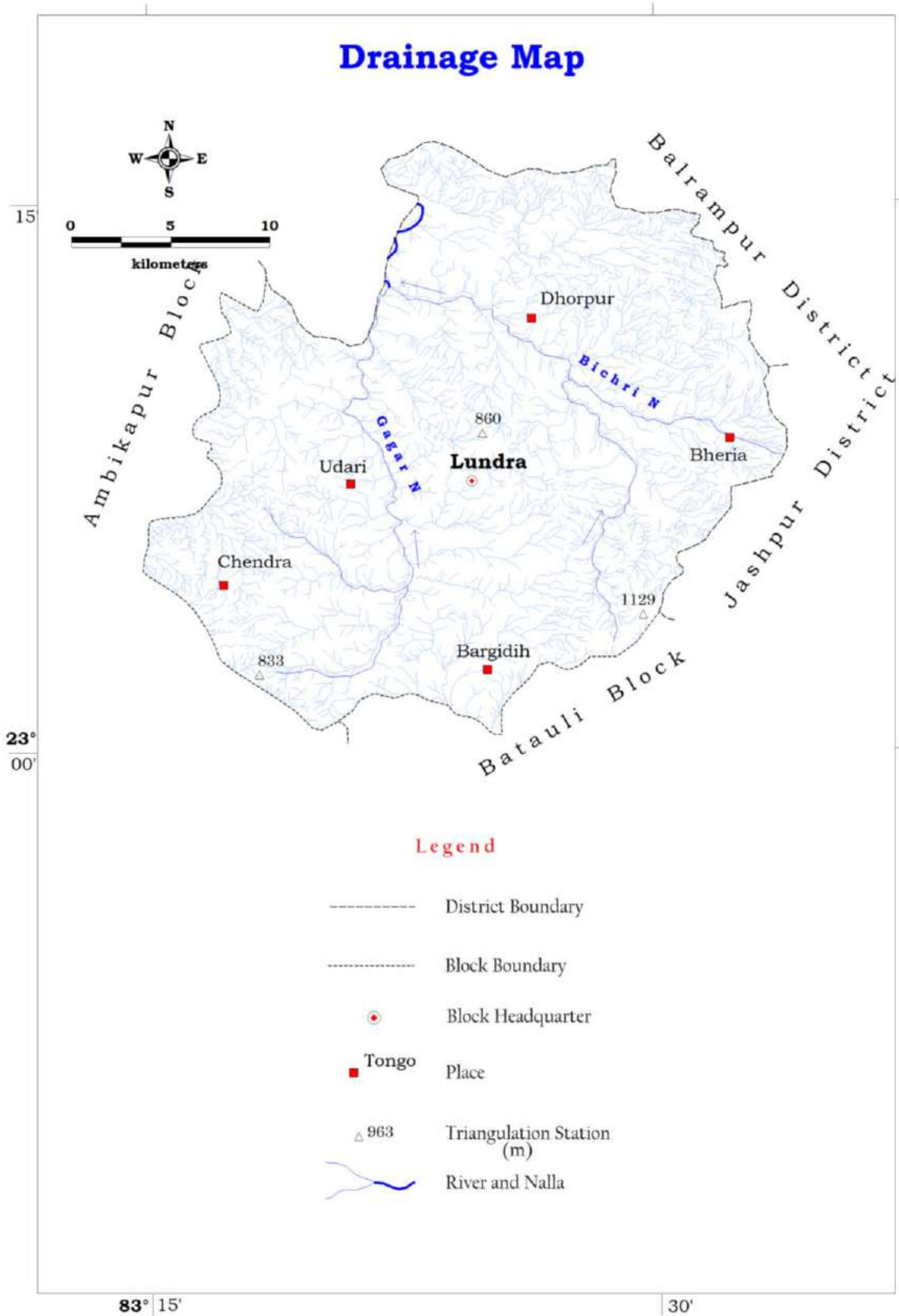


Figure 3 Drainage Map of Lundra Block

<u>Agriculture and Irrigation</u>**:** Agriculture is practiced in the area during Kharif and Rabi season every year. During the Kharif, cultivation is done through rainfall while during the Rabi season; it is done through ground water as well as partly through surface water like canals and other sources. The groundwater abstraction structures are generally Dugwells, Borewells /tubewells. The principal crops in the block are Paddy, Wheat, Vegetables and pulses.

In some areas, double cropping is also practiced. The agricultural pattern, cropping pattern and area irrigated data of Lundra block is given in Table 3 (A, B, C, D, and E).

Table 3 (A): Land use and Agricultural pattern (in ha)

Total geographical area	Forest area	Area not available for cultivation	Nonagricultural & Fallow land	Agricultural Fallow land	Net sown area	Double cropped area	Gross cropped area
74294	16322.4	3997	6788	3983	27900	5094	32994

Table 3 (C): Cropping pattern (in ha)

Kharif	Rabi	Cereal				Pulses	Tilhan	Fruits and Vegetables	Sugarcane	Mirch Masala	Others
		Wheat	Rice	Jowar & Maize	Others						
26798	6196	1242	18417	3122	20	1854	5012	1976	1018	266	67

Table 3 (D): Area irrigated by various sources (in ha)

No. of canals (private and Govt.)	Irrigated area	No. of bore wells/ Tube wells	Irrigated area	No. of dug wells	Irrigated area	No. of Talabs	Irrigated area	Irrigated area by other sources	Net Irrigated area	Gross irrigated area	% of irrigated area wrt. Net sown area
5	178	758	65	185	140	23	105	2675	3163	3336	9.63

Table 3 (E): Statistics showing Irrigation by Ground water

Block	Net Irrigated Area	Net Irrigated Area by ground water	Percentage of Area Irrigated by ground water wrt. Net irrigated area
Lundra	3163	205	6.48

Groundwater Resource Availability and Extraction: Based on the resource assessment made, the resource availability in aquifer wise in Lundra block is given in the table-4.

Table – 4 (A): Ground Water Budget of Lundra block in Ham

Assessment Unit Name	Ground Water Recharge(Ham)				Total Annual Ground Water (Ham) Recharge	Total Natural Discharges (Ham)
	Monsoon Season		Non-monsoon season			
	Recharge from Rainfall	Recharge from Other Sources	Recharge from Rainfall	Recharge from Other Sources		
Lundra	5680.52	201.25	511.25	394.88	6787.90	356.57

Table – 4 (B): Ground Water Dynamic Resource (Unconfined Aquifer) of Lundra block in Ham

Annual Extractable Ground Water Recharge (Ham)	Current Annual Ground Water Extraction (Ham)				Annual GW Allocation for Domestic Use as on 2025	Net Ground Water Availability for future use	Stage of Ground Water Extraction (%)	Categorization (OE/Critical/ Semicritical/ Safe)
	Irrigation Use	Industrial Use	Domestic Use	Total Extraction				
6431.33	1804.00	0.00	291.11	2095.11	329.42	4297.91	32.58	Safe

Table – 4 (C): Ground Water Static Resource (Unconfined Aquifer) and Dynamic Resource (Confined Aquifer) of Lundra block in Ham

Static Resources Area (Ha)	Difference Piezometric Head (Pre-post) m	Storativity (S)	Dynamic Ground Water Resource of Confined Aquifer (Ham)	Bottom level of the top confining layer (m)	In storage Ground Water Resource of Unconfined Aquifer (Ham)	Sum of Dynamic GW (Confined Aquifer) and In storage GW (Unconfined Aquifer) resource (Ham)
74294	6.48	0.00025	118.48	200	13739.93	13858.41

Existing and Future Water Demand (2025)*:* The existing draft for irrigation in the area is 1804.00 Ham while the total extraction for all uses is 2095.11 Ham. At present scenario to meet the future demand for water, a total quantity of 4297.91 ham of ground water is available for future use.

Water Level Behavior: (i) Pre- monsoon water level: In the pre-monsoon period, it has been observed that in Lundra block, water level in dugwells (phreatic aquifer) varies between 5.00 to 10.10 mbgl with average water level of 7.98 mbgl. In semiconfined aquifer, the maximum water level is 15.5 mbgl; the average water level is 13.93 mbgl.

Table 5A: Phreatic aquifer Depth to Water Level in mbgl (Pre-monsoon)

Block Name	Phreatic Aquifer		
	Min	Max	Avg
Lundra	5.00	10.10	7.98

Table 5B: Semiconfined Aquifer Depth to Water Level in mbgl (Pre-monsoon)

Block Name	Semiconfined Aquifer		
	Min	Max	Avg
Lundra	11.00	15.50	13.93

(ii) Post- monsoon water level**:** In the post-monsoon period, it has been observed that the water level varies from 2.70 to 6.34 mbgl with an average of 4.69 mbgl in phreatic aquifer. In semiconfined/fractured formation, the post monsoon water level variation range is 0.65 to 12.25 mbgl with average of 7.45 mbgl.

Table 5C: Phreatic Aquifer Depth to Water Level in mbgl (Post-monsoon)

Block Name	Phreatic Aquifer		
	Min	Max	Avg
Lundra	2.70	6.34	4.69

Table 5D: Semiconfined Aquifer Depth to Water Level in mbgl (Post-monsoon)

Block Name	Semiconfined Aquifer		
	Min	Max	Avg
Lundra	0.65	12.25	7.45

(iii) Seasonal water level fluctuation: The water level fluctuation data indicates that in Lundra block, water level fluctuation in phreatic aquifer varies from 0.92 to 5.10 m with an average fluctuation of 3.30 m. Water level fluctuation in semiconfined Aquifer varies from 1.75 to 10.35 m with an average fluctuation of 6.48 m.

Table 5E: Phreatic Aquifer Depth to Water Level Fluctuation (meter)

Block Name	Phreatic Aquifer		
	Min	Max	Avg
Lundra	0.92	5.10	3.30

Table 5F: Semiconfined Aquifer Depth to Water Level Fluctuation (meter)

Block Name	Semiconfined Aquifer		
	Min	Max	Avg
Lundra	1.75	10.35	6.48

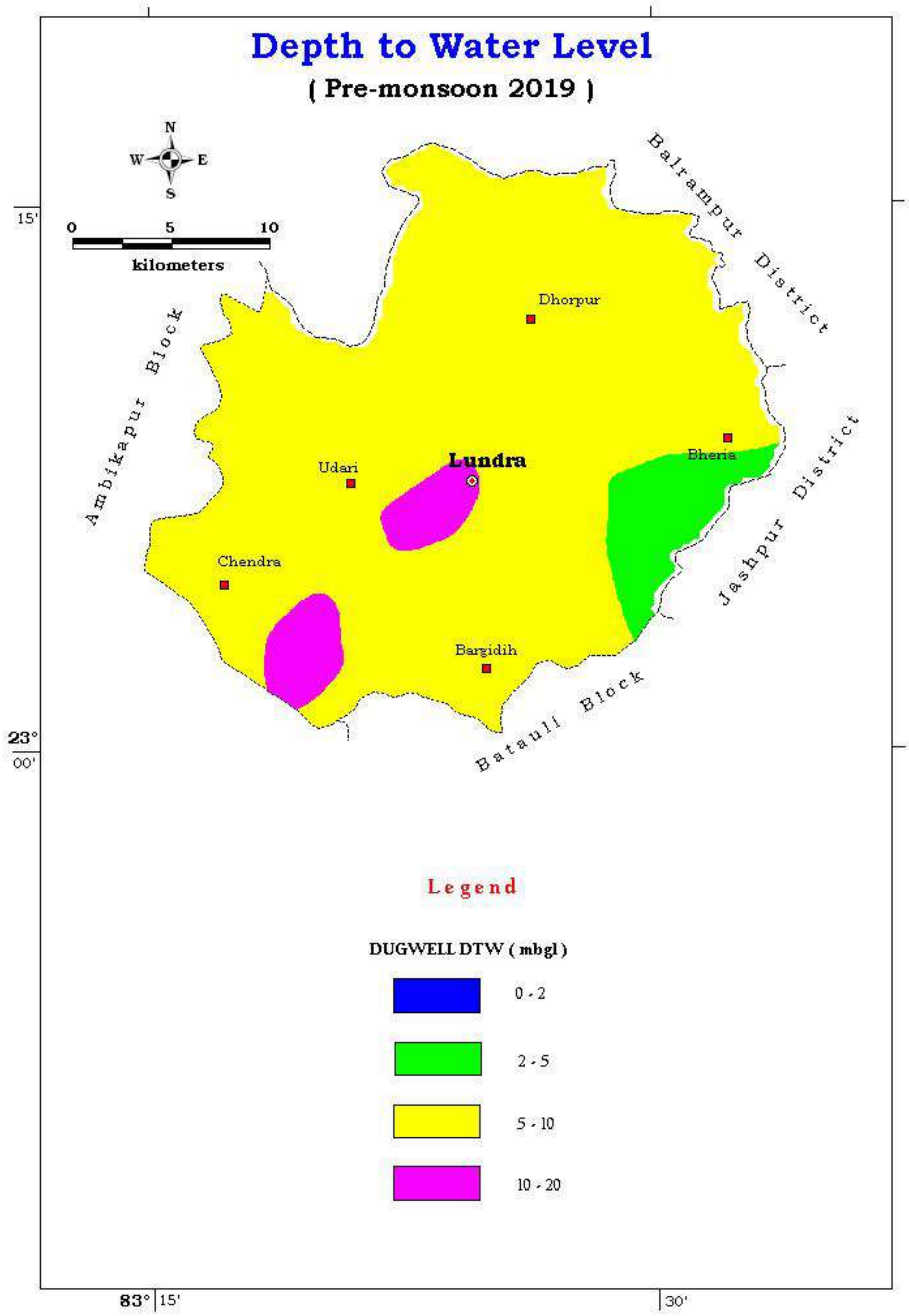


Figure 4 Depth to water level map Phreatic Aquifer (Pre-monsoon)

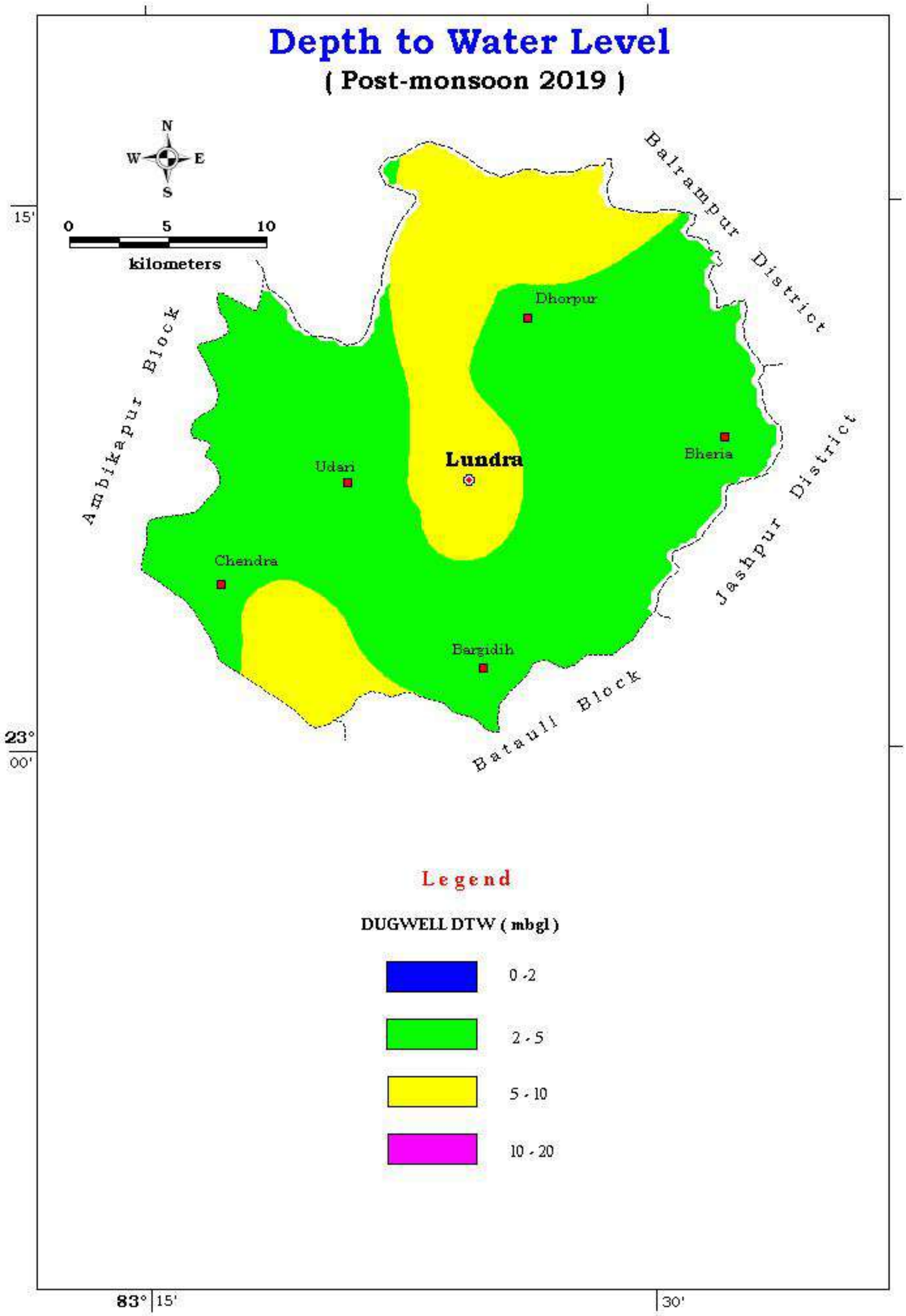


Figure 5 Depth to water level map Phreatic Aquifer (Post-monsoon)

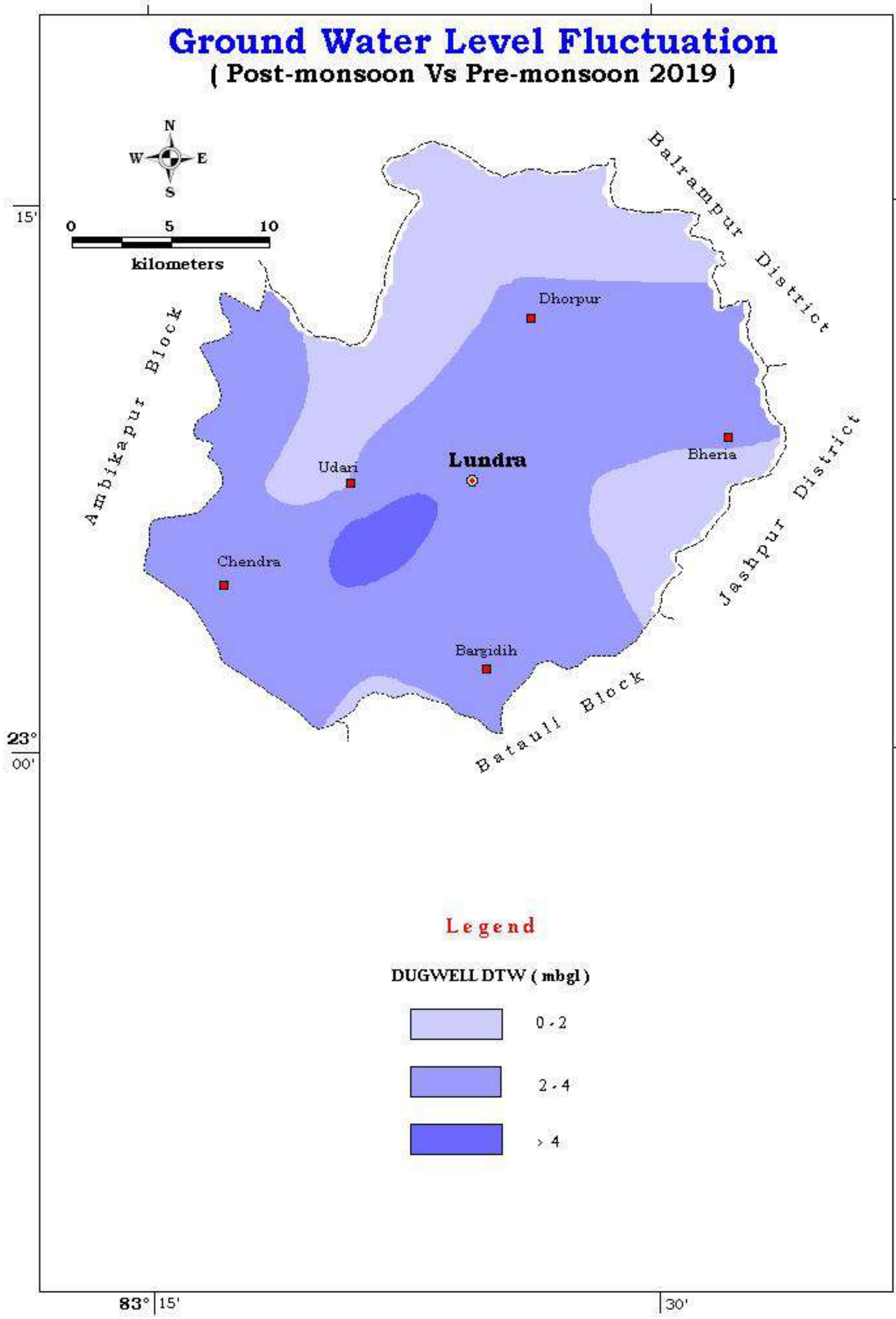


Figure 6 Depth to water level fluctuation map of Phreatic Aquifer

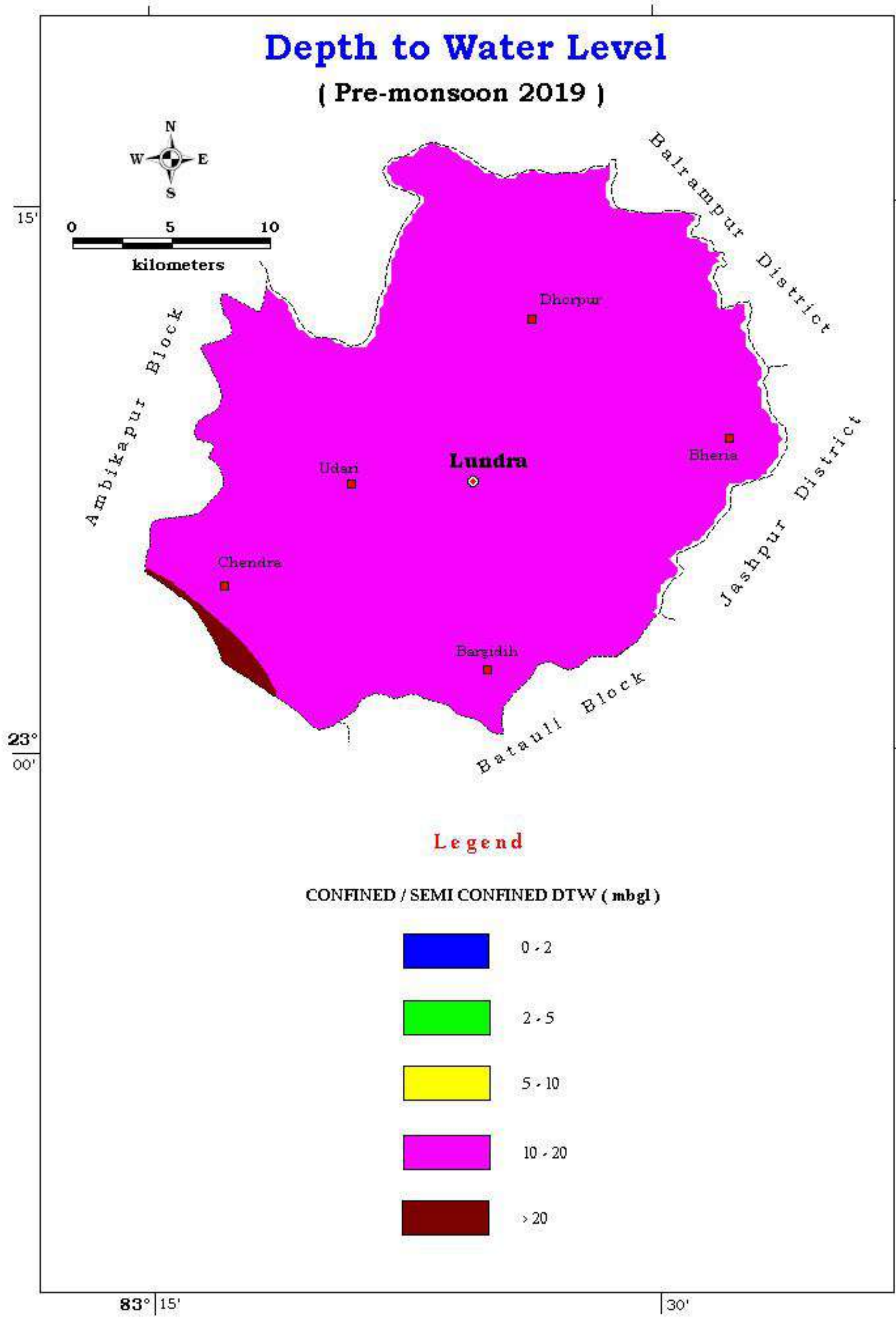


Figure 7 Depth to water level map Semiconfined Aquifer (Pre-monsoon)

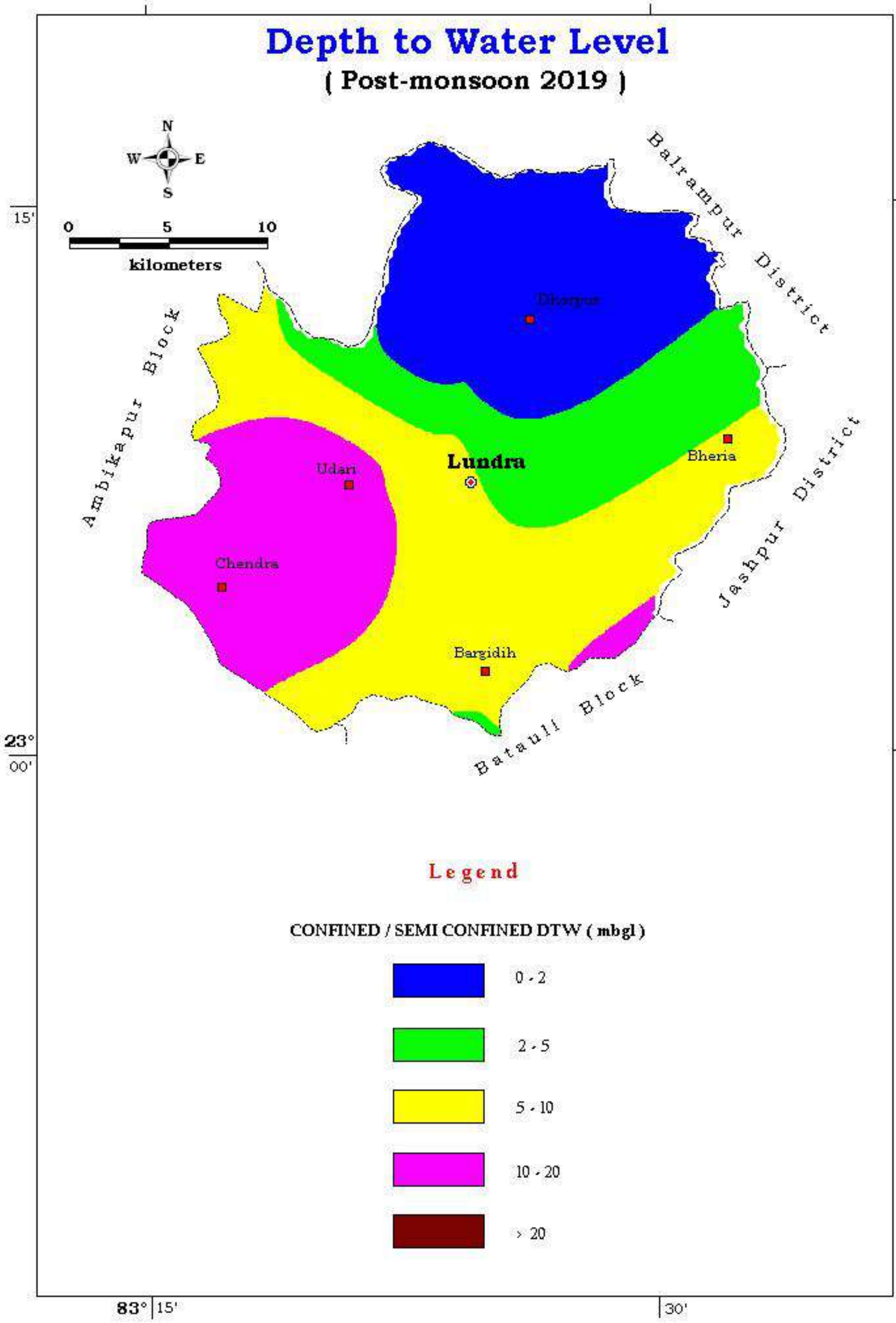


Figure 8 Depth to water level map Semiconfined Aquifer (Post-monsoon)

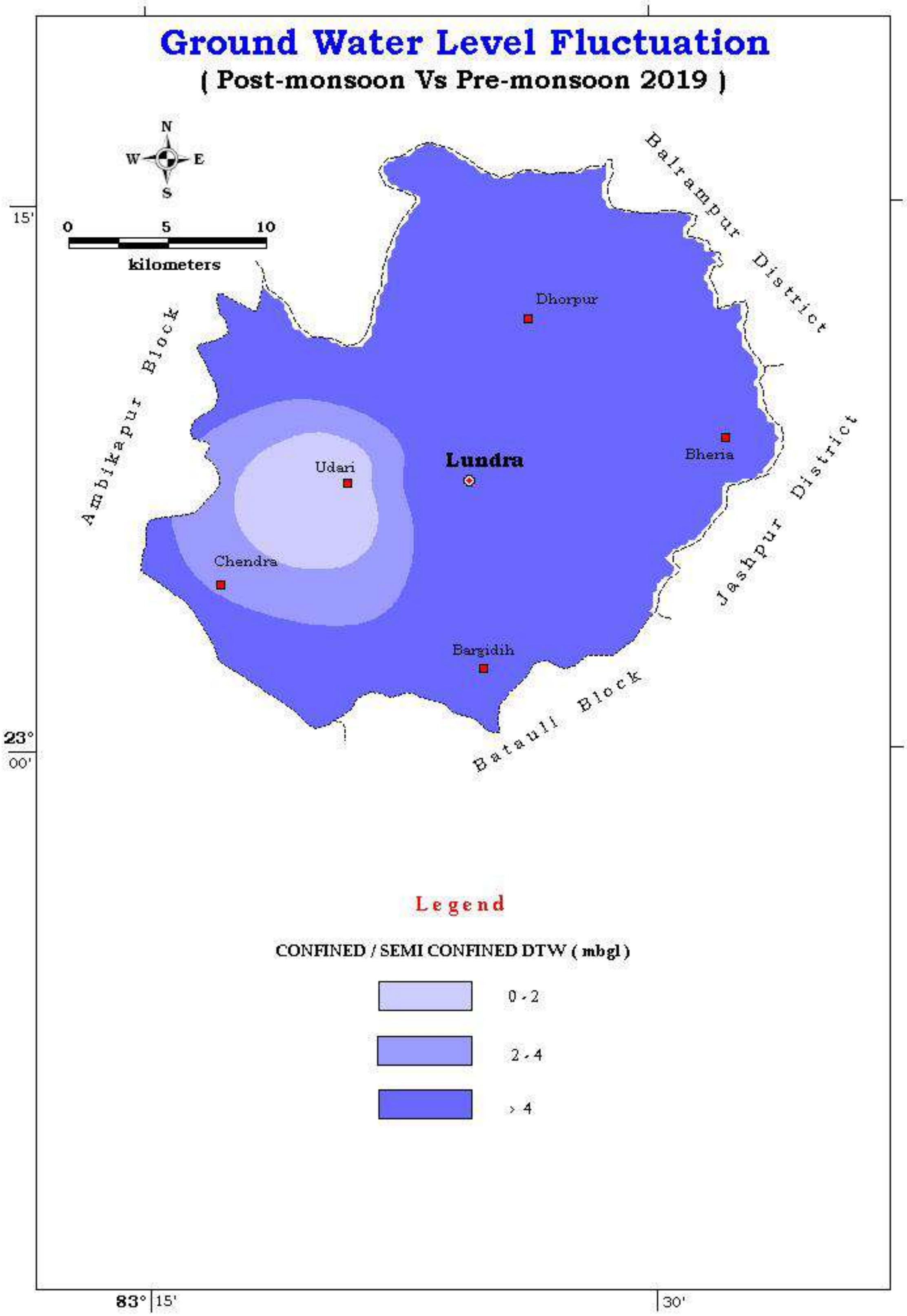


Figure 9 Depth to water level fluctuation map of Semiconfined Aquifer

(iv) The long term water level trend: There is no significant decline in water level in pre and post monsoon period in all observed NHS networks.

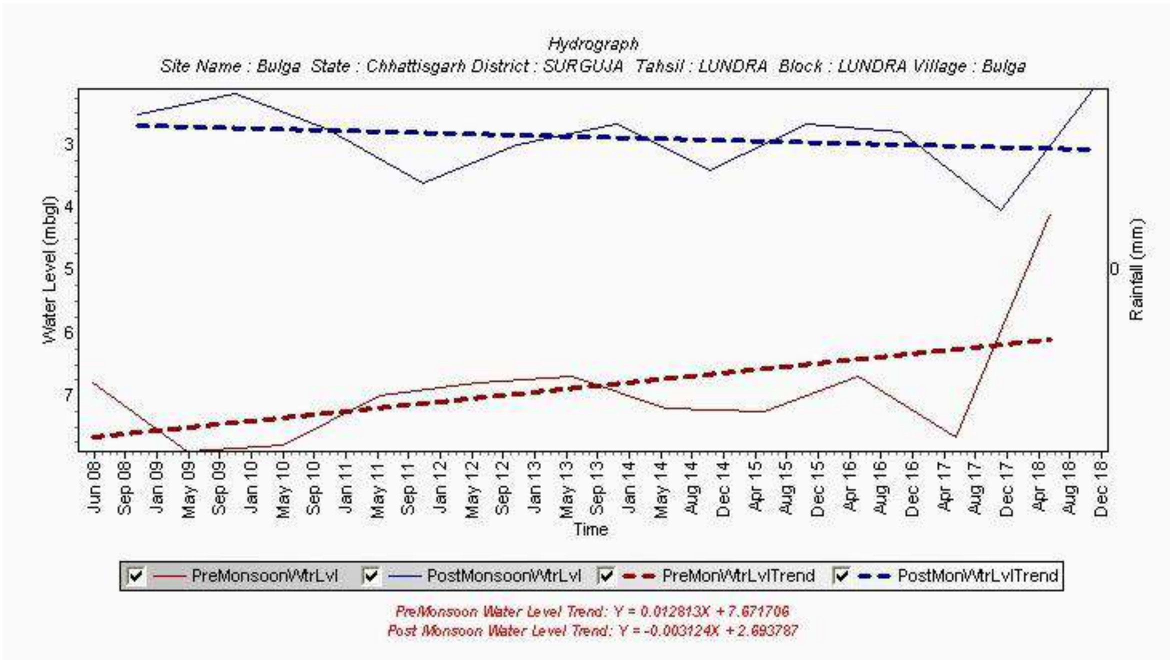


Figure 10 a: Hydrograph of Bulga Village, Lundra block

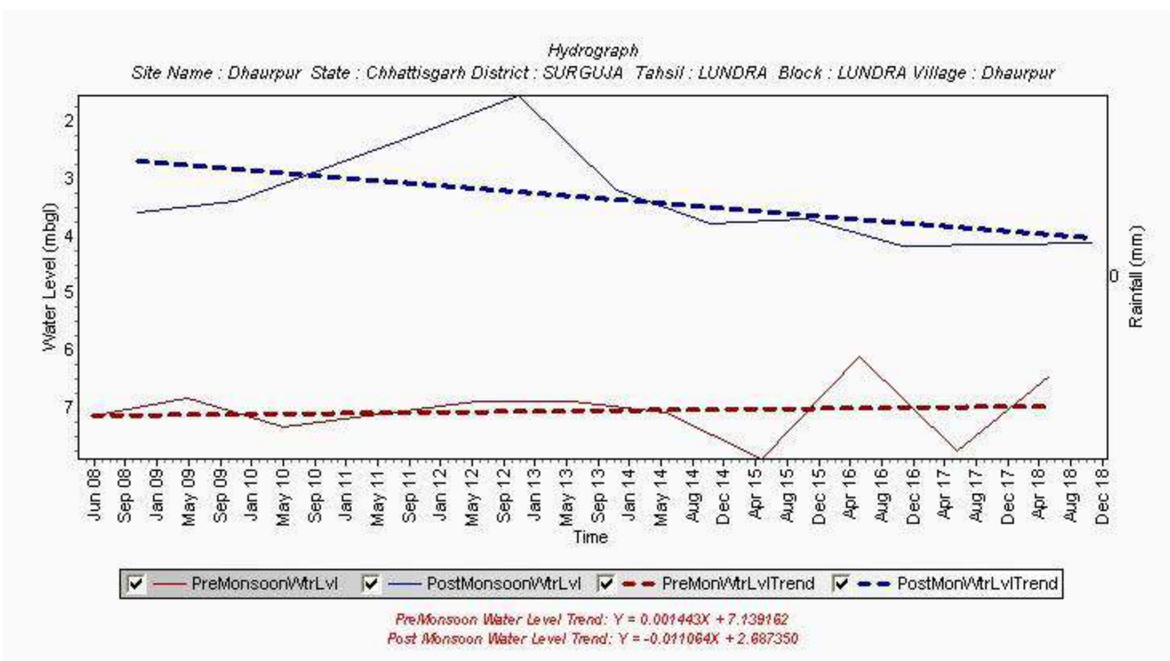


Figure 10 b: Hydrograph of Dhaurpur, Lundra block

2. Aquifer Disposition:

Number of Aquifers: There are two major aquifer system viz. Granite Aquifer system and Sandstone Aquifer system. Both the aquifer system has the shallow aquifer and deeper aquifer which occurs in phreatic and semiconfined condition respectively.

3-d aquifer disposition and basic characteristics of each aquifer:

Sandstone Aquifer System:

After studying the exploratory well details in Sandstone aquifer system, it has been envisaged that Gondwanas rock 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. 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.

The average thickness of the weathered portion is around 21 m. In general, the discharge varies from meagre to 12.5 lps with an average yield of 4.33 lps. The average drawdown of the formation is around 26 m. Rotary drilling technique is preferred in sandstone aquifer where well construction is required depending upon the water zone and formation encountered. Water zone has been encountered up to 200 meters. Transmissivity range observed is 3.74 to 159.1 sq. meter/day. Details of the aquifer characteristics and water zone encountered are shown in annexure.

Granite Aquifer System:

Groundwater occurrence is largely limited to secondary permeability, such as weathered zones, joints, fractures or faults. The potential of weathered zones depends on the degree and depth of weathering and associated fracturing, and the saturated thickness. The aquifers are generally discontinuous, and often confined. Higher yields are obtained where thick weathered zones are associated with bedrock fracturing.

The average thickness of the weathered portion in the area is around 20 m. In general, the discharge varies from meagre to 5.5 lps. The average drawdown of the formation is around 29 m. DTH drilling technique is preferred in Granite aquifer where well construction is required depending upon the thickness of weathered zone. Water zone has been encountered up to 158 mbgl in the formation. Transmissivity range observed is upto 18.72 sq meter/day.

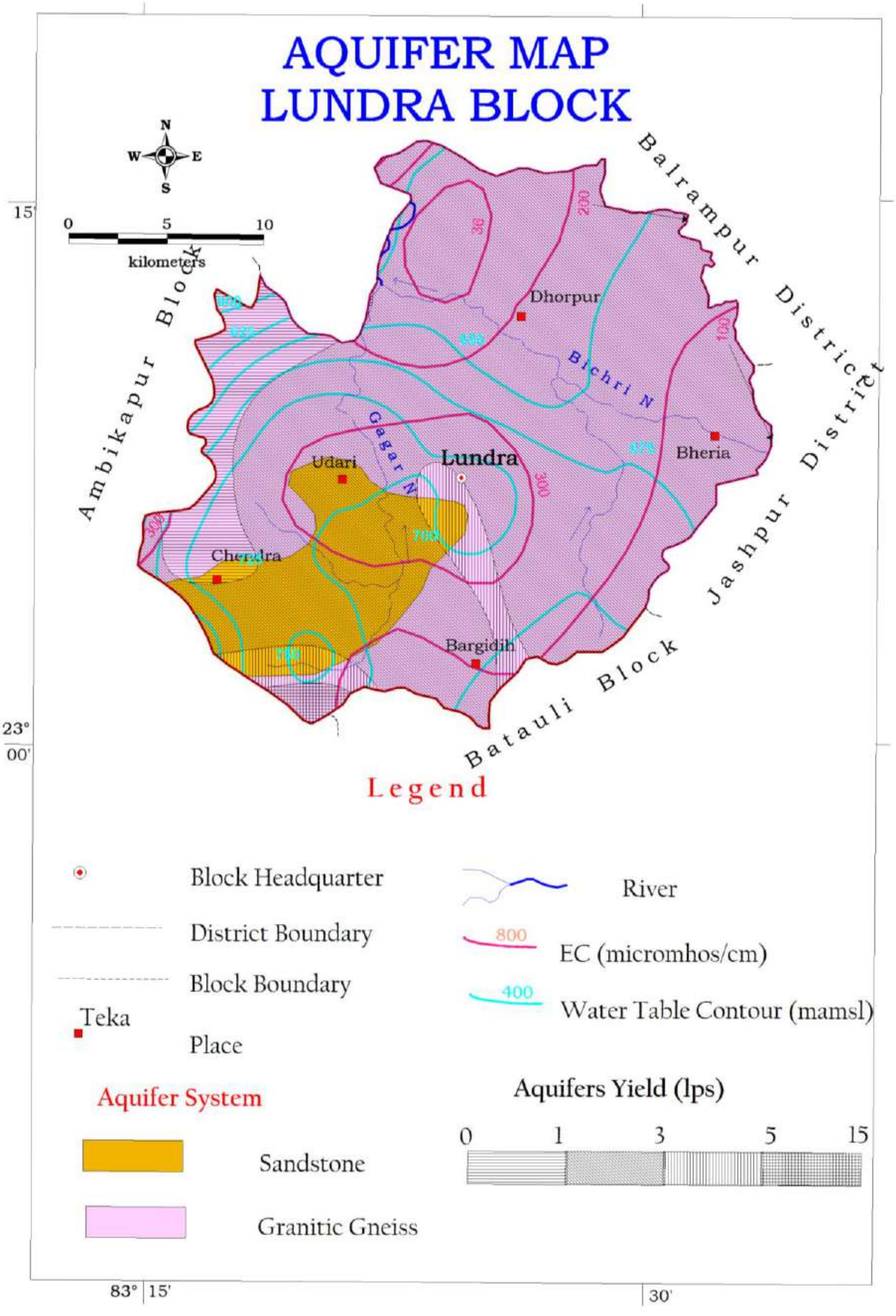


Figure 11: Aquifer map of Lundra block

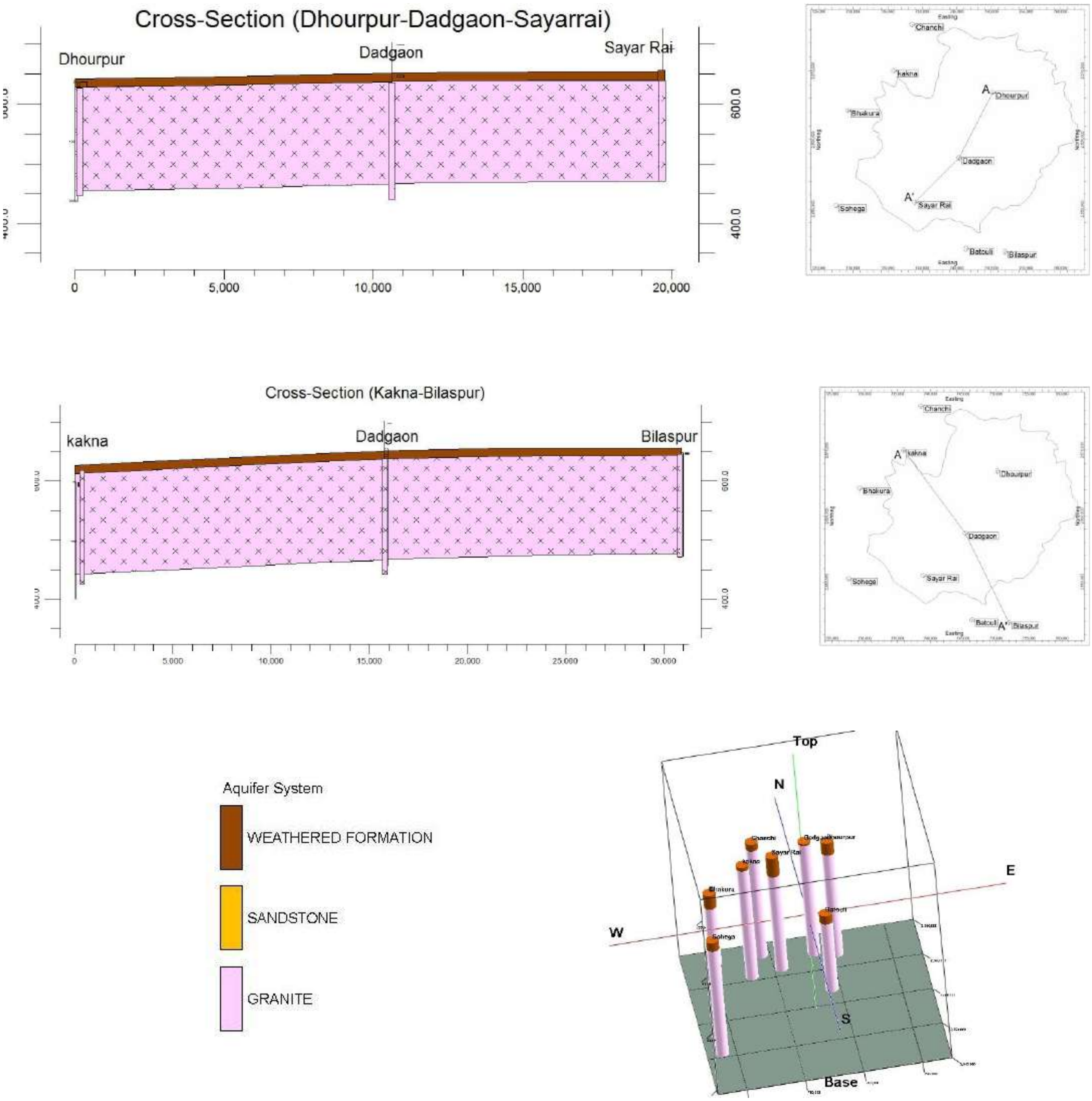


Figure-12, Disposition of Aquifer, Lundra Block

3. **Ground water Resource, extraction, contamination and other issues:**

Resource availability of Lundra block is given in the table -4 where net ground water availability for future use is 4297.91 ham. The extraction details and the future scenario (2025) along with the categorisation are also depicted in the table-4.

Table 7 Categorization of Assessment Unit

District	Block	Stage of Ground water development (%)	Categorisation
Lundra	Lundra	32.58	Safe

Categorisation: Lundra block falls in safe category. The stage of Ground water development is 32.58 %. The Annual Extractable Ground Water Recharge is 6431.33 ham. The Ground water draft for all uses is 2095.11 Ham.

Chemical Quality of Ground water and Contamination**:** Throughout the study area, the water samples from both dugwell and handpumps were collected and chemical analysis has been completed (Annexure I). Several villages have Iron and Flouride concentration more than permissible limit. Overall ground water of the study area is suitable for the drinking, agriculture and industrial purpose. In Lundra at 25 villages Fluoride contamination and at 52 villages Iron contamination reported. (Source: https://ejalshakti.gov.in/IMISReports/MIS.html)

4. **Ground Water Resource enhancement:**

Aquifer wise space available for recharge and proposed interventions:

Table -8: Summarised detail of Volume of porous space available for recharge (Aquifer wise)

Major Aquifer	Area Identified for Artificial Recharge (Sq. Km)	Sp. Yield for the formation	Volume of vadose zone available for recharge(mcm)	Sub surface storage potential (mcm)
Granite gneiss	215.17	0.02	358	7.159

5. Issues:

(i) During summer, dugwells in villages becomes dry at many locations. Several handpumps also stop yielding water. The aquifer itself is a low yielding one.

(ii) In Granite aquifer system potential zone for ground water is related with occurrence of fracture, so drilling a high yield well is always a challenge. Proper scientific study coupled with geophysical investigation may minimize the failure of well.

(iii) Problems in Tube well / Bore well construction in Sandstone Aquifer System: In case of filter point wells drilled with hand bores, the depth of penetration is variable and whenever the Shale or any other compact layers are encountered, further drilling becomes difficult. When portable rotary rigs are deployed for drilling, the drilling operations become very slow and the pore spaces in fine grained layers are invaded by drilling fluid as a result the discharges tend to be poor. Proper well development is seldom carried out by private drillers and as a result fine sands get deposited in the bore. Sometimes caving of wells are commonly reported particularly when the top loss sand is cased and the bottom shales are drilled with down the hole hammer rig.

(iv) Problems in ring well construction Sandstone Aquifer System: The common problem is sand filling inside the rings during and after the lowering of rings, thereby practically eliminating the change of deepening of wells to tap more saturated column in summer months. The weep holes provided in the rings allow water with fine sands and gets filled up as and when sand removal is in progress thereby making it difficult for lowering of rings is highly saturated sands.

(v) High value of Fluoride and Iron has been reported from several locations.

6. Management Plan:

(i) It has been observed during fieldwork, there is colossal wastage of groundwater through private well and public water supply system. So, Information, Education and Communication (IEC) activities need to be organized to sensitize people on the issues of depleting groundwater resource. Massive awareness campaigns are essential to aware people about the importance of community participation in saving water.

(ii) Desiltation of existing Tanks and Talabs to be carried out for efficient storage of rainwater. Also Rain water harvesting structures may be constructed in villages to reduce stress on groundwater.

(iii) It has been observed that the demand of ground water is increasing for irrigation, industrial and domestic uses. At locations where water level is declining, we have to go for artificial recharge on a long-term sustainability basis. Artificial Recharge structures may be constructed at suitable locations especially in the areas where the water level remains more than 3m in the post-monsoon period in this block to arrest the huge non-committed run-off and augment the ground water storage in the area. The different types of artificial structures feasible in the block are described in table-9.

Table-9: Types of Artificial Recharge structures feasible

Name of Block	Area Feasible for recharge (sq.km)	Volume of Sub Surface Potential for Artificial recharge (MCM)	Types of Structures Feasible and their Numbers			
			Percolation tank	Nalas bunding cement plug/ check dam	Gravity head /Dug well/ tube well/Recharge shaft	Gully plugs Gabion structures
Lundra	215.17	7.325	21	26	176	60
	Recharge Capacity (MCM)/structure		0.2192	0.0326	0.00816	0.0073

(iv) Fluoride and Iron filter plant may be installed in the villages having higher value of contaminants.

(v) Treatment of sewage water in village through soak pit for the individual houses and Seechewal model or similar model for community level may be adopted to avoid contamination of ground water. Treated water may also be reused for irrigation and other industrial purposes.

(vi) Since the stage of development in the block is 32.58 %. There is scope of utilizing more ground water for future irrigation purpose. Additional number of Ground water abstraction structure may be developed for the effective utilization of ground water resources in the block. The ground water is presently developed through dug wells and tube wells. Yield potential for the block has been shown in Aquifer map (fig 11). Sites for wells need to be selected only after proper scientific investigation. The ground water quality also needs to be ascertained and the wells used for water supply should be first checked for Iron, Fluoride and other pollutants.

Table 10: Potential of Additional GW abstraction structure creation

Net Groundwater availability (ham)	Stage of ground water Developm ent (%)	Present ground water draft (Ham)	Ground water draft at 70% stage of developmen t (ham)	Surplus ground water at present Stage of Development (ham)	Number of TW Recommended in each block (Assuming unit draft as 1.6 ham/structure/year)	Number of DW Recommended in each block (Assuming unit draft as 0.72 ham/structure/year)
6431.33	32.58	2095.11	4501.93	2406.82	903	1337

7. Conclusion:

For effective utilization of Ground water existing draft for irrigation may be coupled with micro irrigation system. Change in irrigation pattern, optimum use of available resource, use of ground water potential created after artificial recharge can lead to groundwater savings and increase in gross cropped area of the block (Table: 11).

Table 11: Detail of groundwater saved through change in cropping pattern and other interventions

Block	Existing Gross Ground Water Draft for Irrigation in Ham	Additional Saving of GW after using Micro Irrigation methods in Ham (Assuming 30 % saving)	GW Potential created after Artificial recharge structure in Ham	Development by new GW abstraction structure	Additional GW irrigation Potential created in Ham	Additional Irrigation potential creation for Maize/ wheat in winter season in Ha (Assuming 500 mm water requirement)	Percent increase in Crop area compare to Gross cropped area
Lundra	1804.00	541.20	732.50	2406.82	3663.88	7327.75	22.21%

AQUIFER MAPPING AND MANAGEMENT PLAN FOR MAINPAT BLOCK (SURGUJA DISTRICT), CHHATTISGARH

CONTENTS

AQUIFER MAP AND MANAGEMENT PLAN: MAINPAT BLOCK

1. Salient Information:

About the area: Mainpat Block is situated on the southern part of Surguja district of Chhattisgarh and is bounded in the west by Lakhanpur and Ambikapur Blocks, in the east by Sitapur Block, in the north by Batauli Block and in the south by Raigarh district. The block area lies between 22.64 and 22.96 N latitudes and 83.15 and 83.49 E longitudes. The geographical extension of the study area is 671.79 sq. km representing around 12.94 % of the district's geographical area. Administrative map of the block is shown in Fig. 1. Geomorphologically blocks comprises of region of plateau except south western part comprises of pediment. Geomorphology map is shown in Figure 2. The major drainage of the block includes Manchari and Gunghuta River, all of which are parts of Mahanadi basin. Drainage map shown in Fig. 3.

Population: The total population of Mainpat block as per 2011 Census is 76573. The population break up i.e. male- female and rural- urban is given below -

Table- 1: Population Break Up

Block	Total population	Male	Female	Rural population	Urban population
Mainpat	76573	38703	37870	76573	-

Source: CG Census, 2011

Growth rate: The decadal growth rate of the block is 16.48 as per 2011 census.

Rainfall: The study area receives rainfall mainly from south-west monsoon. About 87% of the annual rainfall is received during June to September and July and August are the months of maximum precipitation. The area gets some rainfall during winter season also. Average annual rainfall in the study area is (Average of the last five years i.e. 2013 to 2017) 998 mm with 70 to 80 rainy days.

Table-2: Rainfall data in Mainpat block in mm

Year	2013	2014	2015	2016	2017
Annual rainfall	1301.9	1041.0	914.3	913.2	819.8

Source: IMD

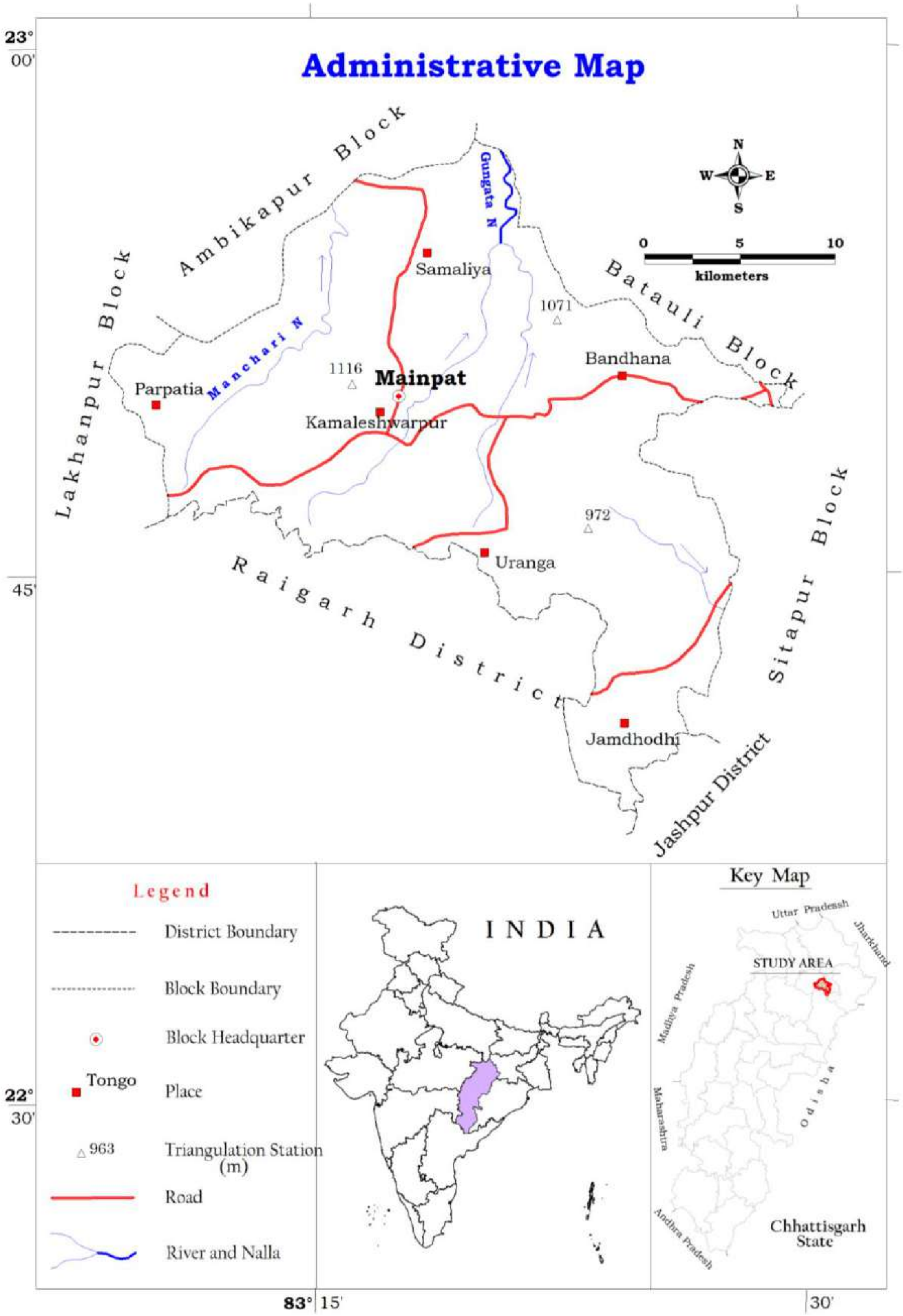


Figure 1 Administrative Map of Mainpat Block

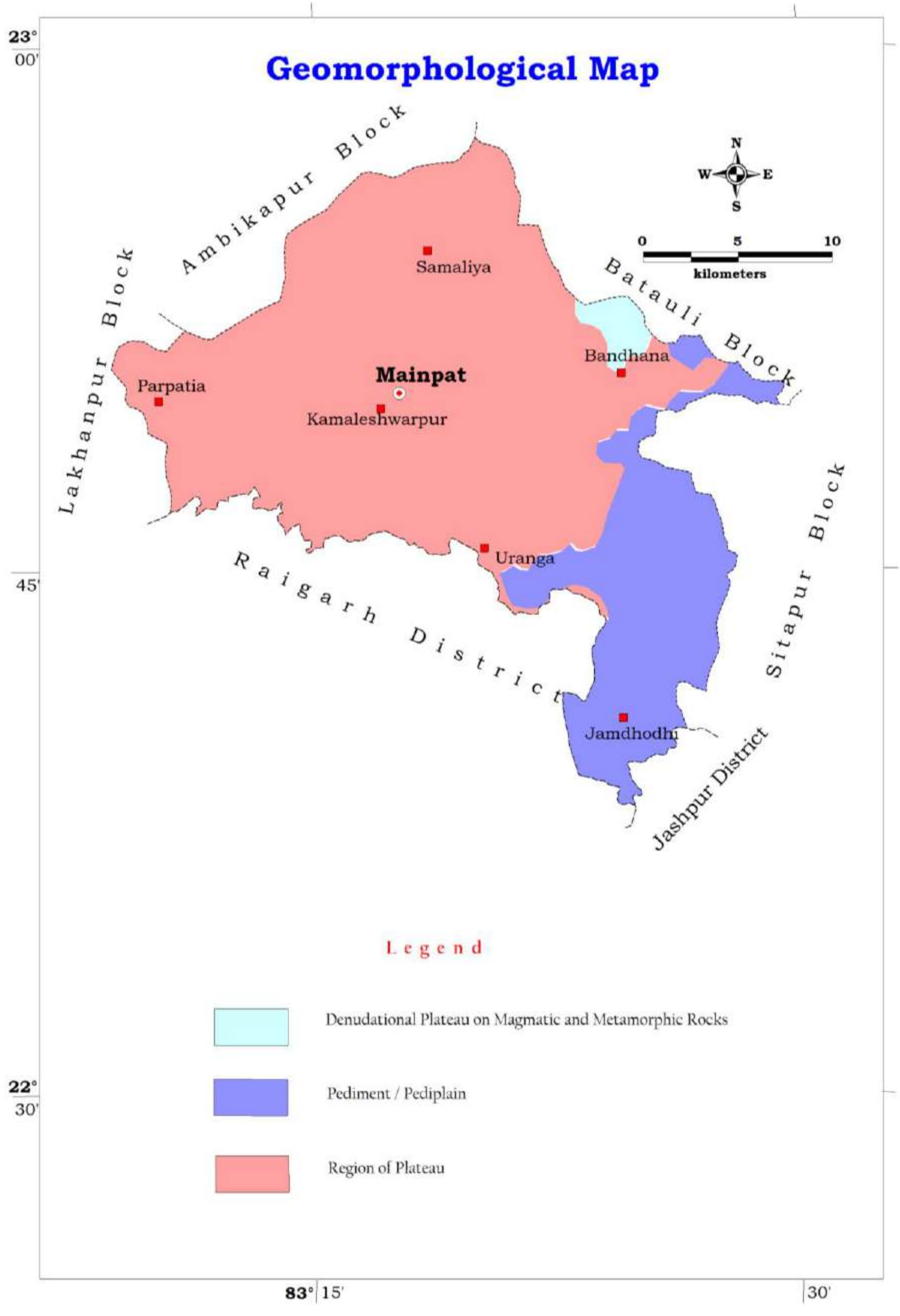


Figure 2 Geomorphology Map of Mainpat Block

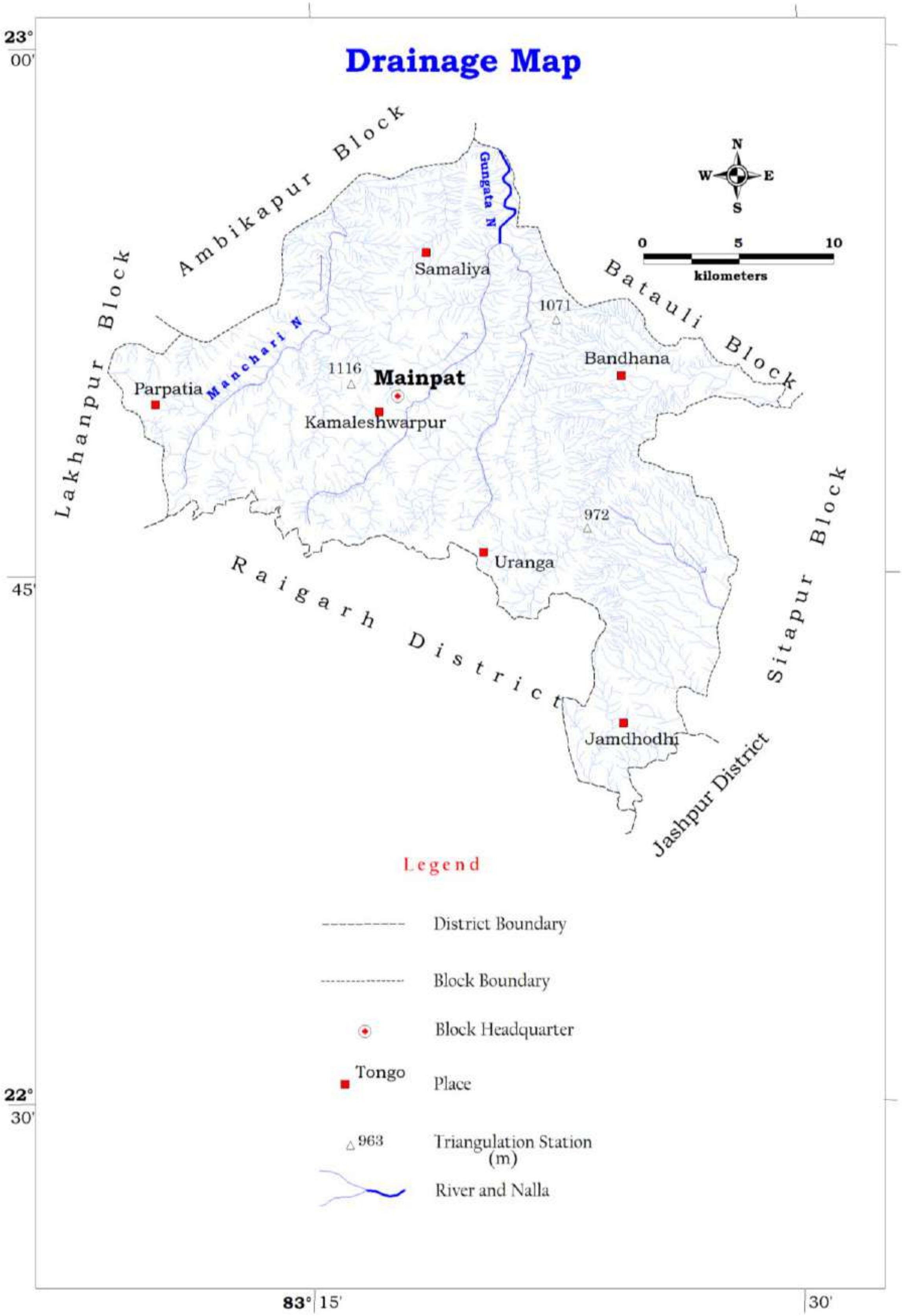


Figure 3 Drainage Map of Mainpat Block

Agriculture and Irrigation: Agriculture is practiced in the area during Kharif and Rabi season every year. During the Kharif, cultivation is done through rainfall while during the Rabi season; it is done through ground water as well as partly through surface water like canals and other sources. The groundwater abstraction structures are generally Dugwells, Borewells /tubewells. The principal crops in the block are Paddy, Wheat, Vegetables and pulses.

In some areas, double cropping is also practiced. The agricultural pattern, cropping pattern and area irrigated data of Mainpat block is given in Table 3 (A, B, C, D, and E).

Table 3 (A): Land use and Agricultural pattern (in ha)

Total geographical area	Forest area	Area not available for cultivation	Nonagricultural & Fallow land	Agricultural Fallow land	Net sown area	Double cropped area	Gross cropped area
67179	22521.4	2533	8300	2458	17629	1652	19281

Table 3 (C): Cropping pattern (in ha)

Kharif	Rabi	Cereal				Pulses	Tilhan	Fruits and Vegetables	Sugarcane	Mirch Masala
		Wheat	Rice	Jowar & Maize	Medo					
17643	1638	286	12084	989	1765	702	2515	763	106	51

Table 3 (D): Area irrigated by various sources (in ha)

No. of canals (private and Govt.)	Irrigated area	No. of bore wells/ Tube wells	Irrigated area	No. of dug wells	Irrigated area	No. of Talabs	Irrigated area	Irrigated area by other sources	Net Irrigated area	Gross irrigated area	% of irrigated area wrt. Net sown area
2	386	49	8	11	36	10	12	30	472	524	2.65

Table 3 (E): Statistics showing Irrigation by Ground water

Block	Net Irrigated Area	Net Irrigated Area by ground water	Percentage of Area Irrigated by ground water wrt. Net Irrigated Area
Mainpat	472	45	9.5

Groundwater Resource Availability and Extraction: Based on the resource assessment made, the resource availability in aquifer wise in Mainpat block is given in the table-4.

Table – 4 (A): Ground Water Budget of Mainpat block in Ham

Assessment Unit Name	Ground Water Recharge(Ham)				Total Annual Ground Water (Ham) Recharge	Total Natural Discharges (Ham)
	Monsoon Season		Non-monsoon season			
	Recharge from Rainfall	Recharge from Other Sources	Recharge from Rainfall	Recharge from Other Sources		
Mainpat	2525.08	51.72	290.43	127.75	2994.98	299.50

Table – 4 (B): Ground Water Dynamic Resource (Unconfined Aquifer) of Mainpat block in Ham

Annual Extractable Ground Water Recharge (Ham)	Current Annual Ground Water Extraction (Ham)				Annual GW Allocation for Domestic Use as on 2025	Net Ground Water Availability for future use	Stage of Ground Water Extraction (%)	Categorization (OE/Critical/ Semicritical/ Safe)
	Irrigation Use	Industrial Use	Domestic Use	Total Extraction				
2695.48	543.67	0.00	184.27	727.94	206.38	1945.43	27.01	Safe

Table – 4 (C): Ground Water Static Resource (Unconfined Aquifer) and Dynamic Resource (Confined Aquifer) of Mainpat block in Ham

Static Resources Area (Ha)	Difference Piezometric Head (Pre-post) m	Storativity (S)	Dynamic Ground Water Resource of Confined Aquifer (Ham)	Bottom level of the top confining layer (m)	In storage Ground Water Resource of Unconfined Aquifer (Ham)	Sum of Dynamic GW (Confined Aquifer) and In storage GW (Unconfined Aquifer) resource (Ham)
67632	6.4	0.000246	112.63	200	12326.67	12439.31

Existing and Future Water Demand (2025)*:* The existing draft for irrigation in the area is 543.67 Ham while the total extraction for all uses is 727.94 Ham. At present scenario to meet the future demand for water, a total quantity of 1945.43ham of ground water is available for future use.

Water Level Behavior: (i) Pre- monsoon water level: In the pre-monsoon period, it has been observed that in Mainpat block, water level in dugwells (phreatic aquifer) varies between 3.30 to 16.60 mbgl with average water level of 7.87 mbgl. In semiconfined aquifer, the maximum water level is 17.86 mbgl; the average water level is 14.46 mbgl.

Table 5A: Phreatic aquifer Depth to Water Level in mbgl (Pre-monsoon)

Block Name	Phreatic Aquifer		
	Min	Max	Avg
Mainpat	3.30	16.60	7.87

Table 5B: Semiconfined Aquifer Depth to Water Level in mbgl (Pre-monsoon)

Block Name	Semiconfined Aquifer		
	Min	Max	Avg
Mainpat	12.15	17.86	14.46

(ii) Post- monsoon water level**:** In the post-monsoon period, it has been observed that the water level varies from 1.40 to 10.40 mbgl with an average of 4.16 mbgl in phreatic aquifer. In semiconfined/fractured formation, the post monsoon water level variation range is 4.36 to 12.26 mbgl with average of 7.64 mbgl.

Table 5C: Phreatic Aquifer Depth to Water Level in mbgl (Post-monsoon)

Block Name	Phreatic Aquifer		
	Min	Max	Avg
Mainpat	1.40	10.40	4.16

Table 5D: Semiconfined Aquifer Depth to Water Level in mbgl (Post-monsoon)

Block Name	Semiconfined Aquifer		
	Min	Max	Avg
Mainpat	4.36	12.26	7.64

(iii) Seasonal water level fluctuation: The water level fluctuation data indicates that in Mainpat block, water level fluctuation in phreatic aquifer varies from 1.10 to 13.95 m with an average fluctuation of 3.71 m. Water level fluctuation in semiconfined Aquifer varies from 3.74 to 10.39 m with an average fluctuation of 6.82 m.

Table 5E: Phreatic Aquifer Depth to Water Level Fluctuation (meter)

Block Name	Phreatic Aquifer		
	Min	Max	Avg
Mainpat	1.10	13.95	3.71

Table 5F: Semiconfined Aquifer Depth to Water Level Fluctuation (meter)

Block Name	Semiconfined Aquifer		
	Min	Max	Avg
Mainpat	3.74	10.39	6.82

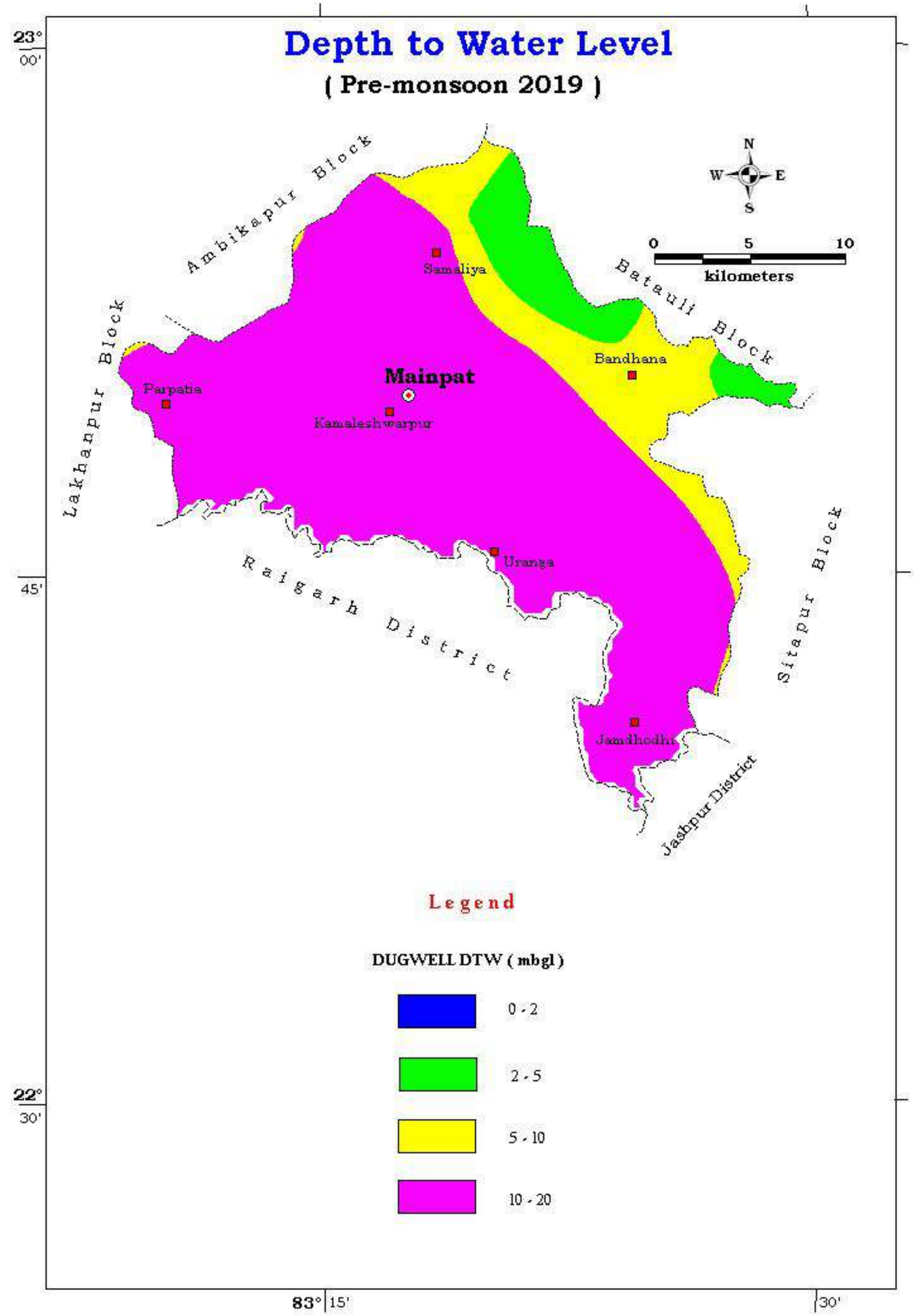


Figure 4 Depth to water level map Phreatic Aquifer (Pre-monsoon)

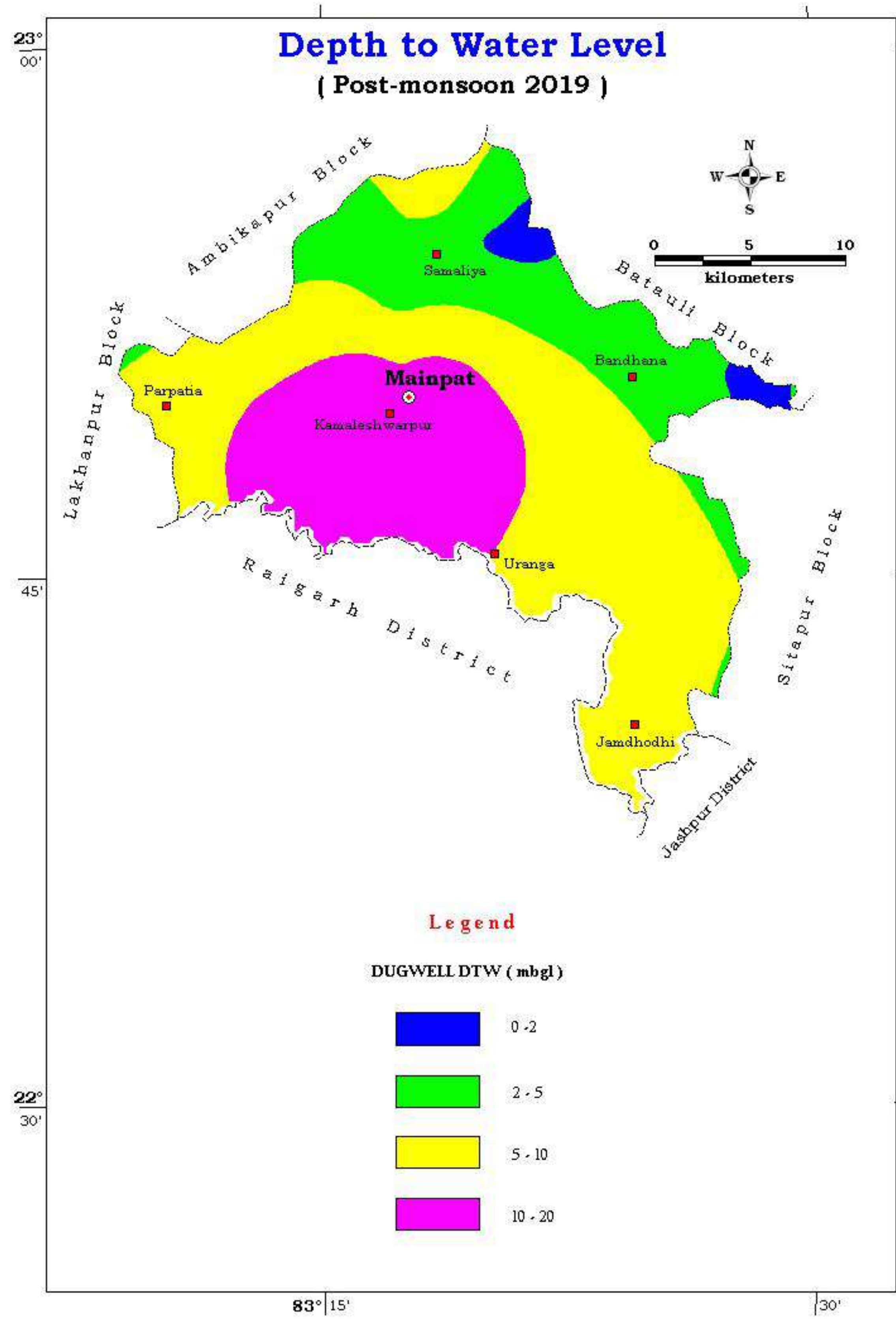


Figure 5 Depth to water level map Phreatic Aquifer (Post-monsoon)

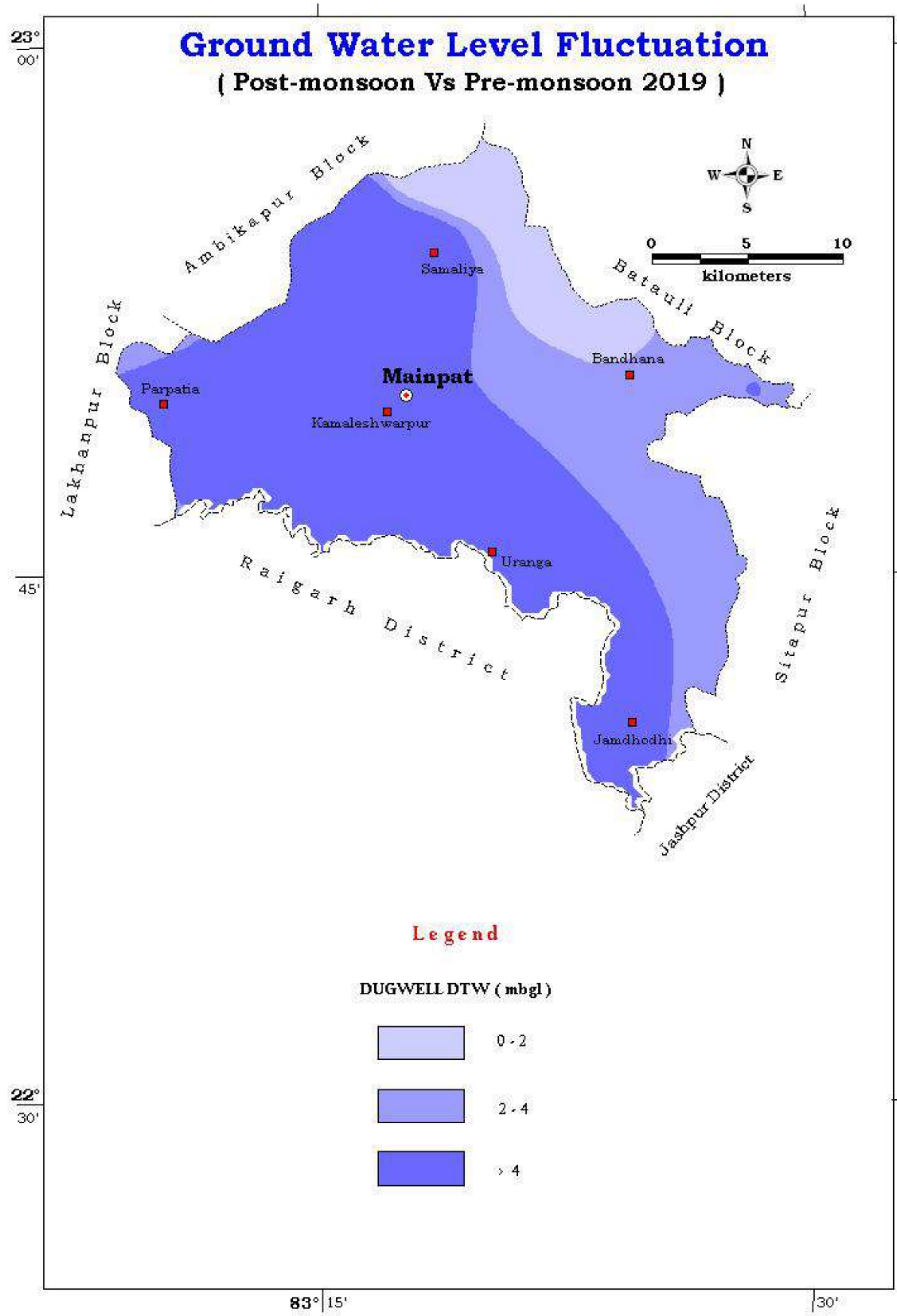


Figure 6 Depth to water level fluctuation map of Phreatic Aquifer

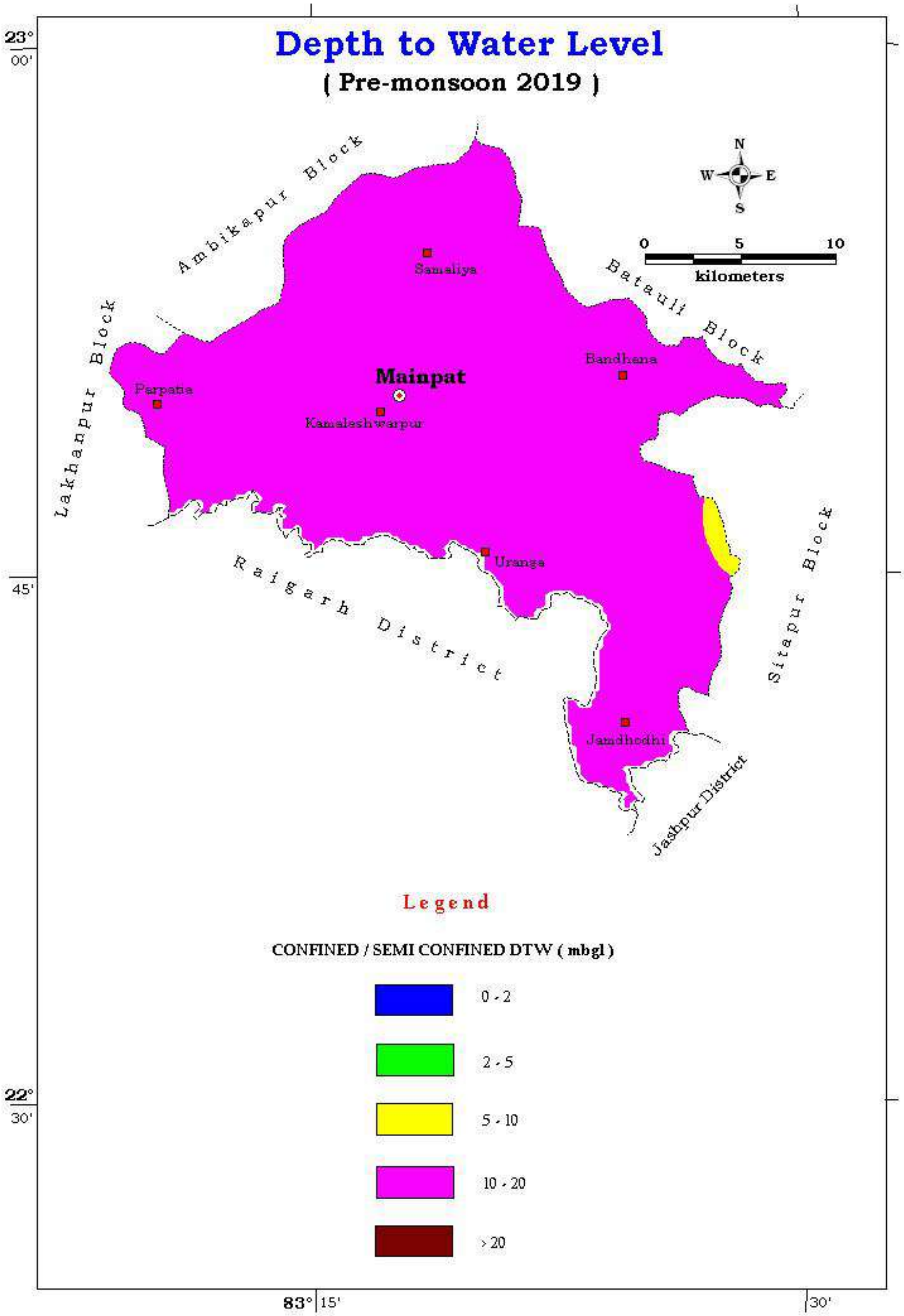
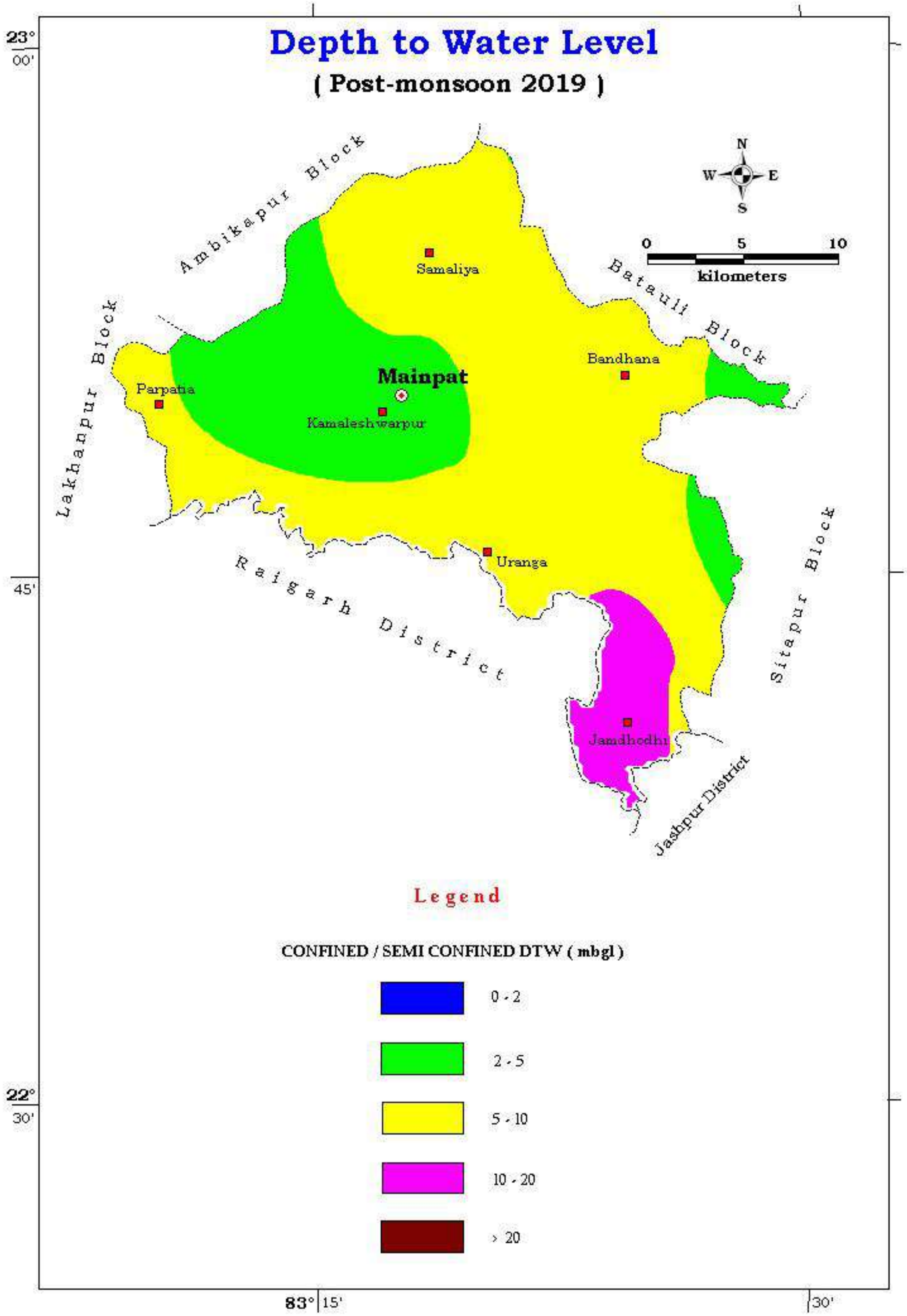


Figure 7 Depth to water level map Semiconfined Aquifer (Pre-monsoon)



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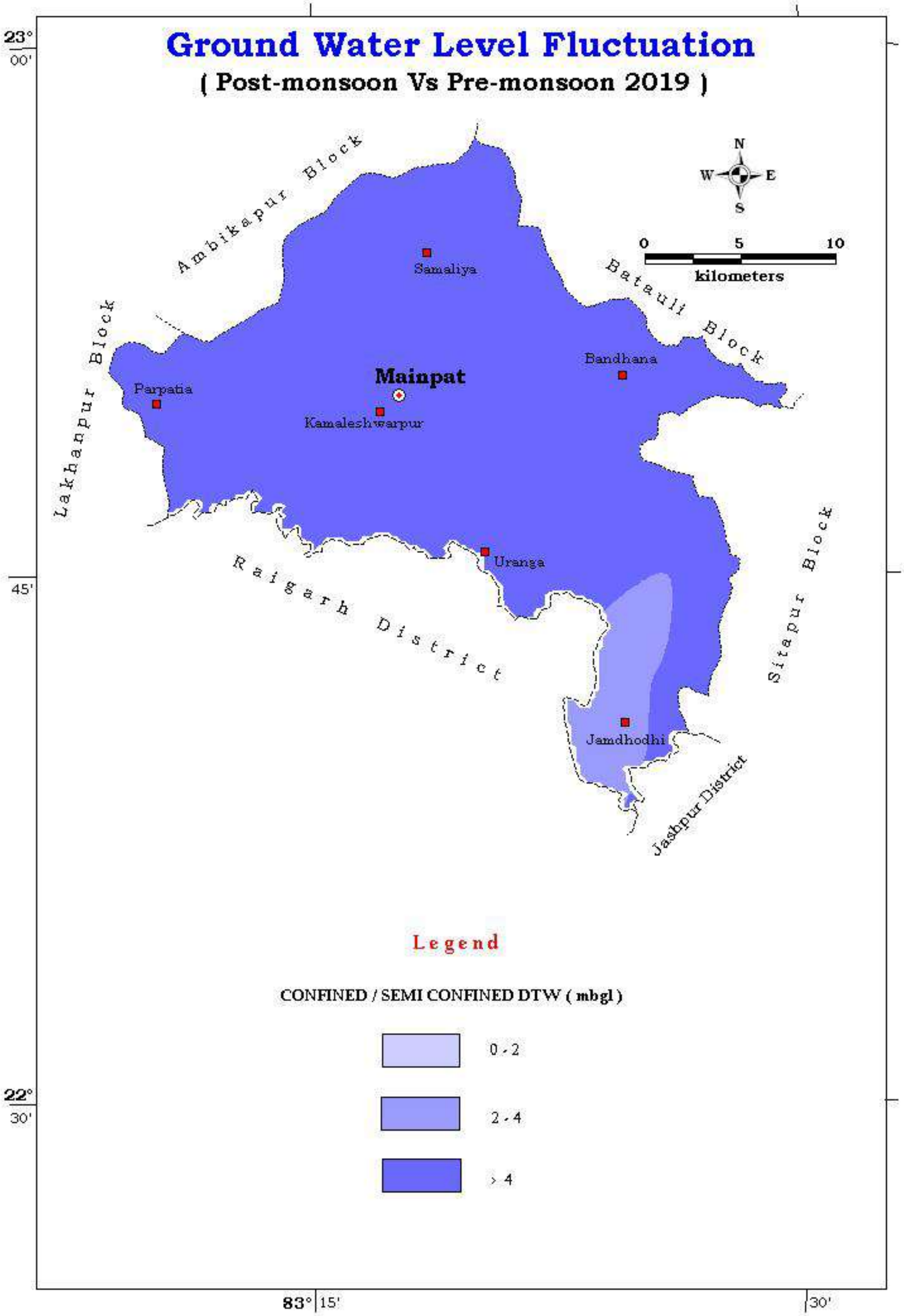

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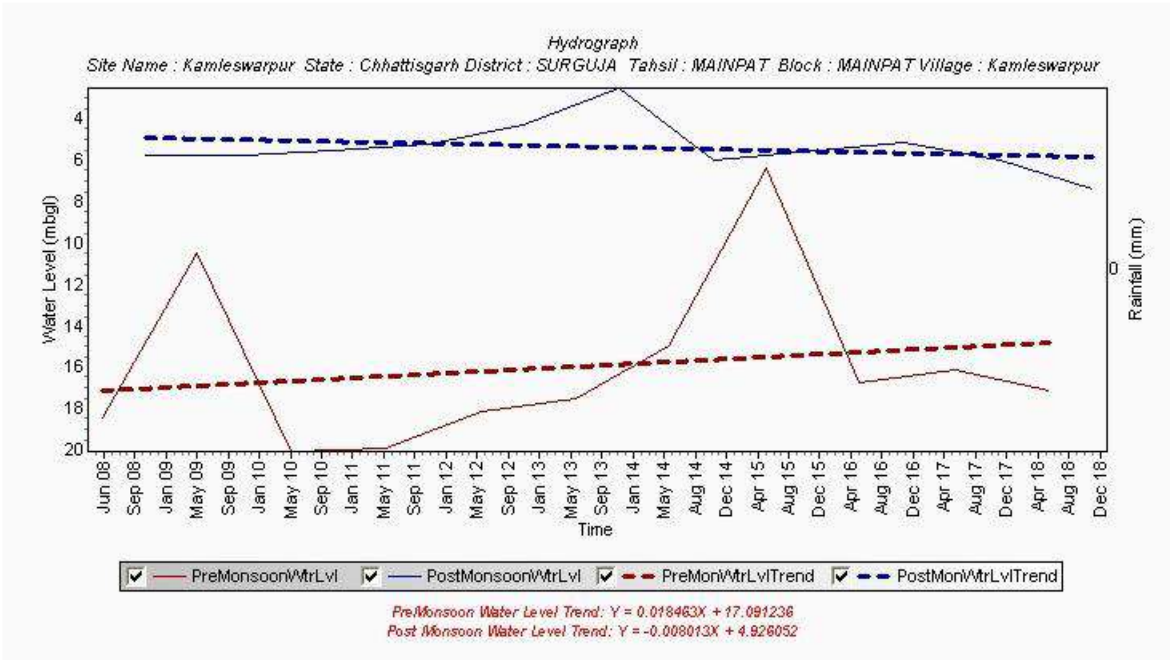

Figure 10 a: Hydrograph of Kamleshwarpur Village, Mainpat block

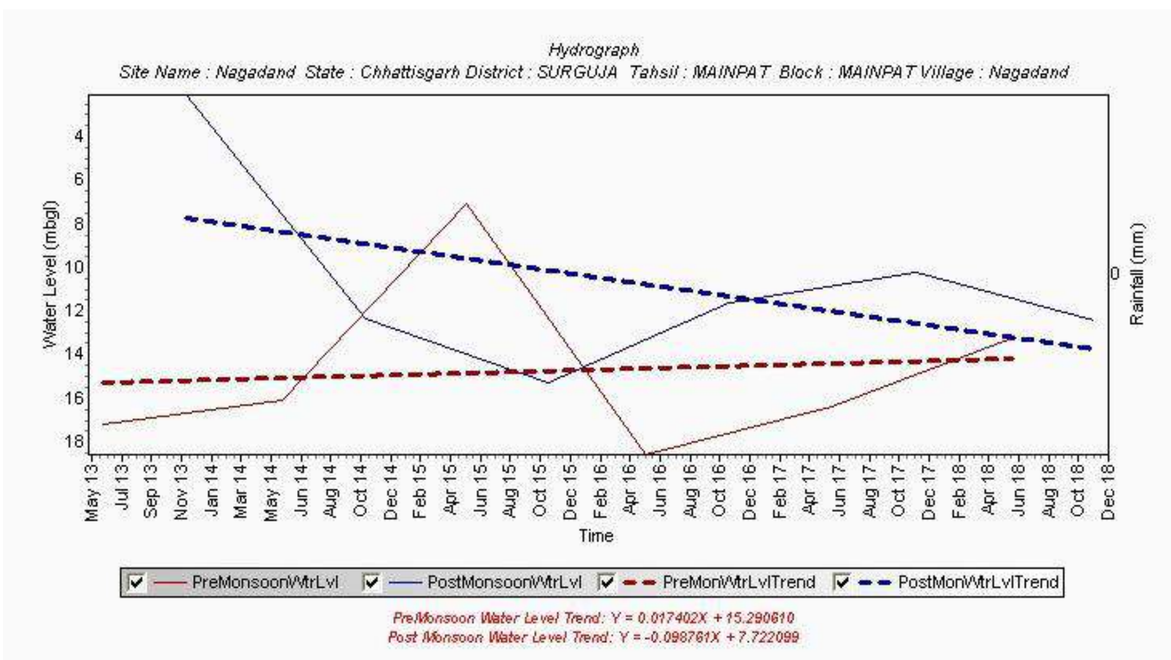

Figure 10 b: Hydrograph of Nagadand Village, Mainpat block

2. Aquifer Disposition:

Number of Aquifers: There are three major aquifer system viz. Granite Aquifer system, Sandstone Aquifer system and Basalt Aquifer system. All the aquifer system has the shallow aquifer and deeper aquifer which occurs in phreatic and semiconfined condition respectively.

3-d aquifer disposition and basic characteristics of each aquifer:

Granite Aquifer System:

Groundwater occurrence is largely limited to secondary permeability, such as weathered zones, joints, fractures or faults. The potential of weathered zones depends on the degree and depth of weathering and associated fracturing, and the saturated thickness. The aquifers are generally discontinuous, and often confined. Higher yields are obtained where thick weathered zones are associated with bedrock fracturing.

The average thickness of the weathered portion in the area is around 20 m. In general, the discharge varies from meagre to 5.5 lps. The average drawdown of the formation is around 29 m. DTH drilling technique is preferred in Granite aquifer where well construction is required depending upon the thickness of weathered zone. Water zone has been encountered up to 158 mbgl in the formation. Transmissivity range observed is upto 18.72 sq meter/day.

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After studying the exploratory well details in Sandstone aquifer system, it has been envisaged that Gondwanas rock 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. 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.

The average thickness of the weathered portion is around 21 m. In general, the discharge varies from meagre to 12.5 lps with an average yield of 4.33 lps. The average drawdown of the formation is around 26 m. Rotary drilling technique is preferred in sandstone aquifer where well construction is required depending upon the water zone and formation encountered. Water zone has been encountered up to 200 meters. Transmissivity range observed is 3.74 to 159.1 sq. meter/day.

Basalt Aquifer System:

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. 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 from1.5 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.

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.

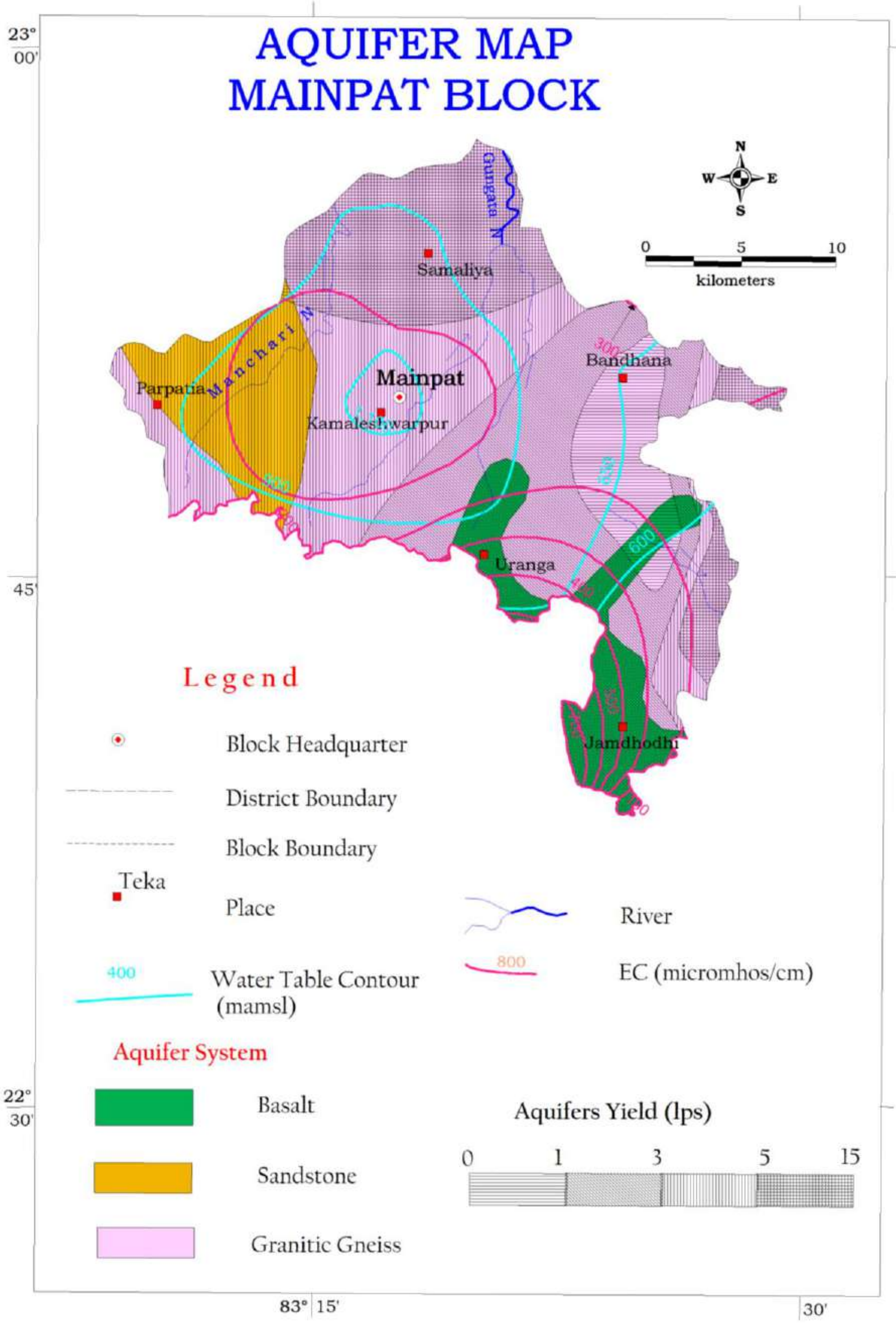

Figure 11: Aquifer map of Mainpat block

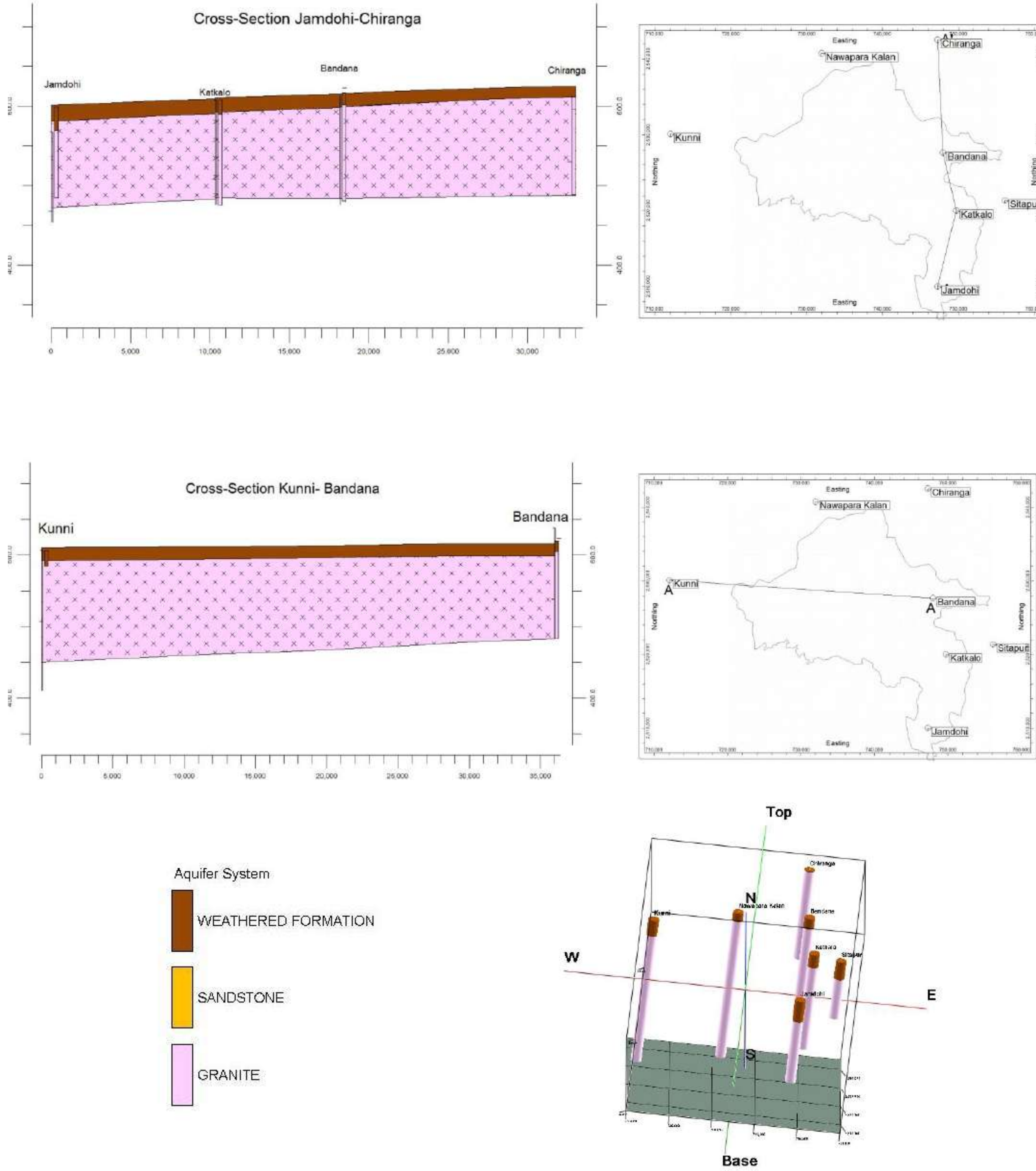

Figure-12, Disposition of Aquifer, Mainpat Block

3. Ground water Resource, extraction, contamination and other issues:

Resource availability of Mainpat block is given in the table -4 where net ground water availability for future use is 1945.43 ham. The extraction details and the future scenario (2025) along with the categorisation are also depicted in the table-4.

Table 7 Categorization of Assessment Unit

District	Block	Stage of Ground water development (%)	Categorisation
Mainpat	Mainpat	27.01	Safe

Categorisation: Mainpat block falls in safe category. The stage of Ground water development is 27.01 %. The Annual Extractable Ground Water Recharge is 2695.48 ham. The Ground water draft for all uses is 727.94 Ham.

Chemical Quality of Ground water and Contamination**:** Throughout the study area, the water samples from both dugwell and handpumps were collected and chemical analysis has been completed (Annexure I). Several villages have Iron and Flouride concentration more than permissible limit. Overall ground water of the study area is suitable for the drinking, agriculture and industrial purpose. In Mainpat at 18 villages Fluoride contamination and at 30 villages Iron contamination reported. (Source: https://ejalshakti.gov.in/IMISReports/MIS.html)

4. Ground Water Resource enhancement:

Aquifer wise space available for recharge and proposed interventions:

Table -8: Summarised detail of Volume of porous space available for recharge (Aquifer wise)

Major Aquifer	Area Identified for Artificial Recharge (Sq. Km)	Sp. Yield for the formation	Volume of vadose zone available for recharge(mcm)	Sub surface storage potential (mcm)
Basalt and Granite gneiss	113.32	0.013	405	5.260

5. Issues:

(i) During summer, dugwells in villages becomes dry at many locations. Several handpumps also stop yielding water. The aquifer itself is a low yielding one.

(ii) In Granite aquifer system potential zone for ground water is related with occurrence of fracture, so drilling a high yield well is always a challenge. Proper scientific study coupled with geophysical investigation may minimize the failure of well.

(iii) Problems in Tube well / Bore well construction in Sandstone Aquifer System: In case of filter point wells drilled with hand bores, the depth of penetration is variable and whenever the Shale or any other compact layers are encountered, further drilling becomes difficult. When portable rotary rigs are deployed for drilling, the drilling operations become very slow and the pore spaces in fine grained layers are invaded by drilling fluid as a result the discharges tend to be poor. Proper well development is seldom carried out by private drillers and as a result fine sands get deposited in the bore. Sometimes caving of wells are commonly reported particularly when the top loss sand is cased and the bottom shales are drilled with down the hole hammer rig.

(iv) Problems in ring well construction Sandstone Aquifer System: The common problem is sand filling inside the rings during and after the lowering of rings, thereby practically eliminating the change of deepening of wells to tap more saturated column in summer months. The weep holes provided in the rings allow water with fine sands and gets filled up as and when sand removal is in progress thereby making it difficult for lowering of rings is highly saturated sands.

(v) High value of Fluoride and Iron has been reported from several locations.

6. Management Plan:

(i) It has been observed during fieldwork, there is colossal wastage of groundwater through private well and public water supply system. So, Information, Education and Communication (IEC) activities need to be organized to sensitize people on the issues of depleting groundwater resource. Massive awareness campaigns are essential to aware people about the importance of community participation in saving water.

(ii) Desiltation of existing Tanks and Talabs to be carried out for efficient storage of rainwater. Also Rain water harvesting structures may be constructed in villages to reduce stress on groundwater.

(iii) It has been observed that the demand of ground water is increasing for irrigation, industrial and domestic uses. At locations where water level is declining, we have to go for artificial recharge on a long-term sustainability basis. Artificial Recharge structures may be constructed at suitable locations especially in the areas where the water level remains more than 3m in the post-monsoon period in this block to arrest the huge non-committed run-off and augment the ground water storage in the area. The different types of artificial structures feasible in the block are described in table-9.

Table-9: Types of Artificial Recharge structures feasible

Name of Block	Area Feasible for recharge (sq.km)	Volume of Sub Surface Potential for Artificial recharge (MCM)	Types of Structures Feasible and their Numbers			
			Percolation tank	Nalas bunding cement plug/ check dam	Gravity head /Dug well/ tube well/Recharge shaft	Gully plugs Gabion structures
Mainpat	113.32	5.897	16	26	130	66
	Recharge Capacity (MCM)/structure		0.2192	0.0326	0.00816	0.0073

(iv) Fluoride and Iron filter plant may be installed in the villages having higher value of contaminants.

(v) Treatment of sewage water in village through soak pit for the individual houses and Seechewal model or similar model for community level may be adopted to avoid contamination of ground water. Treated water may also be reused for irrigation and other industrial purposes.

(vi) Since the stage of development in the block is 27.01 %. There is scope of utilizing more ground water for future irrigation purpose. Additional number of Ground water abstraction structure may be developed for the effective utilization of ground water resources in the block. The ground water is presently developed through dug wells and tube wells. Yield potential for the block has been shown in Aquifer map (fig 11). Sites for wells need to be selected only after proper scientific investigation. The ground water quality also needs to be ascertained and the wells used for water supply should be first checked for Iron, Fluoride and other pollutants.

Table 10: Potential of Additional GW abstraction structure creation

Net Groundwater availability (ham)	Stage of ground water Development (%)	Present ground water draft (Ham)	Ground water draft at 70% stage of development (ham)	Surplus ground water at present Stage of Development (ham)	Number of TW Recommended in each block (Assuming unit draft as 1.6 ham/structure/year)	Number of DW Recommended in each block (Assuming unit draft as 0.72 ham/structure/year)
2695.48	27.01	727.94	1886.84	1158.90	435	644

7. **Conclusion:**

For effective utilization of Ground water existing draft for irrigation may be coupled with micro irrigation system. Change in irrigation pattern, optimum use of available resource, use of ground water potential created after artificial recharge can lead to groundwater savings and increase in gross cropped area of the block (Table: 11).

Table 11: Detail of groundwater saved through change in cropping pattern and other interventions

Block	Existing Gross Ground Water Draft for Irrigation in Ham	Additional Saving of GW after using Micro Irrigation methods in Ham(Assuming 30 % saving)	GW Potential created after Artificial recharge structure in Ham	Development by new GW abstraction structure	Additional GW irrigation Potential created in Ham	Additional Irrigation potential creation for Maize/ wheat in winter season in Ha (Assuming 500 mm water requirement)	Percent increase in Crop area compare to Gross cropped area
Mainpat	543.67	163.10	589.74	1158.90	1847.95	3695.89	19.17%

AQUIFER MAPPING AND MANAGEMENT PLAN FOR SITAPUR BLOCK (SURGUJA DISTRICT), CHHATTISGARH

CONTENTS

AQUIFER MAP AND MANAGEMENT PLAN: SITAPUR BLOCK

1. Salient Information:

About the area: Sitapur Block is situated on the southern part of Surguja district of Chhattisgarh and is bounded in the north by Batauli block, in west by Mainpat Block, in the east and south by Jashpur district. The block area lies between 22.62 and 22.90 N latitudes and 83.42 and 83.69 E longitudes. The geographical extension of the study area is 500.99 sq. km representing around 9.65 % of the district's geographical area. Administrative map of the block is shown in Fig. 1. Geomorphologically blocks comprises of Pediments except in north eastern part having denudational hills and valleys on Proterozoic rocks. Geomorphology map is shown in Figure 2. The major drainage of the block includes Mand and Maini River all of which are parts of Mahanadi Basin. Drainage map shown in Fig. 3.

Population: The total population of Sitapur block as per 2011 Census is 96131 out of which rural population is 86770 while the urban population is 9361.The population break up i.e. male- female and rural- urban is given below -

Table- 1: Population Break Up

Block	Total population	Male	Female	Rural population	Urban population
Sitapur	96131	47843	48288	86770	9361

Source: CG Census, 2011

Growth rate: The decadal growth rate of the block is 13.35 as per 2011 census.

Rainfall: The study area receives rainfall mainly from south-west monsoon. About 87% of the annual rainfall is received during June to September and July and August are the months of maximum precipitation. The area gets some rainfall during winter season also. Average annual rainfall in the study area is (Average of the last five years i.e. 2013 to 2017) 1141.62 mm with 70 to 80 rainy days.

Table-2: Rainfall data in Sitapur block in mm

Year	2013	2014	2015	2016	2017
Annual rainfall	1262.3	914.6	1099.4	1270.7	1161.1

Source: IMD

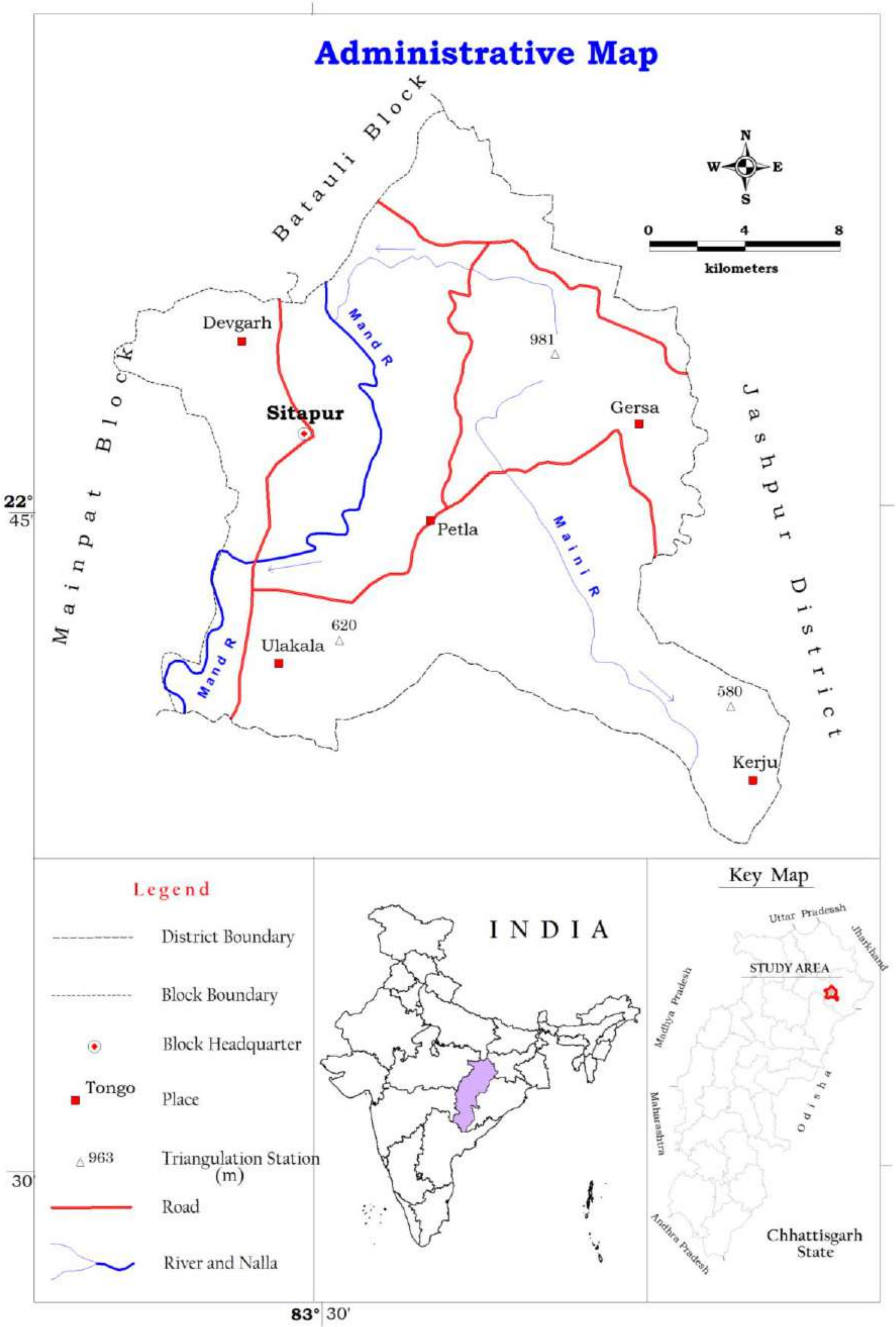

Figure 1 Administrative Map of Sitapur Block

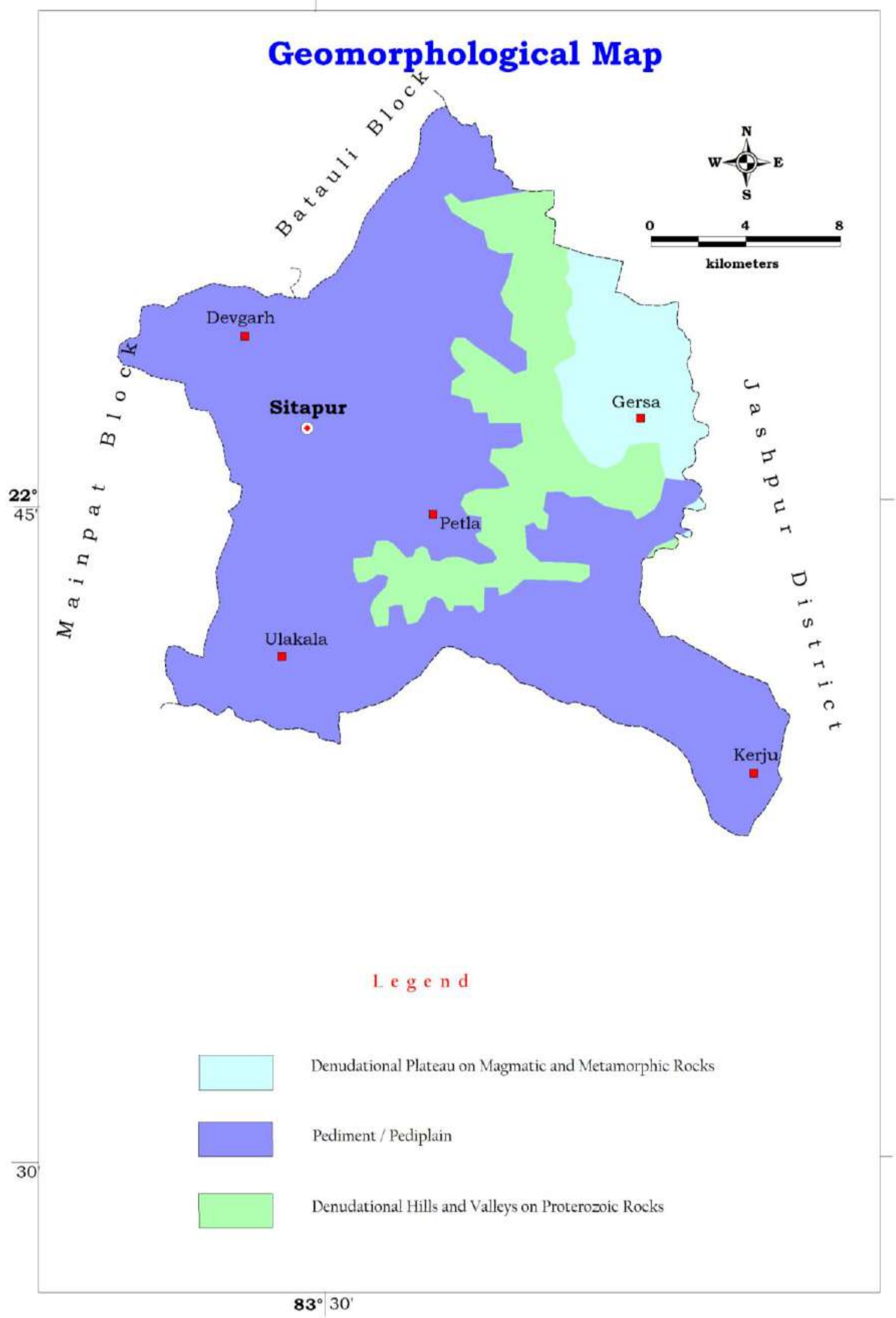

Figure 2 Geomorphology Map of Sitapur Block

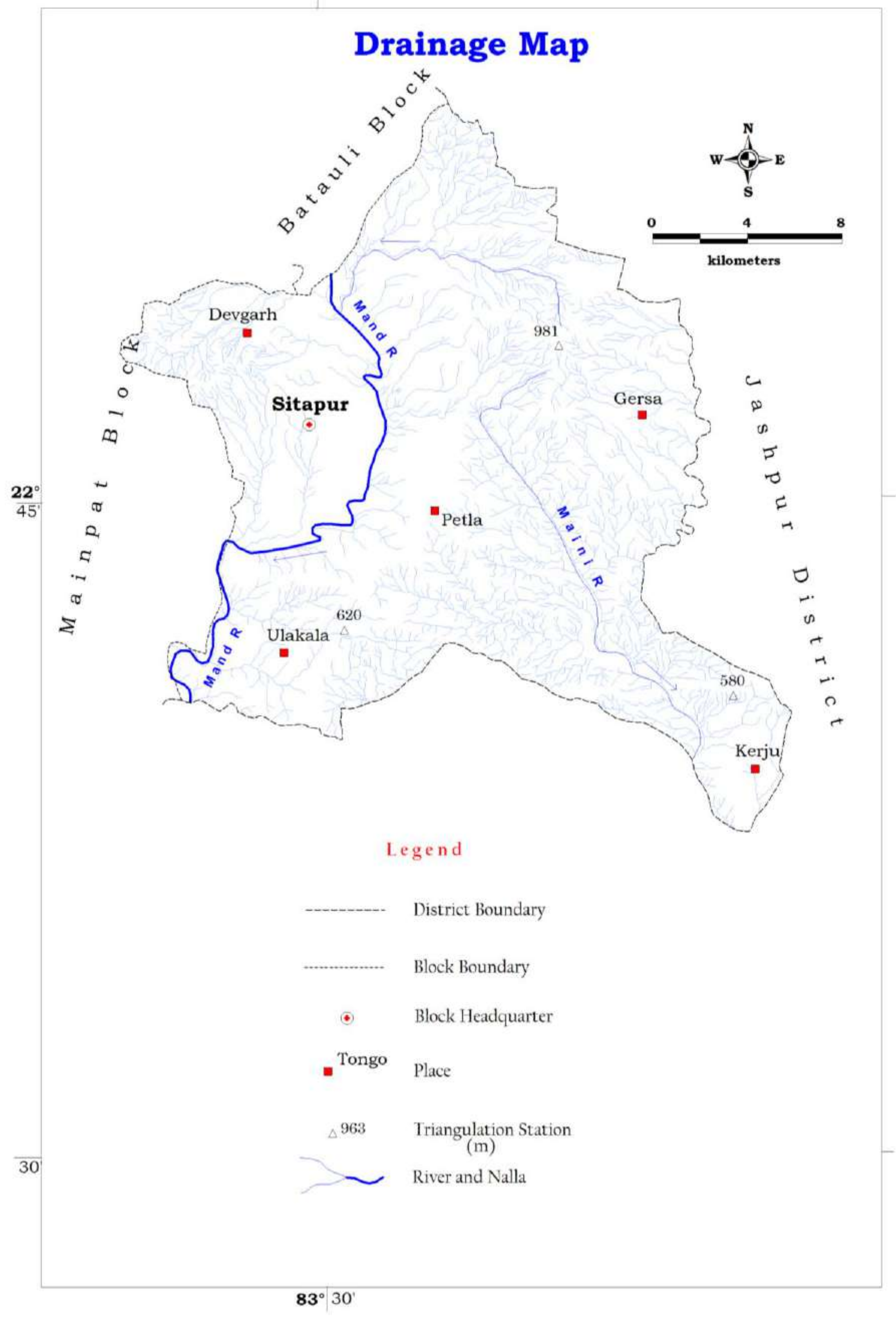

Figure 3 Drainage Map of Sitapur Block

Agriculture and Irrigation**:** Agriculture is practiced in the area during Kharif and Rabi season every year. During the Kharif, cultivation is done through rainfall while during the Rabi season; it is done through ground water as well as partly through surface water like canals and other sources. The groundwater abstraction structures are generally Dugwells, Borewells /tubewells. The principal crops in the block are Paddy, Wheat, Vegetables and pulses.

In some areas, double cropping is also practiced. The agricultural pattern, cropping pattern and area irrigated data of Sitapur block is given in Table 3 (A, B, C, D, and E).

Table 3 (A): Land use and Agricultural pattern (in ha)

Total geographical area	Forest area	Area not available for cultivation	Nonagricultural & Fallow land	Agricultural Fallow land	Net sown area	Double cropped area	Gross cropped area
50099	10854	2823	2995	5123	22596	1581	24177

Table 3 (C): Cropping pattern (in ha)

Kharif	Rabi	Cereal				Pulses	Tilhan	Fruits and Vegetables	Sugarcane	Mirch Masala	Others
		Wheat	Rice	Jowar & Maize	Others						
22561	1616	422	17084	779	24	2175	2746	677	158	94	37

Table 3 (D): Area irrigated by various sources (in ha)

No. of canals (private and Govt.)	Irrigated area	No. of bore wells/ Tube wells	Irrigated area	No. of dug wells	Irrigated area	No. of Talabs	Irrigated area	Irrigated area by other sources	Net Irrigated area	Gross irrigated area	% of irrigated area wrt. Net sown area
2	557	49	21	140	44	58	0	379	1001	1112	4.24

Table 3 (E): Statistics showing Irrigation by Ground water

Block	Net Irrigated Area	Net Irrigated Area by ground water	Percentage of Area Irrigated by ground water wrt. Net Irrigated Area
Sitapur	1001	65	6.49

Groundwater Resource Availability and Extraction: Based on the resource assessment made, the resource availability in aquifer wise in Sitapur block is given in the table-4.

Table – 4 (A): Ground Water Budget of Sitapur block in Ham

Assessment Unit Name	Ground Water Recharge(Ham)				Total Annual Ground Water (Ham) Recharge	Total Natural Discharges (Ham)
	Monsoon Season		Non-monsoon season			
	Recharge from Rainfall	Recharge from Other Sources	Recharge from Rainfall	Recharge from Other Sources		
Sitapur	3679.92	237.45	398.83	242.97	4559.17	455.92

Table – 4 (B): Ground Water Dynamic Resource (Unconfined Aquifer) of Sitapur block in Ham

Annual Extractable Ground Water Recharge (Ham)	Current Annual Ground Water Extraction (Ham)				Annual GW Allocation for Domestic Use as on 2025	Net Ground Water Availability for future use	Stage of Ground Water Extraction (%)	Categorization (OE/Critical/ Semicritical/ Safe)
	Irrigation Use	Industrial Use	Domestic Use	Total Extraction				
4103.25	1049.90	0.00	231.08	1280.98	253.93	2799.42	31.22	Safe

Table – 4 (C): Ground Water Static Resource (Unconfined Aquifer) and Dynamic Resource (Confined Aquifer) of Sitapur block in Ham

Static Resources Area (Ha)	Difference Piezometric Head (Pre-post) m	Storativity (S)	Dynamic Ground Water Resource of Confined Aquifer (Ham)	Bottom level of the top confining layer (m)	In storage Ground Water Resource of Confined Aquifer (Ham)	Sum of Dynamic GW resources and In storage GW resource of Confined Aquifer (Ham)
50099	5.73	0.00025	70.60	200	9301.38	9371.98

Existing and Future Water Demand (2025): The existing draft for irrigation in the area is 1049.90 Ham while the total extraction for all uses is 1280.98 Ham. At present scenario to meet the future demand for water, a total quantity of 2799.42 ham of ground water is available for future use.

Water Level Behavior: (i) Pre- monsoon water level: In the pre-monsoon period, it has been observed that in Sitapur block, water level in dugwells (phreatic aquifer) varies between 3.90 to 9.0 mbgl with average water level of 5.84 mbgl. In semiconfined aquifer, the maximum water level is 22.25 mbgl; the average water level is 15.71 mbgl.

Table 5A: Phreatic aquifer Depth to Water Level in mbgl (Pre-monsoon)

Block Name	Phreatic Aquifer		
	Min	Max	Avg
Sitapur	3.90	9.00	5.84

Table 5B: Semiconfined Aquifer Depth to Water Level in mbgl (Pre-monsoon)

Block Name	Semiconfined Aquifer		
	Min	Max	Avg
Sitapur	8.80	22.25	15.71

(ii) Post- monsoon water level**:** In the post-monsoon period, it has been observed that the water level varies from 1.65 to 5.00 mbgl with an average of 3.26 mbgl in phreatic aquifer. In semiconfined/fractured formation, the post monsoon water level variation range is 3.61 to 15.24 mbgl with average of 9.98 mbgl.

Table 5C: Phreatic Aquifer Depth to Water Level in mbgl (Post-monsoon)

Block Name	Phreatic Aquifer		
	Min	Max	Avg
Sitapur	1.65	5.00	3.26

Table 5D: Semiconfined Aquifer Depth to Water Level in mbgl (Post-monsoon)

Block Name	Semiconfined Aquifer		
	Min	Max	Avg
Sitapur	3.61	15.24	9.98

(iii) Seasonal water level fluctuation: The water level fluctuation data indicates that in Sitapur block, water level fluctuation in phreatic aquifer varies from 1.30 to 4.00 m with an average fluctuation of 2.58 m. Water level fluctuation in semiconfined Aquifer varies from 0.91 to 9.19 m with an average fluctuation of 5.73 m.

Table 5E: Phreatic Aquifer Depth to Water Level Fluctuation (meter)

Block Name	Phreatic Aquifer		
	Min	Max	Avg
Sitapur	1.30	4.00	2.58

Table 5F: Semiconfined Aquifer Depth to Water Level Fluctuation (meter)

Block Name	Semiconfined Aquifer		
	Min	Max	Avg
Sitapur	0.91	9.19	5.73

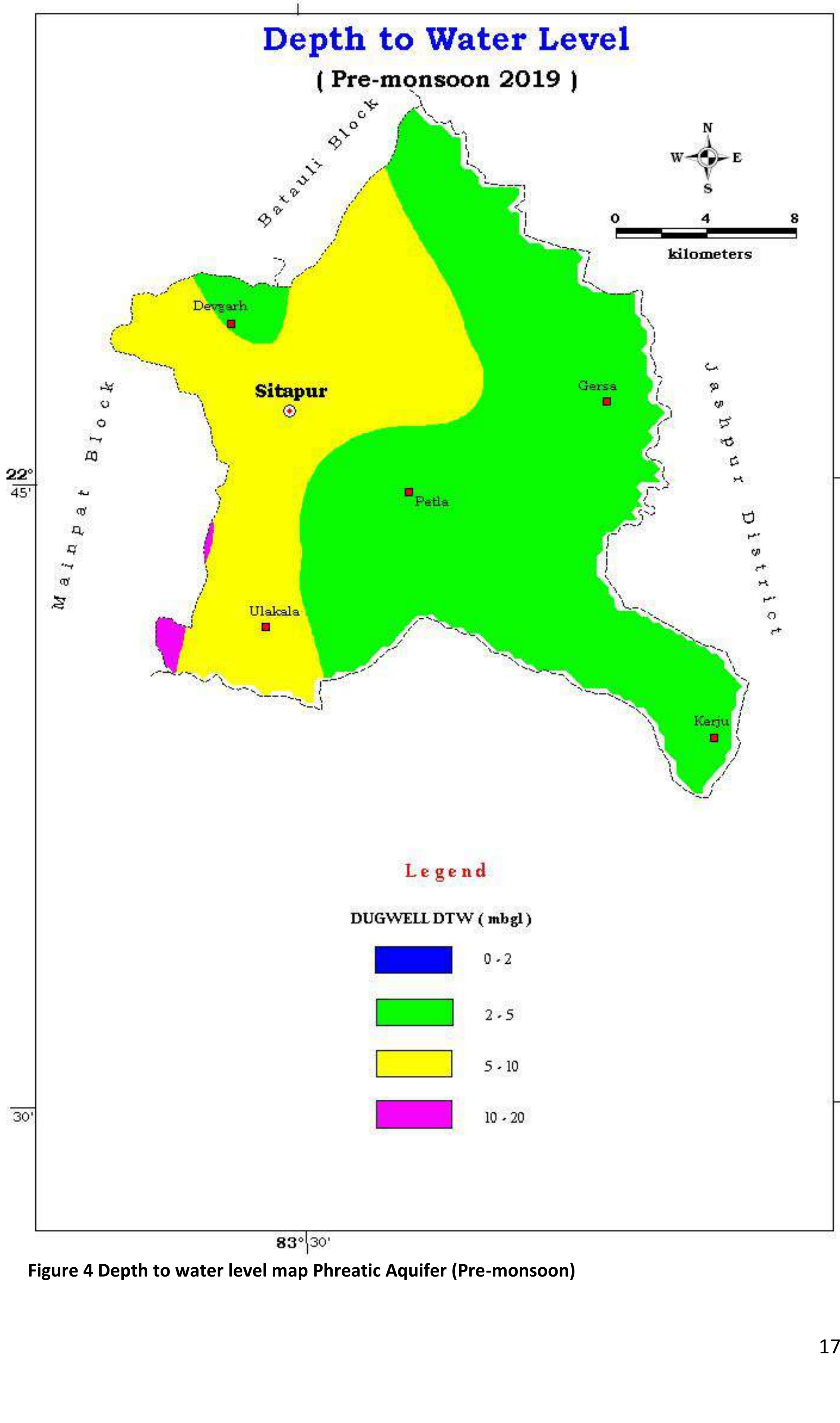

Figure 4 Depth to water level map Phreatic Aquifer (Pre-monsoon)

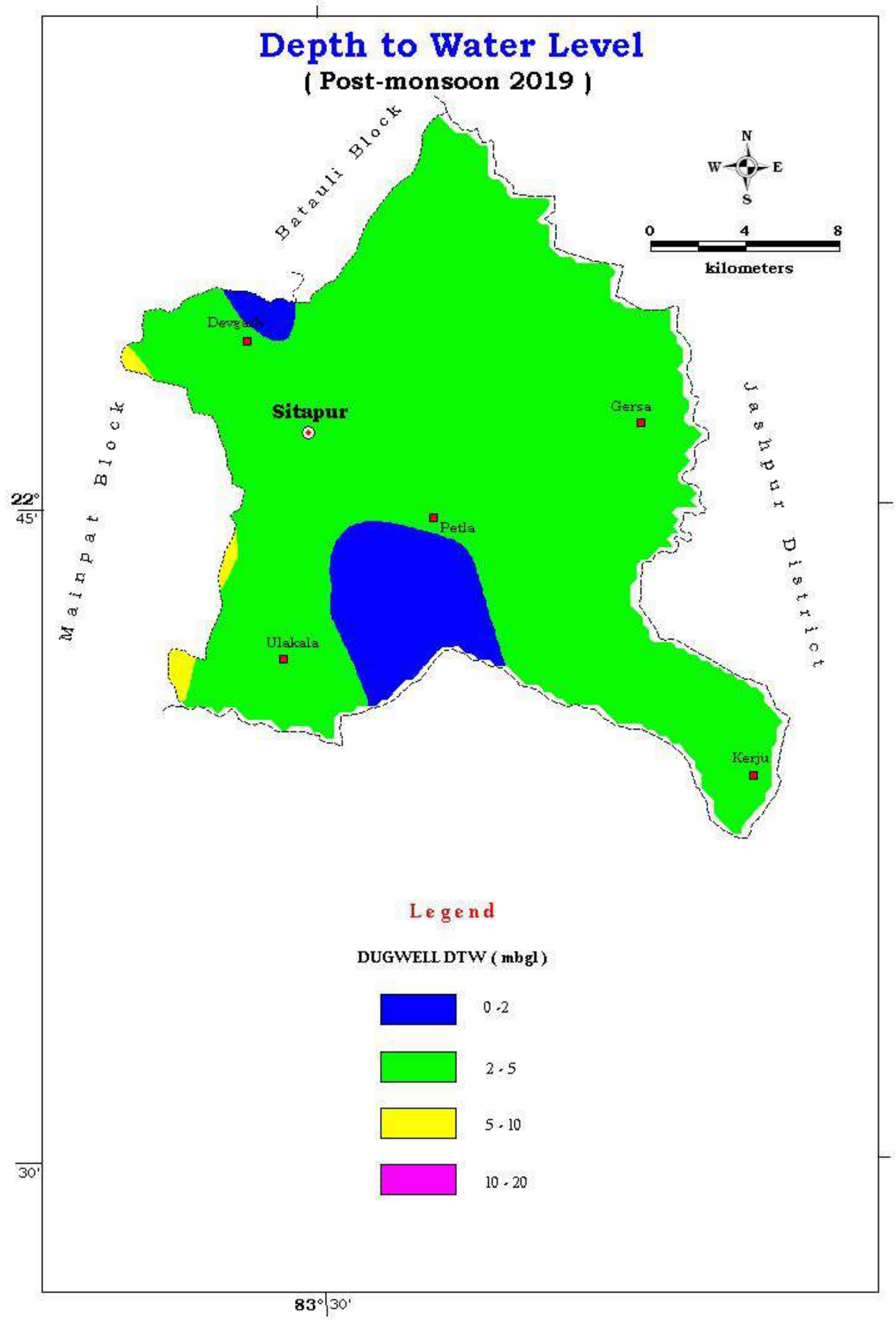

Figure 5 Depth to water level map Phreatic Aquifer (Post-monsoon)

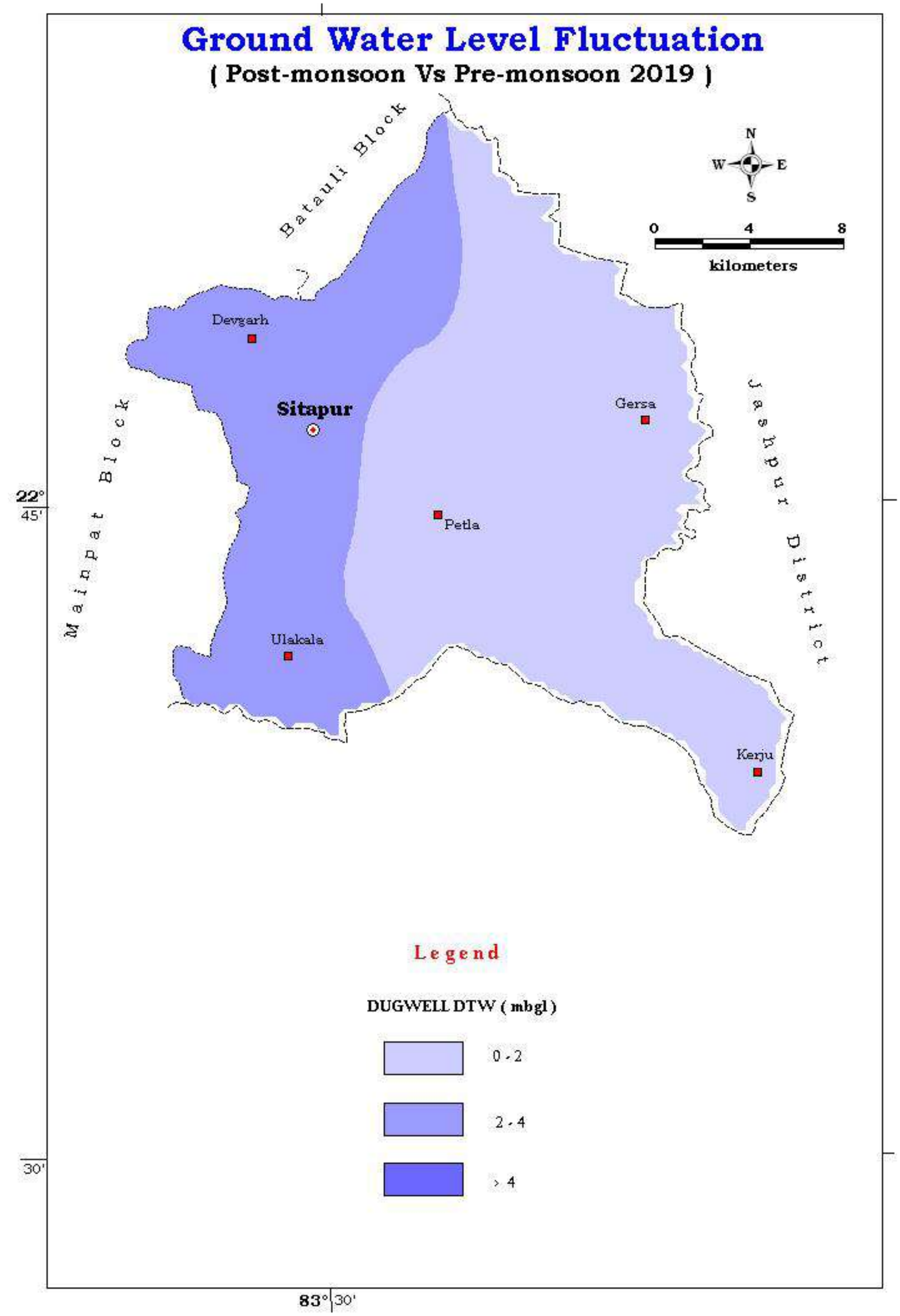

Figure 6 Depth to water level fluctuation map of Phreatic Aquifer

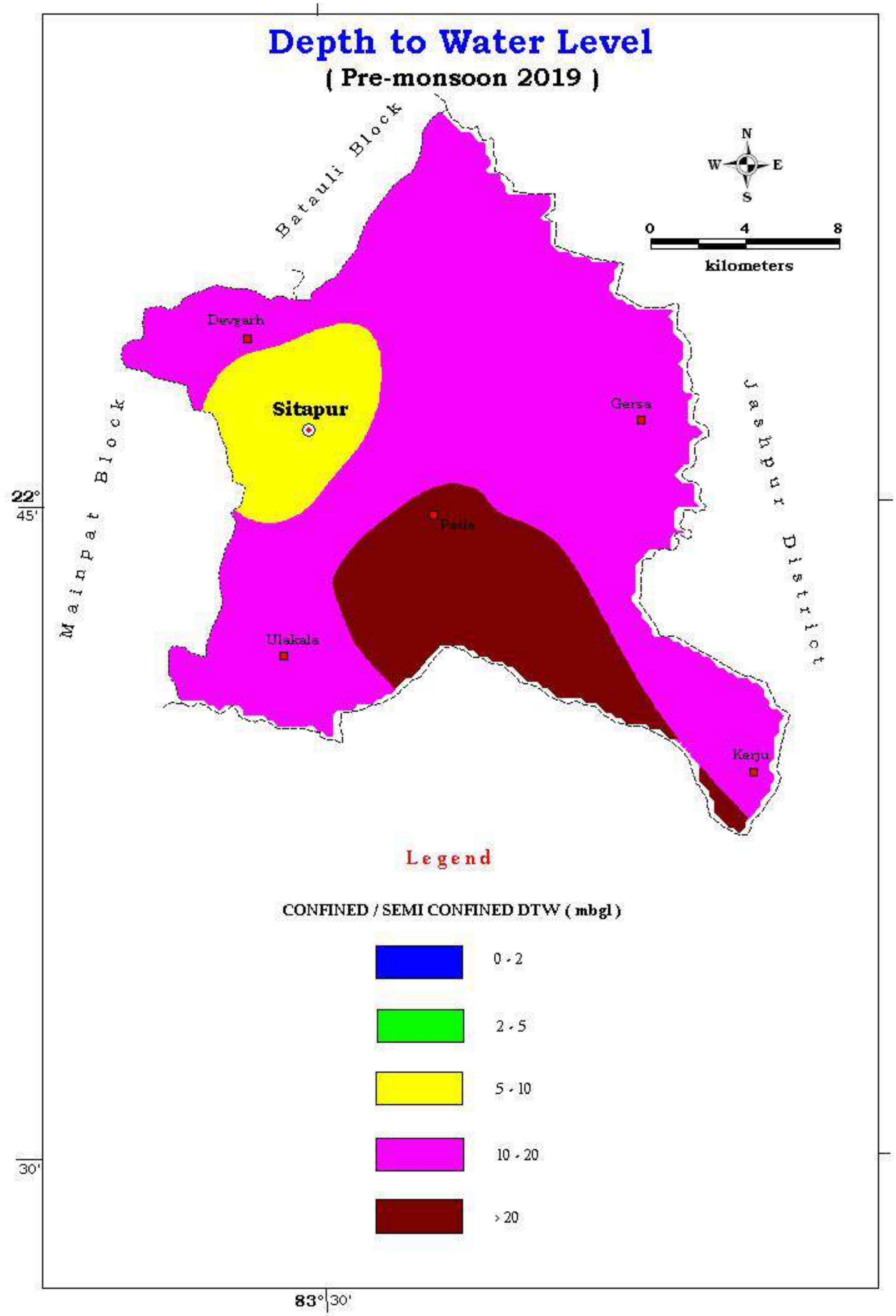

Figure 7 Depth to water level map Semiconfined Aquifer (Pre-monsoon)

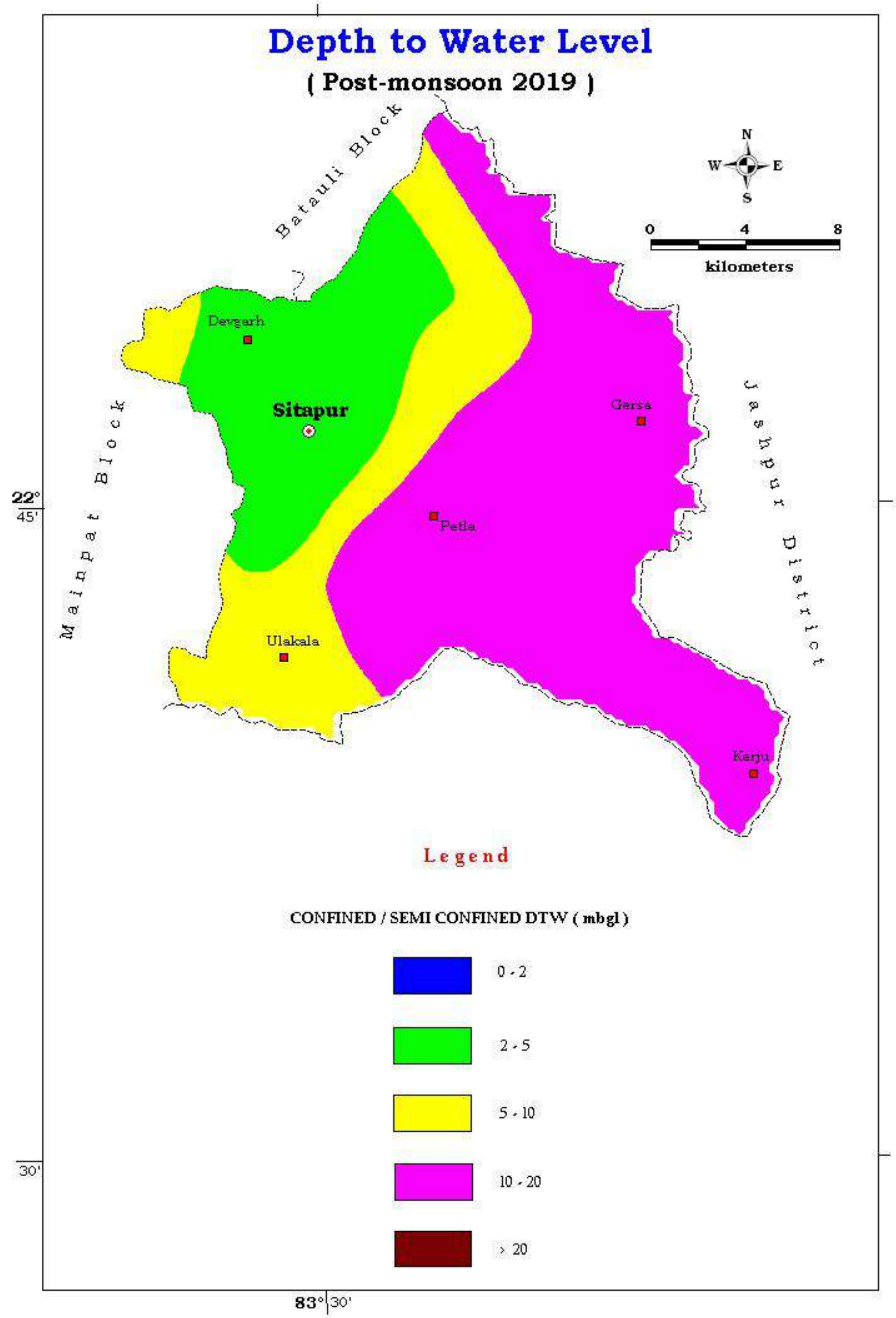

Figure 8 Depth to water level map Semiconfined Aquifer (Post-monsoon)

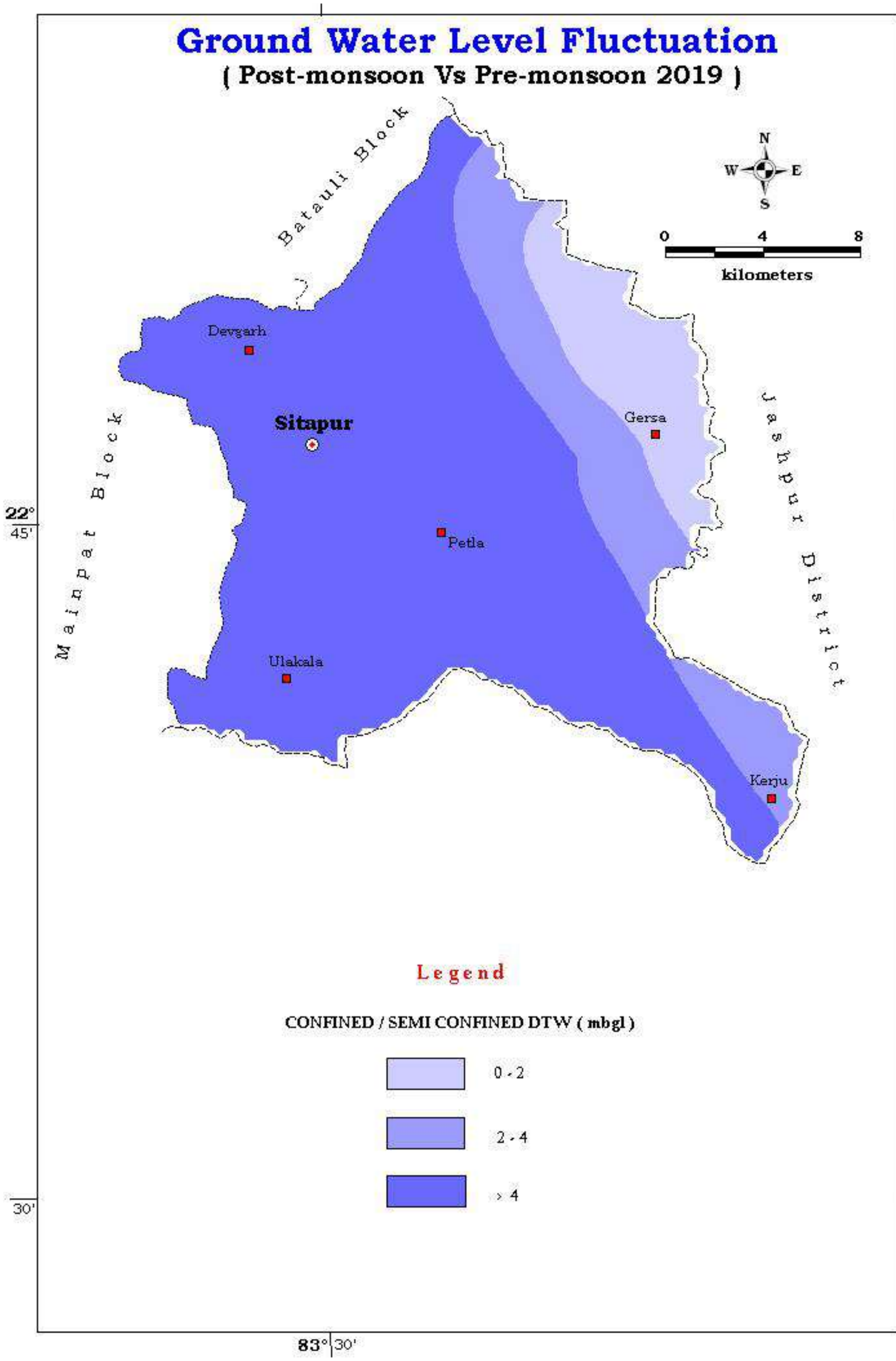

Figure 9 Depth to water level fluctuation map of Semiconfined Aquifer

(iv) <u>The long term water level trend</u>: There is no significant decline in water level in pre and post monsoon period in all observed NHS networks.

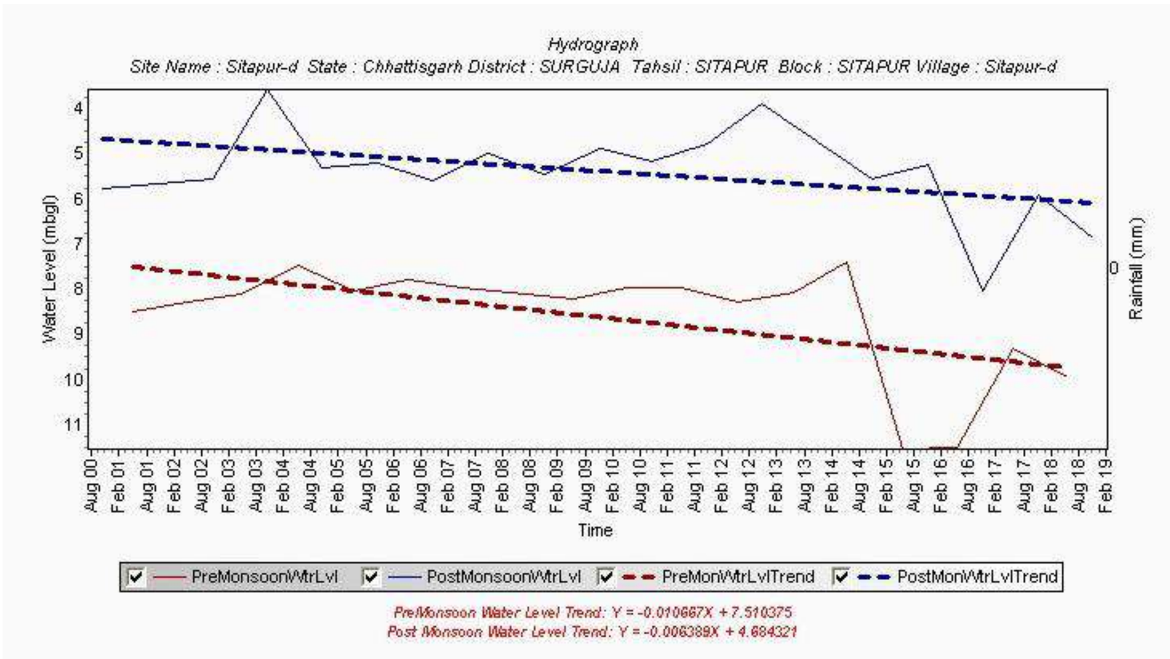

Figure 10 a: Hydrograph of Sitapur Village, Sitapur block

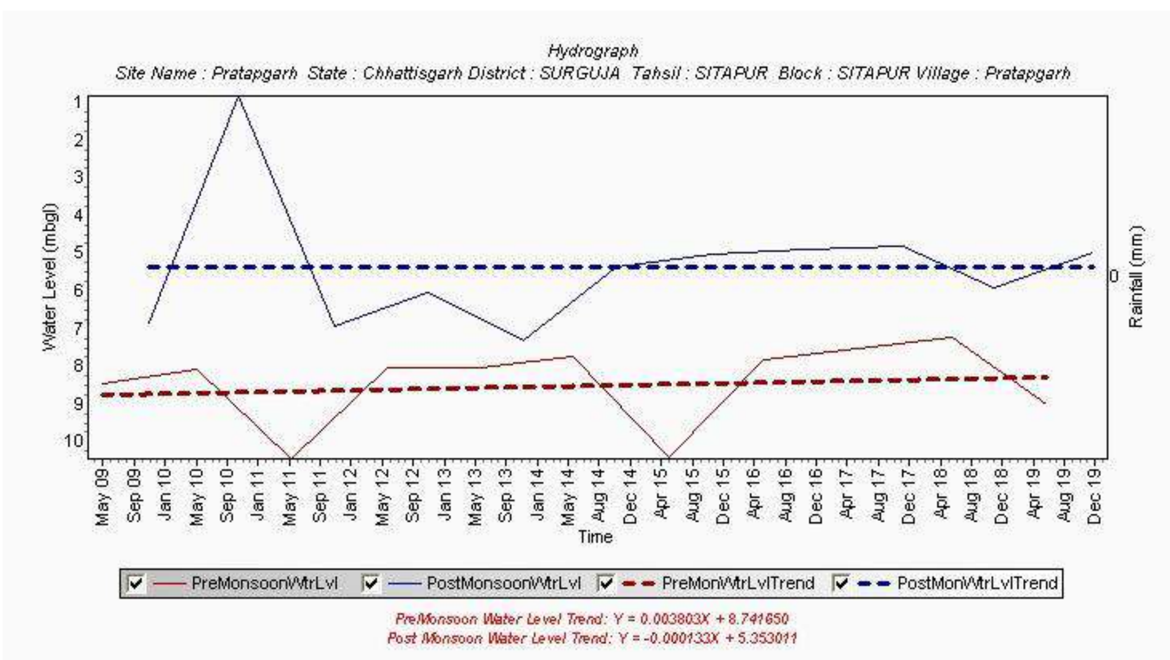

Figure 10 b: Hydrograph of Pratapgarh Village, Sitapur block

2. Aquifer Disposition:

Number of Aquifers: There is one major aquifer system viz. Granite Aquifer system and. Granite aquifer system has the shallow aquifer and deeper aquifer which occurs in phreatic and semiconfined condition respectively. Although there are few patches of unclassified metamorphic, biotite schist and other rocks.

3-d aquifer disposition and basic characteristics of each aquifer:
Granite Aquifer System: Groundwater occurrence is largely limited to secondary permeability, such as weathered zones, joints, fractures or faults. The potential of weathered zones depends on the degree and depth of weathering and associated fracturing, and the saturated thickness. The aquifers are generally discontinuous, and often confined. Higher yields are obtained where thick weathered zones are associated with bedrock fracturing. considering the fact that the hydrogeology of weathered–fractured aquifers is highly heterogeneous due to complexity in geological, structural and geomorphological features hydrogeological characteristics is summarized as follows.
The average thickness of the weathered portion in the area is around 20 m. In general, the discharge varies from meagre to 12.7 lps. The average drawdown of the formation is around 29 m. DTH drilling technique is preferred in Granite aquifer where well construction is required depending upon the thickness of weathered zone. Water zone has been encountered up to 158 mbgl in the formation. Transmissivity range observed is upto 43.72 sq meter/day.

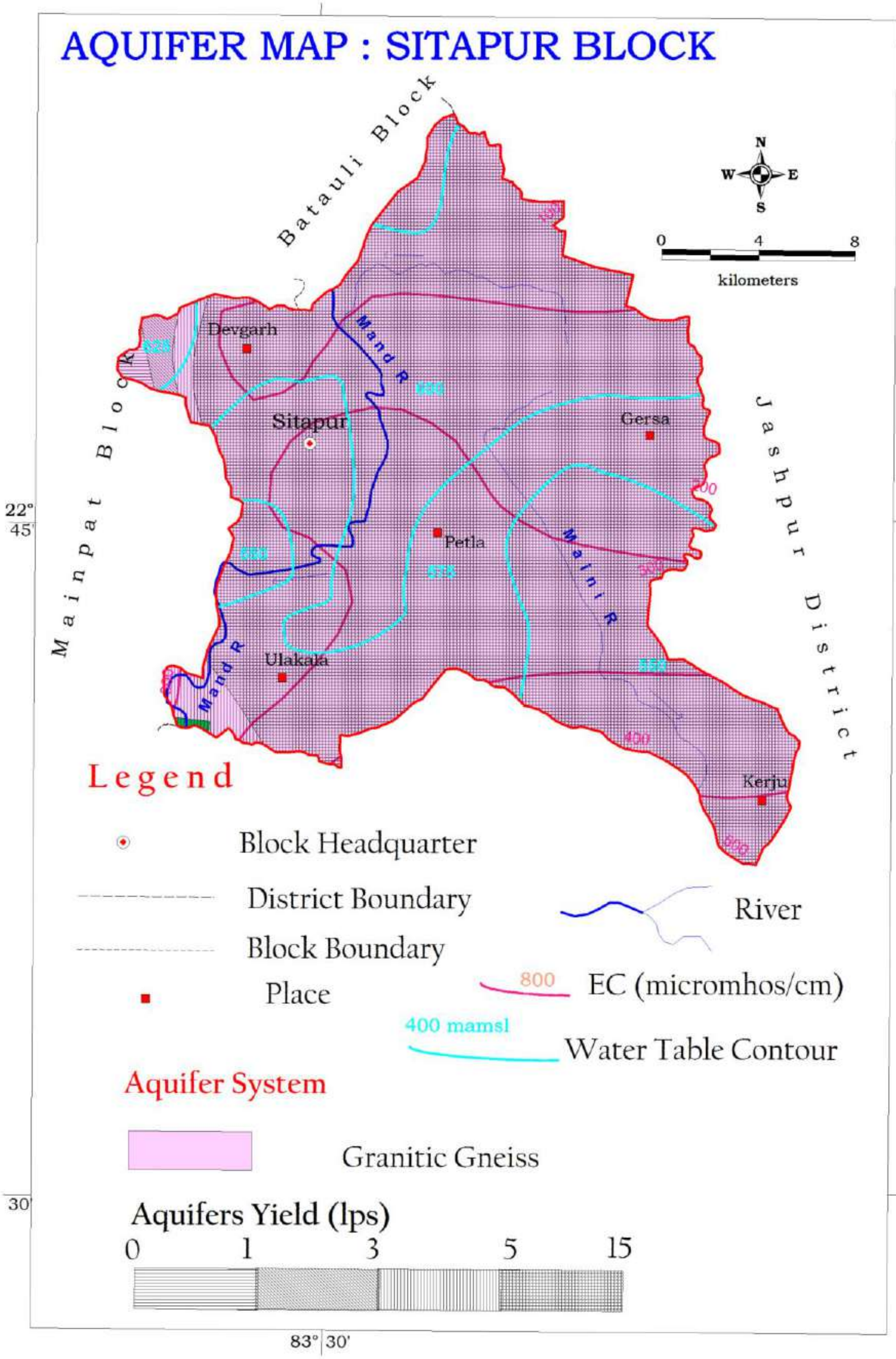

Figure 11: Aquifer map of Sitapur block

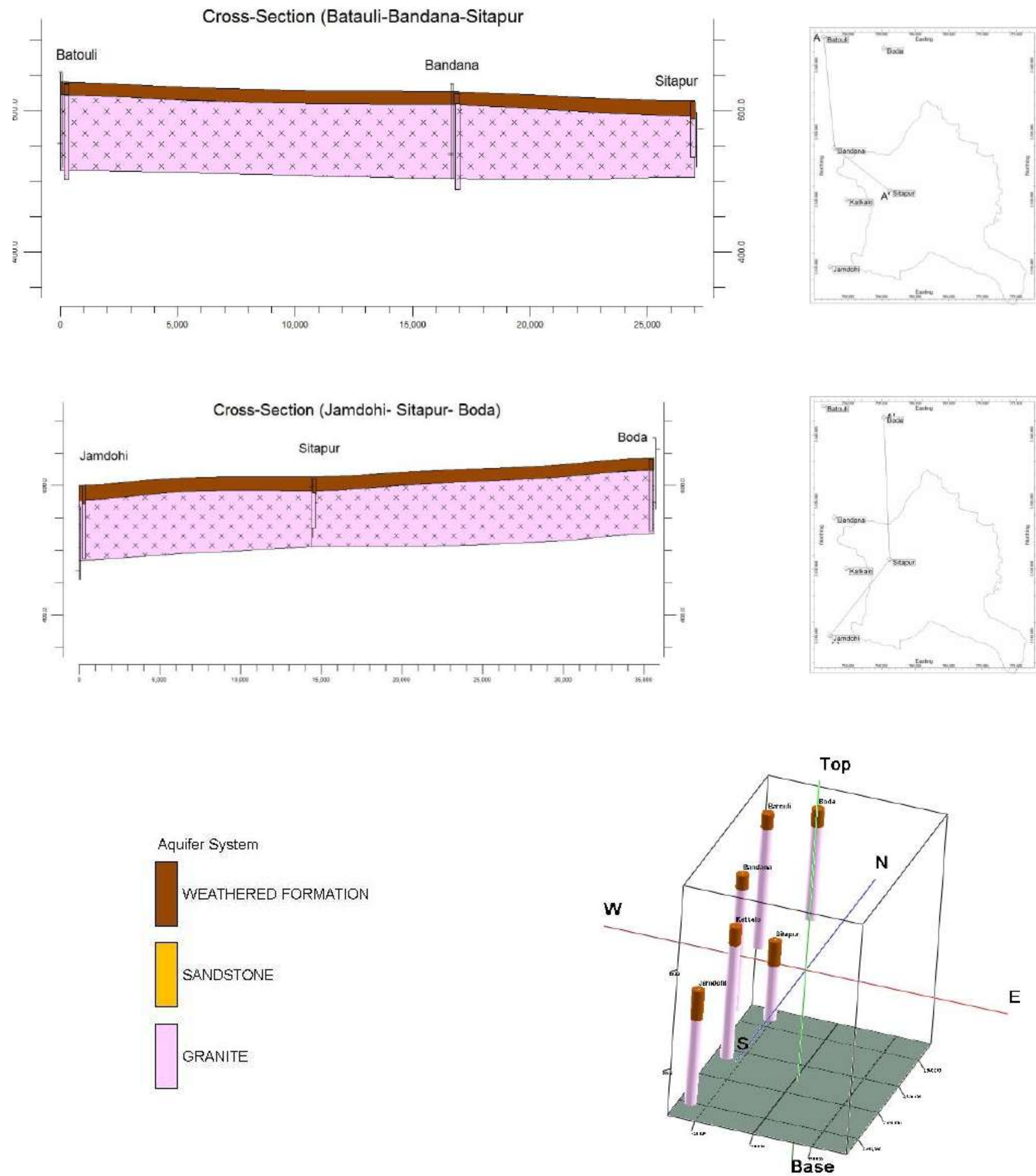

Figure-12, Disposition of Aquifer, Sitapur Block

3. Ground water Resource, extraction, contamination and other issues:

Resource availability of Sitapur block is given in the table -4 where net ground water availability for future use is 2799.42 ham. The extraction details and the future scenario (2025) along with the categorisation are also depicted in the table-4.

Table 7 Categorization of Assessment Unit

District	Block	Stage of Ground water development (%)	Categorisation
Sitapur	Sitapur	31.22	Safe

Categorisation: Sitapur block falls in safe category. The stage of Ground water development is 31.22 %. The Annual Extractable Ground Water Recharge is 4103.25 ham. The Ground water draft for all uses is 1280.98 Ham.

Chemical Quality of Ground water and Contamination**:** Throughout the study area, the water samples from both dugwell and handpumps were collected and chemical analysis has been completed (Annexure I). Several villages have Iron and Flouride concentration more than permissible limit. Overall ground water of the study area is suitable for the drinking, agriculture and industrial purpose. In Sitapur at 34 villages Fluoride contamination and at 23 villages Iron contamination reported. (Source: https://ejalshakti.gov.in/IMISReports/MIS.html)

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Aquifer wise space available for recharge and proposed interventions:

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Major Aquifer	Area Identified for Artificial Recharge (Sq. Km)	Sp. Yield for the formation	Volume of vadose zone available for recharge(mcm)	Sub surface storage potential (mcm)
Granite gneiss	57.54	0.02	86	1.726

5. Issues:

(i) During summer, dugwells in villages becomes dry at many locations. Several handpumps also stop yielding water. The aquifer itself is a low yielding one.

(ii) In Granite aquifer system potential zone for ground water is related with occurrence of fracture, so drilling a high yield well is always a challenge. Proper scientific study coupled with geophysical investigation may minimize the failure of well.
(iii) Fluoride and Iron filter plant may be installed in the villages having higher value of contaminants.

6. Management Plan:

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(ii) Desiltation of existing Tanks and Talabs to be carried out for efficient storage of rainwater. Also Rain water harvesting structures may be constructed in villages to reduce stress on groundwater.
(iii) It has been observed that the demand of ground water is increasing for irrigation, industrial and domestic uses. At locations where water level is declining, we have to go for artificial recharge on a long-term sustainability basis. Artificial Recharge structures may be constructed at suitable locations especially in the areas where the water level remains more than 3m in the post-monsoon period in this block to arrest the huge non-committed run-off and augment the ground water storage in the area. The different types of artificial structures feasible in the block are described in table-9.

Table-9: Types of Artificial Recharge structures feasible

Name of Block	Area Feasible for recharge (sq.km)	Volume of Sub Surface Potential for Artificial recharge (MCM)	Types of Structures Feasible and their Numbers			
			Percolation tank	Nalas bunding cement plug/ check dam	Gravity head /Dug well/ tube well/Recharge shaft	Gully plugs Gabion structures
Sitapur	57.54	2.195	5	14	43	40
	Recharge Capacity (MCM)/structure		0.2192	0.0326	0.00816	0.0073

(iv) Fluoride and Iron filter plant may be installed in the villages having higher value of contaminants.
(v) Treatment of sewage water in village through soak pit for the individual houses and Seechewal model or similar model for community level may be adopted to avoid

contamination of ground water. Treated water may also be reused for irrigation and other industrial purposes.

(vi) Since the stage of development in the block is 31.22 %. There is scope of utilizing more ground water for future irrigation purpose. Additional number of Ground water abstraction structure may be developed for the effective utilization of ground water resources in the block. The ground water is presently developed through dug wells and tube wells. Yield potential for the block has been shown in Aquifer map (fig 11). Sites for wells need to be selected only after proper scientific investigation. The ground water quality also needs to be ascertained and the wells used for water supply should be first checked for Iron, Fluoride and other pollutants.

Table 10: Potential of Additional GW abstraction structure creation

Net Groundwater availability (ham)	Stage of ground water Development (%)	Present ground water draft (Ham)	Ground water draft at 70% stage of development (ham)	Surplus ground water at present Stage of Development (ham)	Number of TW Recommended in each block (Assuming unit draft as 1.6 ham/structure/year)	Number of DW Recommended in each block (Assuming unit draft as 0.72 ham/structure/year)
4103.25	31.22	1280.98	2872.28	1591.30	597	884

7. Conclusion:

For effective utilization of Ground water existing draft for irrigation may be coupled with micro irrigation system. Change in irrigation pattern, optimum use of available resource, use of ground water potential created after artificial recharge can lead to groundwater savings and increase in gross cropped area of the block (Table: 11).

Table 11: Detail of groundwater saved through change in cropping pattern and other interventions

Block	Existing Gross Ground Water Draft for Irrigation in Ham	Additional Saving of GW after using Micro Irrigation methods in Ham (Assuming 30 % saving)	GW Potential created after Artificial recharge structure in Ham	Development by new GW abstraction structure	Additional GW irrigation Potential created in Ham	Additional Irrigation potential creation for Maize/ wheat in winter season in Ha (Assuming 500 mm water requirement)	Percent increase in Crop area compare to Gross cropped area
Sitapur	1049.90	314.97	219.53	1591.30	2078.89	4157.78	17.20%

AQUIFER MAPPING AND MANAGEMENT PLAN FOR UDAIPUR BLOCK (SURGUJA DISTRICT), CHHATTISGARH

CONTENTS

AQUIFER MAP AND MANAGEMENT PLAN: UDAIPUR BLOCK

1. Salient Information:

About the area: Udaipur Block is situated on the southern part of Surguja district of Chhattisgarh and is bounded on the north by Lakhanpur block, in the west by Surajpur district, in the south by Korba distrct and in the east by Lakhanpur block and Raigarh district. The block area lies between 22.64 and 23.05 N latitudes and 82.76 and 83.13 E longitudes. The geographical extension of the study area is 1417.30 sq. km representing around 27 % of the district's geographical area. Administrative map of the block is shown in Fig. 1. Blocks mainly comprise of structural plains on Gondwana rocks and there is region of plateau in southern part. Geomorphology map is shown in Figure 2. The major drainage of the block includes Rehar river which is part of Son sub basin and Ganga Basin, Chornai Nala and Atem Nala which are part of Mahanadi Basin, Drainage map shown in Fig. 3.

Population: The total population of Udaipur block as per 2011 Census is 78918. The population break up i.e. male- female, rural & urban is given below -

Table- 1: Population Break Up

Block	Total population	Male	Female	Rural population	Urban population
Udaipur	79818	39780	39138	79818	0

Source: CG Census, 2011

Growth rate: The decadal growth rate of the block is 19.13 as per 2011 census.

Rainfall: The study area receives rainfall mainly from south-west monsoon. About 87% of the annual rainfall is received during June to September and July and August are the months of maximum precipitation. The area gets some rainfall during winter season also. Average annual rainfall in the study area is (Average of the last five years i.e. 2013 to 2017) 811.1 mm with 70 to 80 rainy days.

Table-2: Rainfall data in Udaipur block in mm

Year	2013	2014	2015	2016	2017
Annual rainfall	775.0	678.8	829.0	586.8	1185.8

Source: IMD

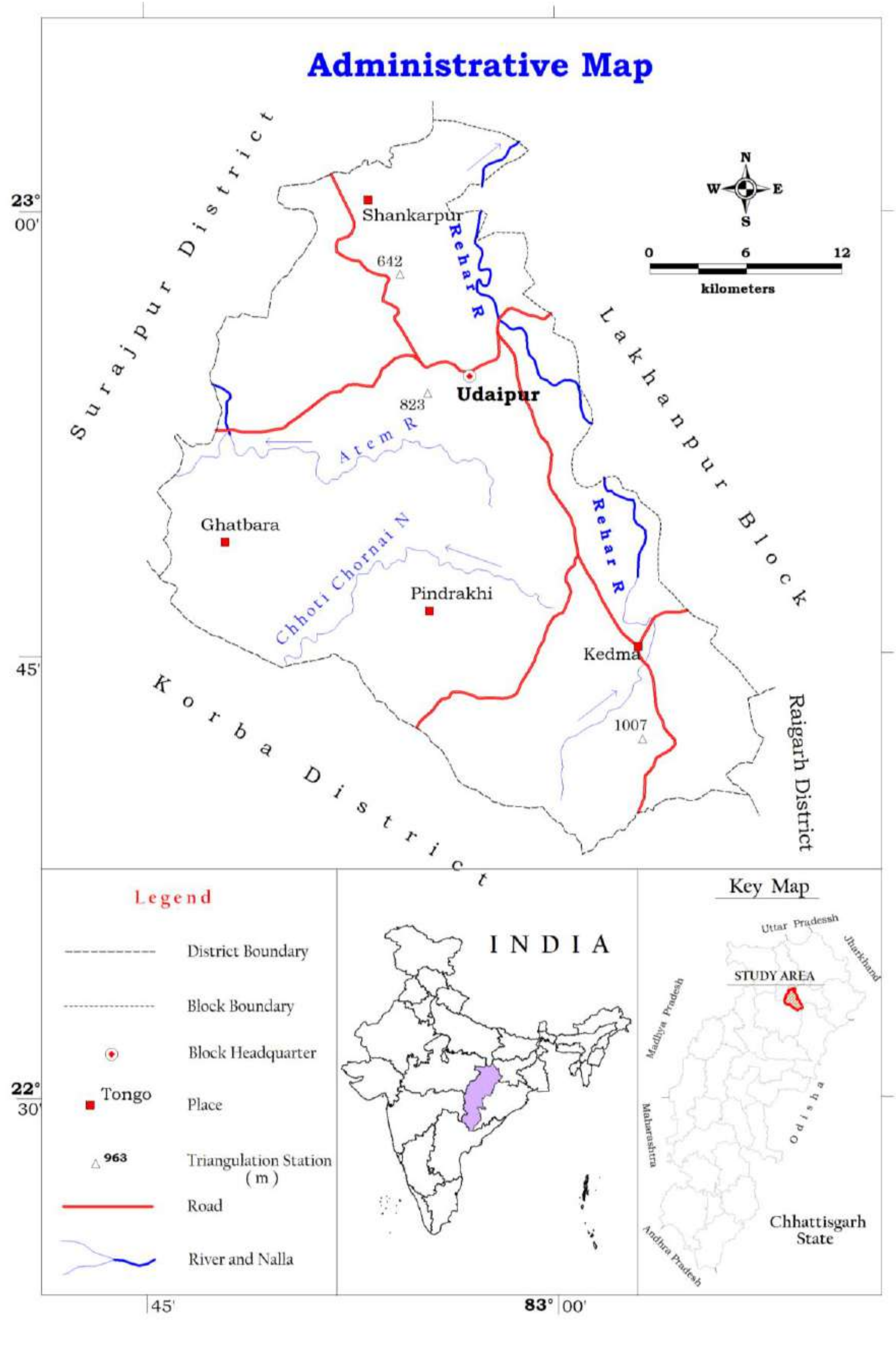

Figure 1 Administrative Map of Ambikapur Block

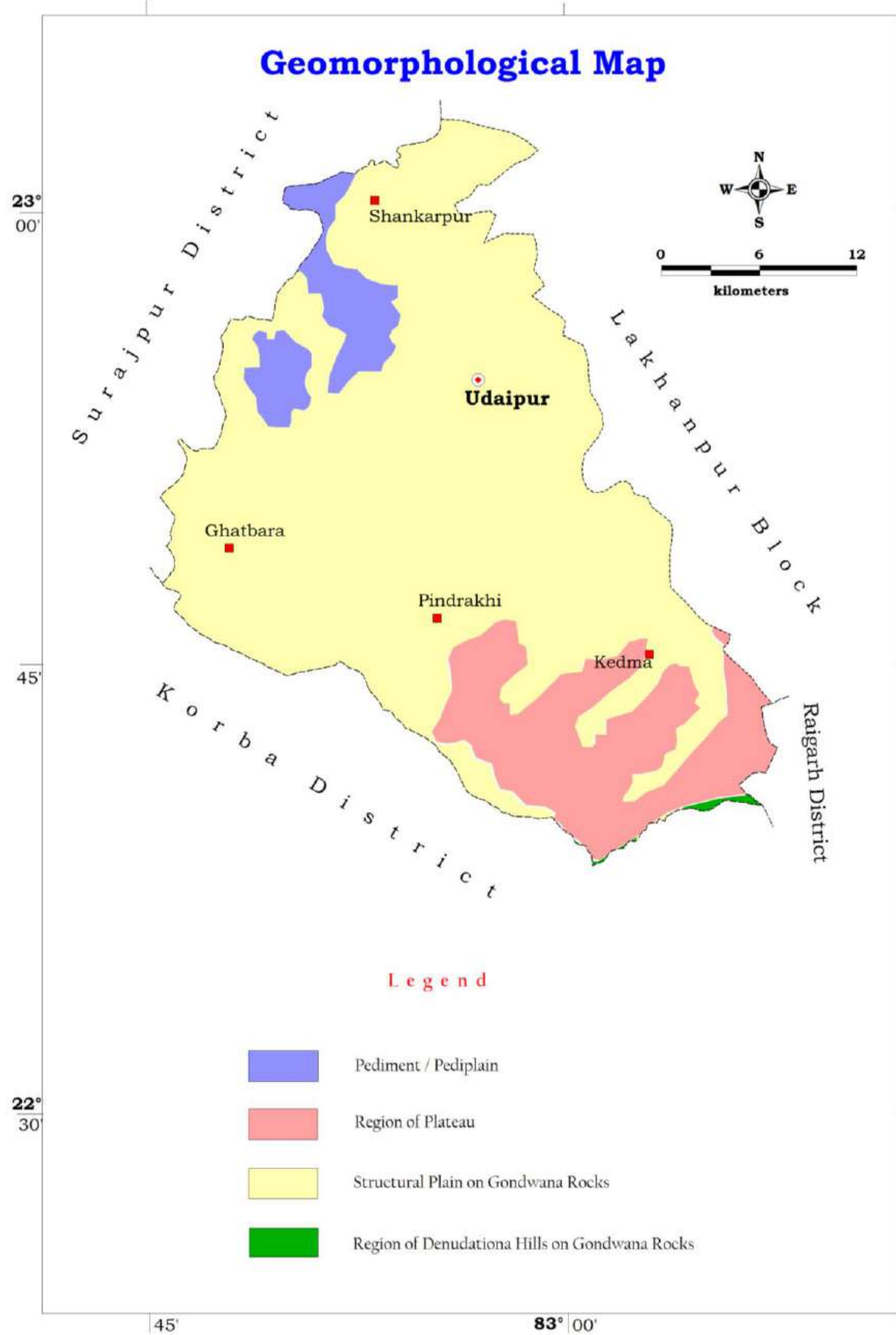

Figure 2 Geomorphology Map of Ambikapur Block

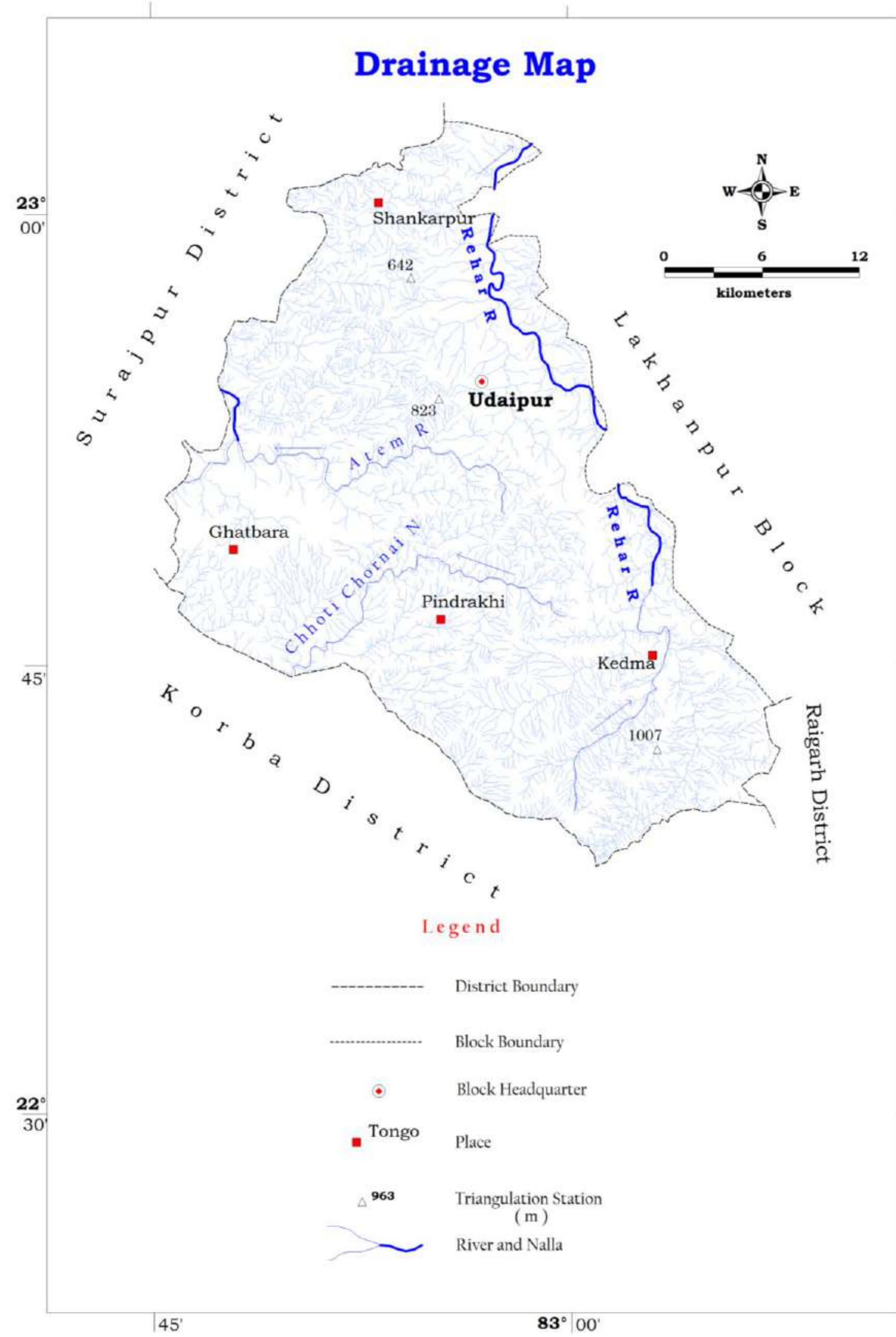

Figure 3 Drainage Map of Ambikapur Block

Agriculture and Irrigation: Agriculture is practiced in the area during Kharif and Rabi season every year. During the Kharif, cultivation is done through rainfall while during the Rabi season; it is done through ground water as well as partly through surface water like canals and other sources. The groundwater abstraction structures are generally Dugwells, Borewells /tubewells. The principal crops in the block are Paddy, Wheat, Vegetables and pulses.

In some areas, double cropping is also practiced. The agricultural pattern, cropping pattern and area irrigated data of Udaipur block is given in Table 3 (A, B, C, D, and E).

Table 3 (A): Land use and Agricultural pattern (in ha)

Total geographical area	Revenue forest area	Area not available for cultivation	Nonagricultural & Fallow land	Agricultural Fallow land	Net sown area	Double cropped area	Gross cropped area
141734	54298.9	3197	14852	5978	15136	1487	16623

Table 3 (C): Cropping pattern (in ha)

Kharif	Rabi	Cereal				Pulses	Tilhan	Fruits and Vegetables	Sugarcane	Mirch Masala
		Wheat	Rice	Jowar & Maize	Others					
15112	1511	216	12193	791	90	1303	1126	752	24	107

Table 3 (D): Area irrigated by various sources (in ha)

No. of canals (private and Govt.)	Irrigated area	No. of bore wells/ Tube wells	Irrigated area	No. of dug wells	Irrigated area	No. of Talabs	Irrigated area	Irrigated area by other sources	Net Irrigated area	Gross irrigated area	% of irrigated area wrt. sown area
4	138	108	10	2231	702	95	60	418	827	895	5.38

Table 3 (E): Statistics showing Irrigation by Ground water

Block	Net Irrigated Area	Net Irrigated Area by ground water	Percentage of Area Irrigated by ground water
Udaipur	827	712	86.1

Groundwater Resource Availability and Extraction: Based on the resource assessment made, the resource availability in aquifer wise in Udaipur block is given in the table-4.

Table – 4 (A): Ground Water Budget of Udaipur block in Ham

Assessment Unit Name	Ground Water Recharge(Ham)				Total Annual Ground Water (Ham) Recharge	Total Natural Discharges (Ham)
	Monsoon Season		Non-monsoon season			
	Recharge from Rainfall	Recharge from Other Sources	Recharge from Rainfall	Recharge from Other Sources		
Udaipur	9598.03	130.61	1040.22	313.06	11081.92	1108.19

Table – 4 (B): Ground Water Dynamic Resource (Unconfined Aquifer) of Udaipur block in Ham

Annual Extractable Ground Water Recharge (Ham)	Current Annual Ground Water Extraction(Ham)				Annual GW Allocation for Domestic Use as on 2025	Net Ground Water Availability for future use	Stage of Ground Water Extraction (%)	Categorization (OE/Critical/Semicritical/Safe)
	Irrigation Use	Industrial Use	Domestic Use	Total Extraction				
9973.73	1518.90	0.00	192.68	1711.58	219.11	8235.72	17.16	Safe

Table – 4 (C): Ground Water Static Resource (Unconfined Aquifer) and Dynamic Resource (Confined Aquifer) of Udaipur block in Ham

Static Resources Area (Ha)	Difference Piezometric Head (Pre-post) m	Storativity (S)	Dynamic Ground Water Resource of Confined Aquifer (Ham)	Bottom level of the top confining layer (m)	In storage Ground Water Resource of Unconfined Aquifer (Ham)	Sum of Dynamic GW (Confined Aquifer) and In storage GW (Unconfined Aquifer) resource (Ham)
141730	5.37	0.00025	187.14	200	25739.59	25926.73

Existing and Future Water Demand (2025)*:* The existing draft for irrigation in the area is 1518.90 Ham while the total extraction for all uses is 1711.58 Ham. At present scenario to meet the future demand for water, a total quantity of 8235.72 ham of ground water is available for future use.

Water Level Behavior: (i) Pre- monsoon water level: In the pre-monsoon period, it has been observed that in Udaipur block, water level in dugwells (phreatic aquifer) varies between 3.50 to 13.91 mbgl with average water level of 7.19 mbgl. In semiconfined aquifer, the maximum water level is 17.0 mbgl; the average water level is 12.53 mbgl.

Table 5A: Phreatic aquifer Depth to Water Level in mbgl (Pre-monsoon)

Block Name	Phreatic Aquifer		
	Min	Max	Avg
Udaipur	3.50	13.91	7.19

Table 5B: Semiconfined Aquifer Depth to Water Level in mbgl (Pre-monsoon)

Block Name	Semiconfined Aquifer		
	Min	Max	Avg
Udaipur	6.6	17.0	12.53

(ii) Post- monsoon water level**:** In the post-monsoon period, it has been observed that the water level varies from 1.60 to 6.71 mbgl with an average of 3.89 mbgl in phreatic aquifer. In semiconfined/fractured formation, the post monsoon water level variation range is 3.83 to 12.06 mbgl with average of 7.16 mbgl.

Table 5C: Phreatic Aquifer Depth to Water Level in mbgl (Post-monsoon)

Block Name	Phreatic Aquifer		
	Min	Max	Avg
Udaipur	1.60	6.71	3.89

Table 5D: Semiconfined Aquifer Depth to Water Level in mbgl (Post-monsoon)

Block Name	Semiconfined Aquifer		
	Min	Max	Avg
Udaipur	3.83	12.06	7.16

(iii) Seasonal water level fluctuation: The water level fluctuation data indicates that in Udaipur block, water level fluctuation in phreatic aquifer varies from 1.22 to 9.73 m with an average fluctuation of 3.31 m. Water level fluctuation in semiconfined Aquifer varies from 1.42 to 8.14 m with an average fluctuation of 5.37 m.

Table 5E: Phreatic Aquifer Depth to Water Level Fluctuation (meter)

Block Name	Phreatic Aquifer		
	Min	Max	Avg
Udaipur	1.22	9.73	3.31

Table 5F: Semiconfined Aquifer Depth to Water Level Fluctuation (meter)

Block Name	Semiconfined Aquifer		
	Min	Max	Avg
Udaipur	1.42	8.14	5.37

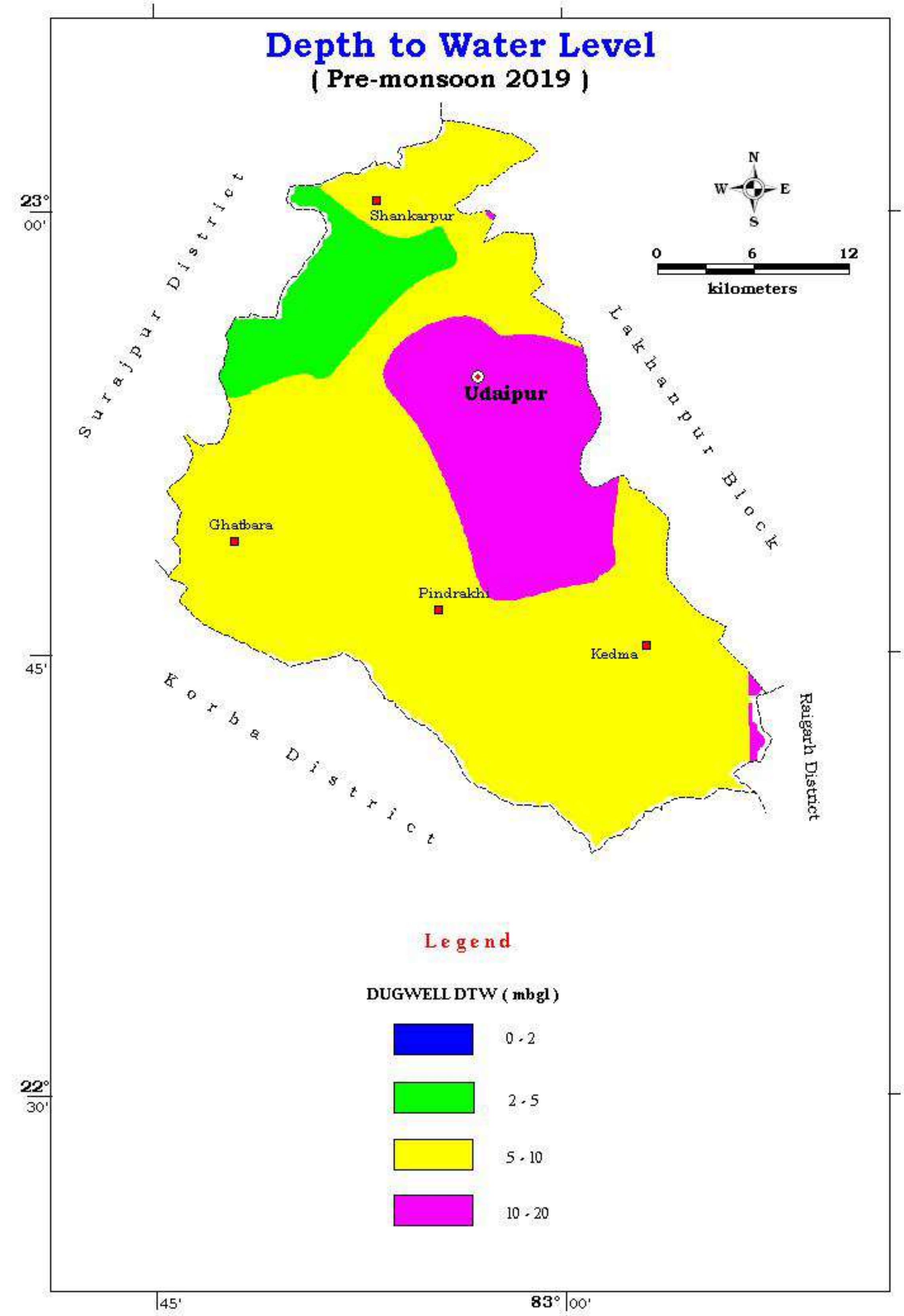

Figure 4 Depth to water level map Phreatic Aquifer (Pre-monsoon)

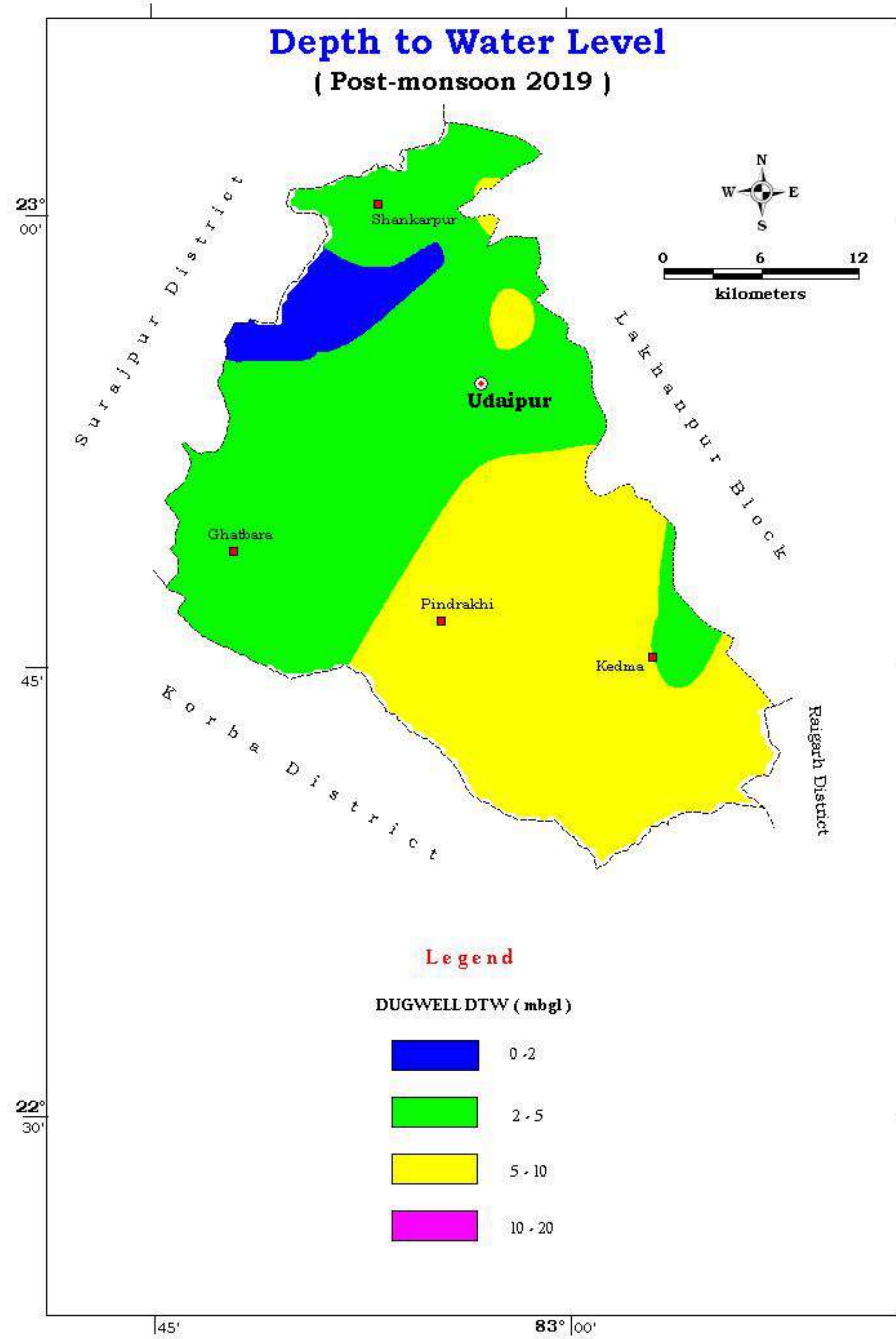

Figure 5 Depth to water level map Phreatic Aquifer (Post-monsoon)

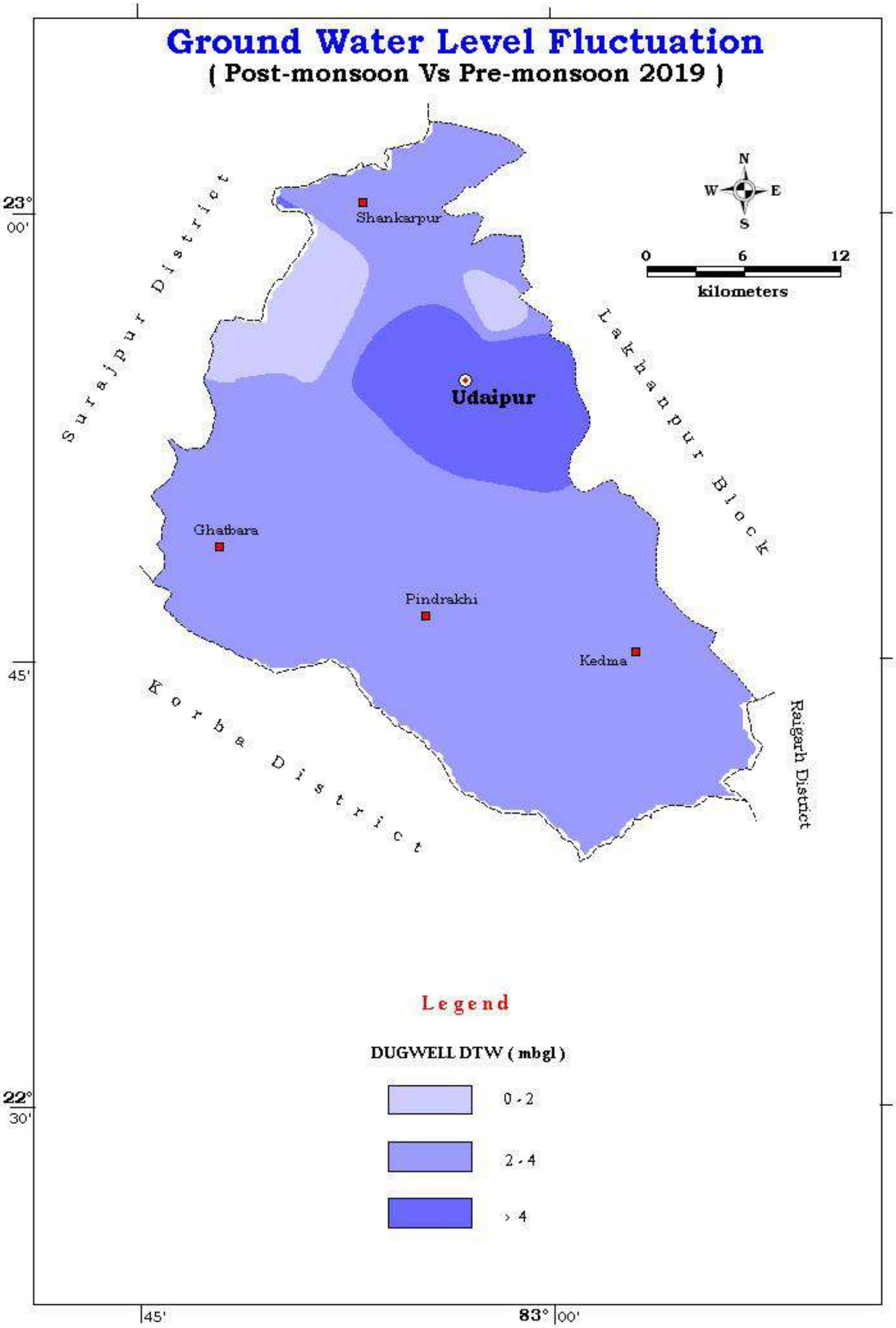

Figure 6 Depth to water level fluctuation map of Phreatic Aquifer

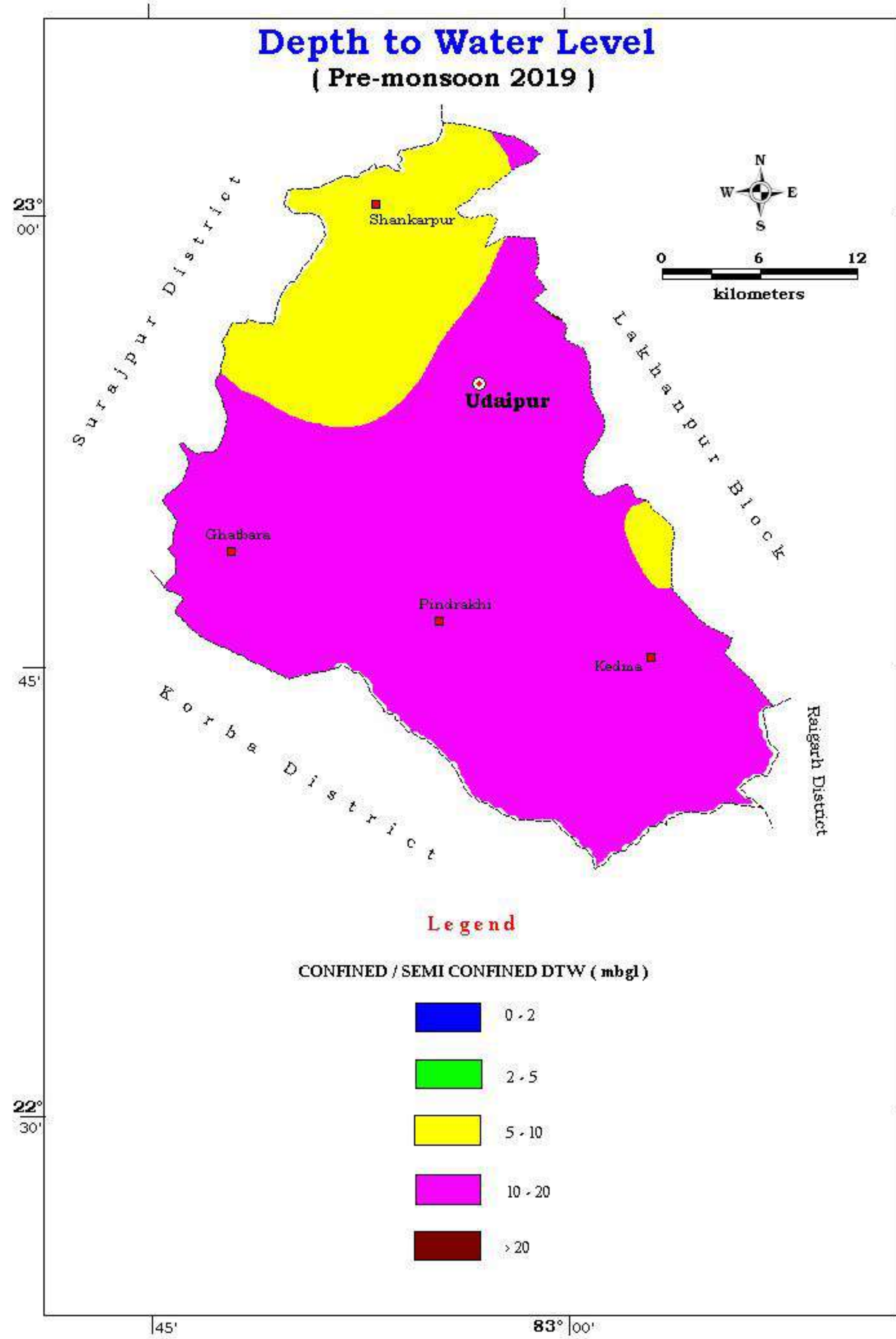

Figure 7 Depth to water level map Semiconfined Aquifer (Pre-monsoon)

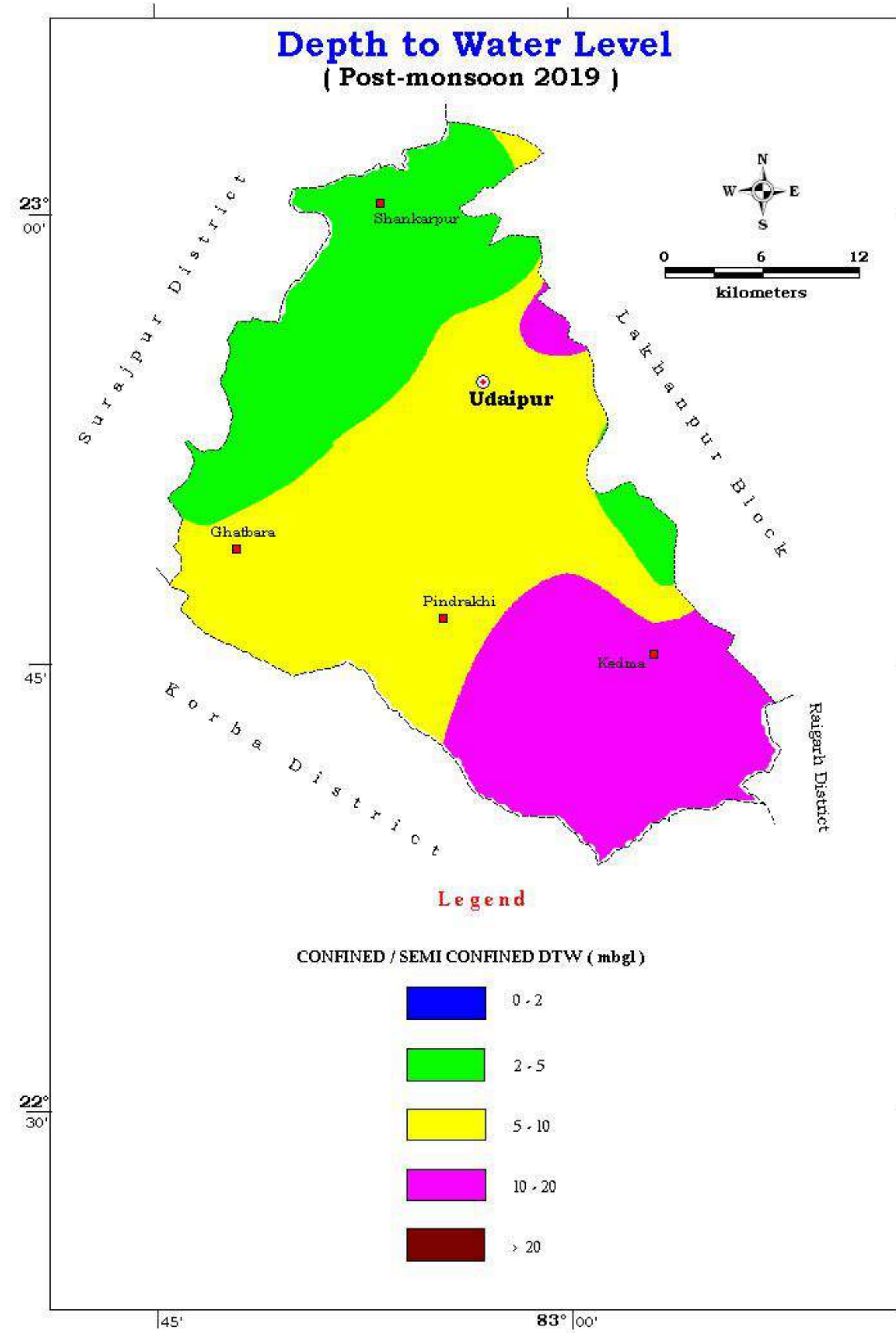

Figure 8 Depth to water level map Semiconfined Aquifer (Post-monsoon)

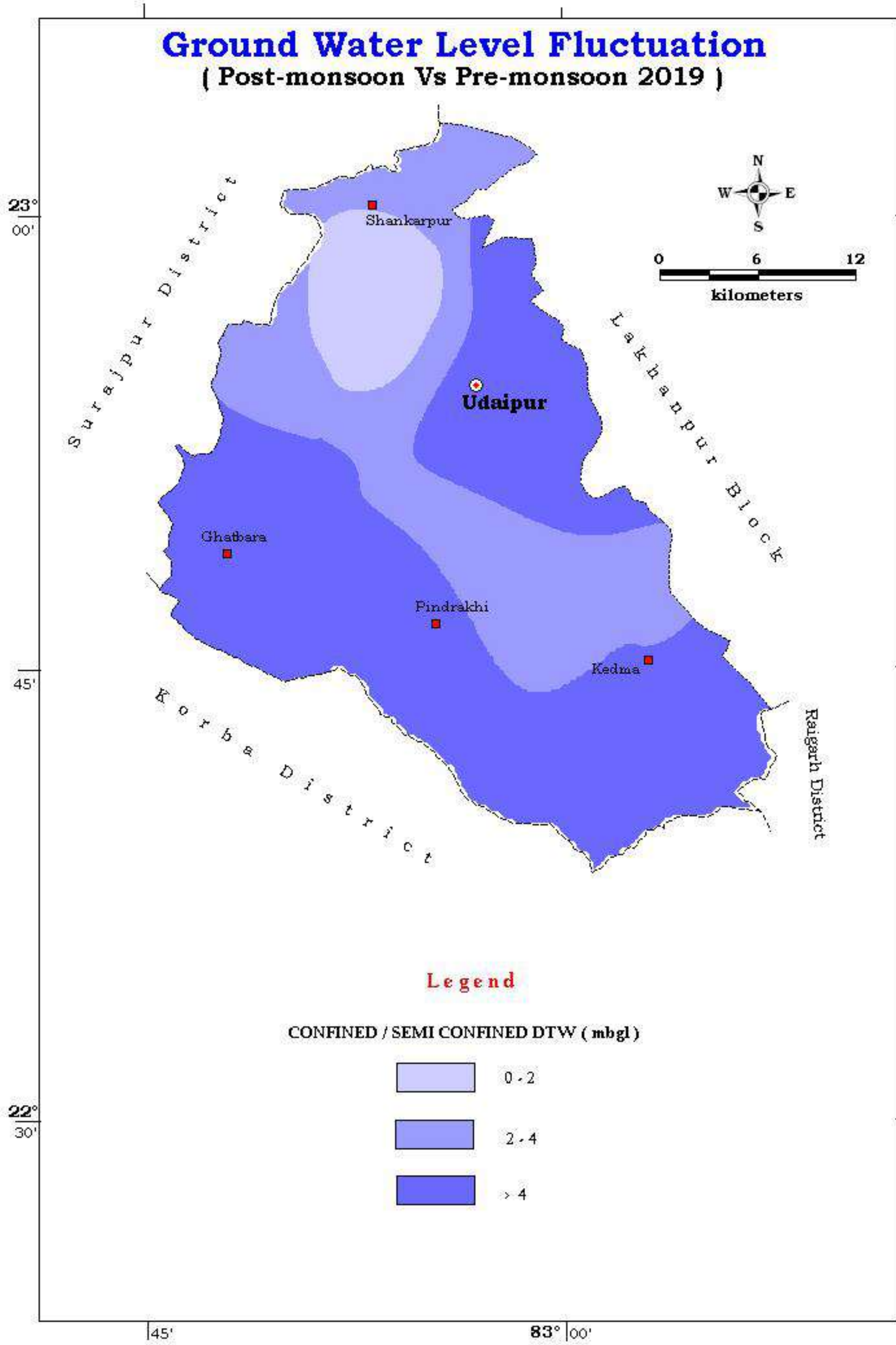

Figure 9 Depth to water level fluctuation map of Semiconfined Aquifer

(iv) <u>The long term water level trend</u>: There is no significant decline in water level in pre and post monsoon period in all observed NHS networks.

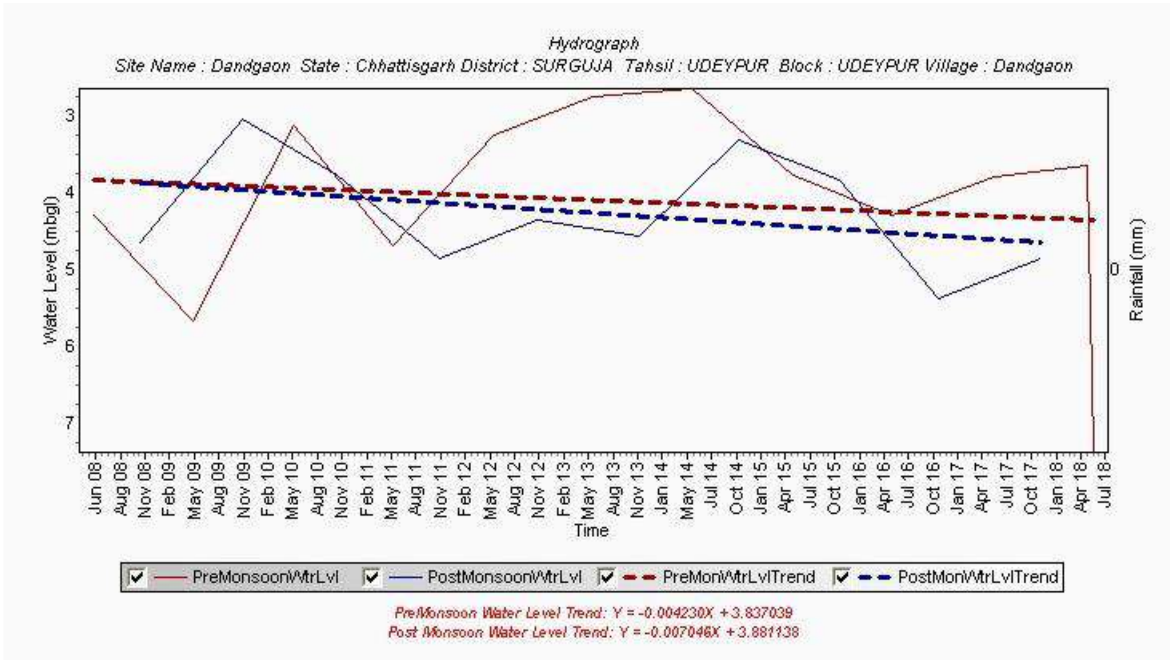

Figure 10 a: Hydrograph of Dandgaon village, Udaipur block

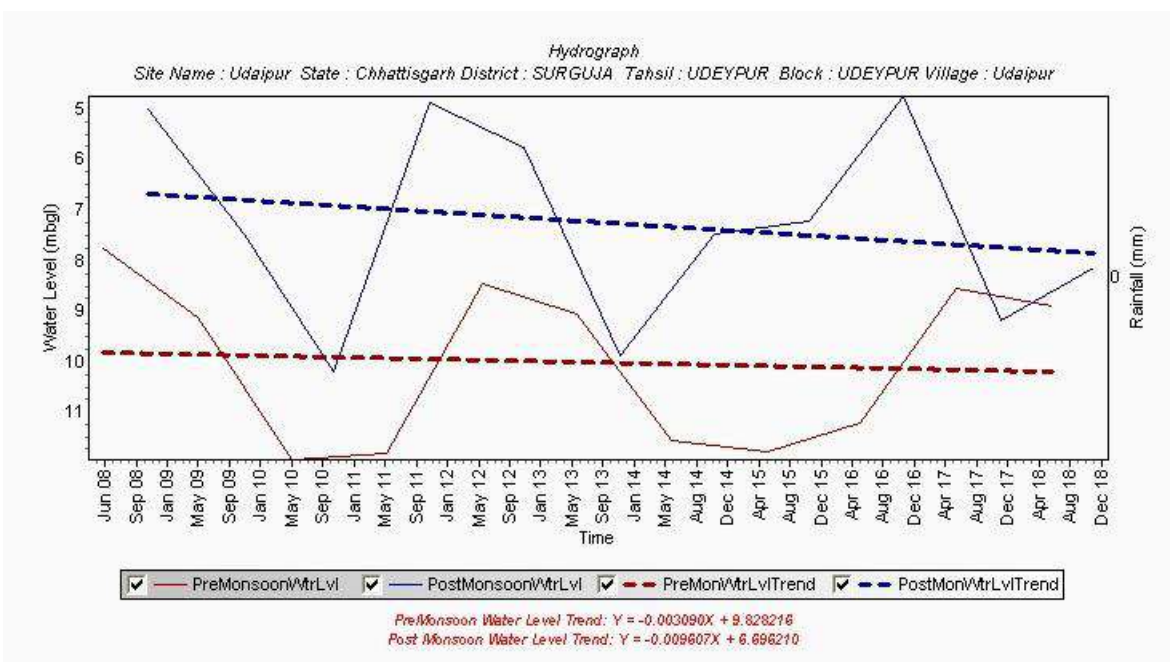

Figure 10 b: Hydrograph of Udaipur town, Udaipur block

2. Aquifer Disposition:

Number of Aquifers: There are two major aquifer system viz. Granite Aquifer system and Sandstone Aquifer system. Both the aquifer system has the shallow aquifer and deeper aquifer which occurs in phreatic and semiconfined condition respectively.

3-d aquifer disposition and basic characteristics of each aquifer:

Sandstone Aquifer System:

After studying the exploratory well details in Sandstone aquifer system, it has been envisaged that Gondwanas rock 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. 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.

The average thickness of the weathered portion is around 21 m. In general, the discharge varies from meagre to 12.5 lps with an average yield of 4.33 lps. The average drawdown of the formation is around 26 m. Rotary drilling technique is preferred in sandstone aquifer where well construction is required depending upon the water zone and formation encountered. Water zone has been encountered up to 200 meters. Transmissivity range observed is 3.74 to 159.1 sq. meter/day. Details of the aquifer characteristics and water zone encountered are shown in annexure.

Granite Aquifer System:

Groundwater occurrence is largely limited to secondary permeability, such as weathered zones, joints, fractures or faults. The potential of weathered zones depends on the degree and depth of weathering and associated fracturing, and the saturated thickness. The aquifers are generally discontinuous, and often confined. Higher yields are obtained where thick weathered zones are associated with bedrock fracturing.

The average thickness of the weathered portion in the area is around 20 m. In general, the discharge varies from meagre to 5.5 lps. The average drawdown of the formation is around 29 m. DTH drilling technique is preferred in Granite aquifer where well construction is required depending upon the thickness of weathered zone. Water zone has been encountered up to 158 mbgl in the formation. Transmissivity range observed is upto 18.72 sq meter/day.

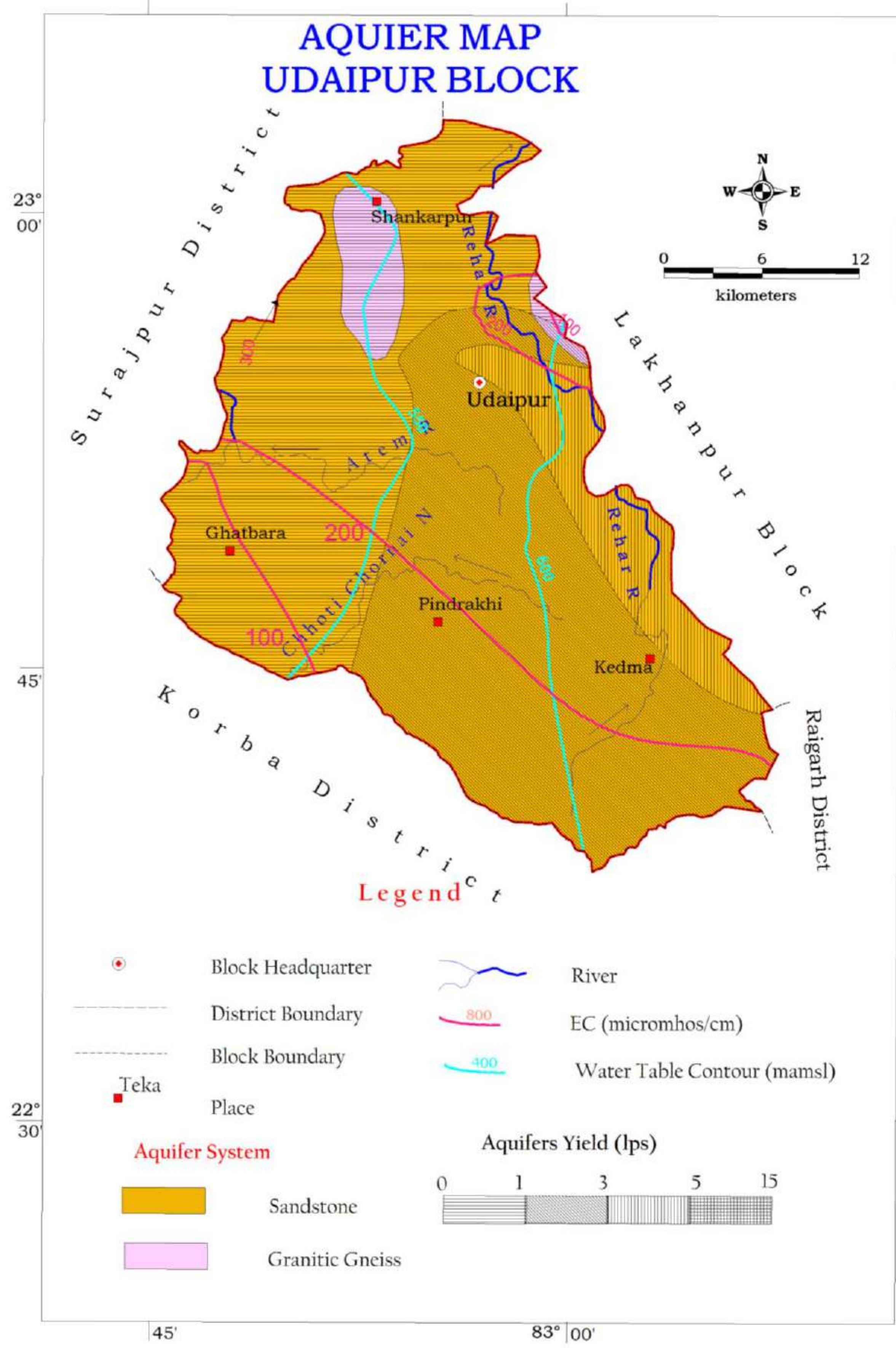

Figure 11: Aquifer map of Udaipur block

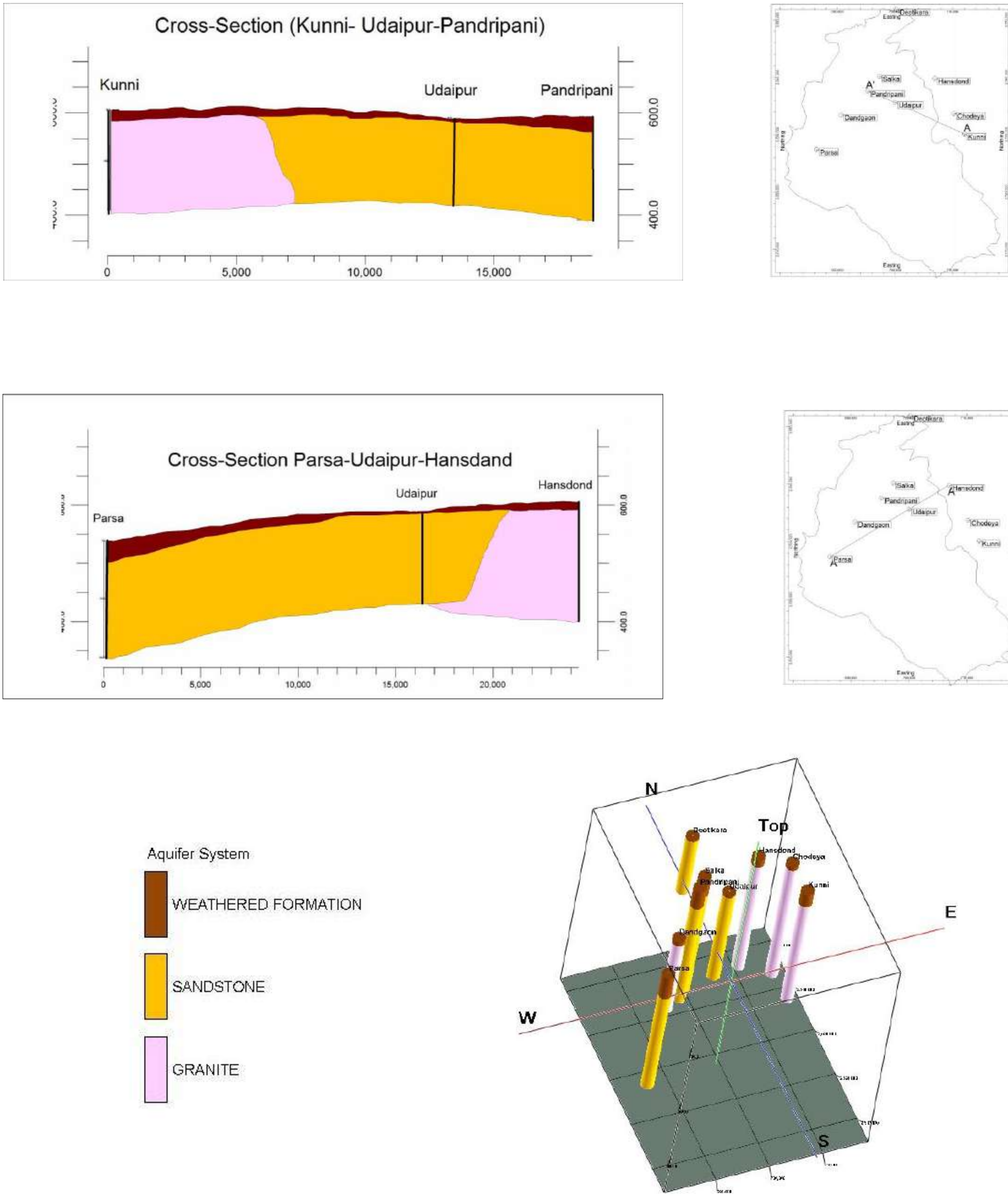

Figure-12, Disposition of Aquifer, Udaipur Block

3. **Ground water Resource, extraction, contamination and other issues:**

Resource availability of Udaipur block is given in the table -4 where net ground water availability for future use is 8235.72 ham. The extraction details and the future scenario (2025) along with the categorisation are also depicted in the table-4.

Table 7 Categorization of Assessment Unit

District	Block	Stage of Ground water development (%)	Categorisation
Udaipur	Udaipur	17.36	Safe

Categorisation: Udaipur block falls in safe category. The stage of Ground water development is 17.36 %. The Annual Extractable Ground Water Recharge is 9973.73 ham. The Ground water draft for all uses is 1711.58 Ham. The Ground water resource for future uses for Udaipur Block is 8235.72 Ham.

Chemical Quality of Ground water and Contamination**:** Throughout the study area, the water samples from both dugwell and handpumps were collected and chemical analysis has been completed (Annexure I).
Overall ground water of the study area is suitable for the drinking, agriculture and industrial purpose. In Udaipur at 73 villages Fluoride contamination and at 87 villages Iron contamination reported. (Source: https://ejalshakti.gov.in/IMISReports/MIS.html)

4. **Ground Water Resource enhancement:**

   Aquifer wise space available for recharge and proposed interventions:

Table -8: Summarised detail of Volume of porous space available for recharge (Aquifer wise)

Major Aquifer	Area Identified for Artificial Recharge (Sq. Km)	Sp. Yield for the formation	Volume of vadose zone available for recharge(mcm)	Sub surface storage potential (mcm)
Sandstone (Gondwana)	352.35	0.01	694	6.94

5. Issues:

(i) During summer, dugwells in villages becomes dry at many locations. Several handpumps also stop yielding water. The aquifer itself is a low yielding one.

(ii) In Granite aquifer system potential zone for ground water is related with occurrence of fracture, so drilling a high yield well is always a challenge. Proper scientific study coupled with geophysical investigation may minimize the failure of well.

(iii) Problems in Tube well / Bore well construction in Sandstone Aquifer System: In case of filter point wells drilled with hand bores, the depth of penetration is variable and whenever the Shale or any other compact layers are encountered, further drilling becomes difficult. When portable rotary rigs are deployed for drilling, the drilling operations become very slow and the pore spaces in fine grained layers are invaded by drilling fluid as a result the discharges tend to be poor. Proper well development is seldom carried out by private drillers and as a result fine sands get deposited in the bore. Sometimes caving of wells are commonly reported particularly when the top loss sand is cased and the bottom shales are drilled with down the hole hammer rig.

(iv) Problems in ring well construction Sandstone Aquifer System: The common problem is sand filling inside the rings during and after the lowering of rings, thereby practically eliminating the change of deepening of wells to tap more saturated column in summer months. The weep holes provided in the rings allow water with fine sands and gets filled up as and when sand removal is in progress thereby making it difficult for lowering of rings is highly saturated sands.

(v) High value of Fluoride and Iron has been reported from several locations.

6. Management Plan:

(i) It has been observed during fieldwork, there is colossal wastage of groundwater through private well and public water supply system. So, Information, Education and Communication (IEC) activities need to be organized to sensitize people on the issues of depleting groundwater resource. Massive awareness campaigns are essential to aware people about the importance of community participation in saving water.

(ii) Desiltation of existing Tanks and Talabs to be carried out for efficient storage of rainwater. Also Rain water harvesting structures may be constructed in villages to reduce stress on groundwater.

(iii) It has been observed that the demand of ground water is increasing for irrigation, industrial and domestic uses. At locations where water level is declining, we have to go for artificial recharge on a long-term sustainability basis. Artificial Recharge structures may be constructed at suitable locations especially in the areas where the water level remains more than 3m in the post-monsoon period in this block to arrest the huge non-committed run-off and augment the ground water storage in the area. The different types of artificial structures feasible in the block are described in table-9.

Table-9: Types of Artificial Recharge structures feasible

Name of Block	Area Feasible for recharge (sq.km)	Volume of Sub Surface Potential for Artificial recharge (MCM)	Types of Structures Feasible and their Numbers			
			Percolation tank	Nalas bunding cement plug/ check dam	Gravity head /Dug well/ tube well/Recharge shaft	Gully plugs Gabion structures
Udaipur	352.35	8.087	21	43	171	94
	Recharge Capacity (MCM)/structure		0.2192	0.0326	0.00816	0.0073

(iv) Fluoride and Iron filter plant may be installed in the villages having higher value of contaminants.

(v) In urban areas STP may be installed for the treatment of sewage water in proper numbers to avoid contamination of ground water. Treatment of sewage water in village through soak pit for the individual houses and Seechewal model or similar model for community level may be adopted to avoid contamination of ground water. Treated water may also be reused for irrigation and other industrial purposes.

(vi) Since the stage of development in the block is 54.14 %. There is scope of utilizing more ground water for future irrigation purpose. Additional number of Ground water abstraction structure may be developed for the effective utilization of ground water resources in the block. The ground water is presently developed through dug wells and tube wells. Yield potential for the block has been shown in Aquifer map (fig 11). Sites for wells need to be selected only after proper scientific investigation. The ground water quality also needs to be ascertained and the wells used for water supply should be first checked for Iron, Fluoride and other pollutants.

Table 10: Potential of Additional GW abstraction structure creation

Net Groundwater availability (ham)	Stage of ground water Development (%)	Present ground water draft (Ham)	Ground water draft at 70% stage of development (ham)	Surplus ground water at present Stage of Development (ham)	Number of TW Recommended in each block (Assuming unit draft as 1.6 ham/structure/year)	Number of DW Recommended in each block (Assuming unit draft as 0.72 ham/structure/year)
9973.73	17.16	1711.58	6981.61	5270.03	1976	2928

6. Conclusion:

For effective utilization of Ground water existing draft for irrigation may be coupled with micro irrigation system. Change in irrigation pattern, optimum use of available resource, use of ground water potential created after artificial recharge can lead to groundwater savings and increase in gross cropped area of the block (Table: 11).

Table 11: Detail of groundwater saved through change in cropping pattern and other interventions

Block	Existing Gross Ground Water Draft for Irrigation in Ham	Additional Saving of GW after using Micro Irrigation methods in Ham(Assuming 30 % saving)	GW Potential created after Artificial recharge structure in Ham	Development by new GW abstraction structure	Additional GW irrigation Potential created in Ham	Additional Irrigation potential creation for Maize/ wheat in winter season in Ha (Assuming 500 mm water requirement)	Percent increase in Crop area compare to Gross cropped area
Udaipur	1518.90	455.67	808.66	5270.03	6419.62	12839.24	77.24%

केन्द्रीय भूमि जल बोर्ड

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