केंद्रीय भूमि जल बोर्ड

जल संसाधन, नदी विकास और गंगा संरक्षण मंत्रालय

भारत सरकार

Central Ground Water Board

Ministry of Water Resources, River Development and Ganga Rejuvenation

Government of India

Report on

AQUIFER MAPPING AND MANAGEMENT PLAN

Barmkela Block, Raigarh District, Chhattisgarh

उत्तर मध्य छत्तीसगढ़ क्षेत्र, रायपुर

North Central Chhattisgarh Region, Raipur

REPORT ON
AQUIFER MAPPING AND MANAGEMENT PLAN
OF BARMKELA BLOCK , RAIGARH DISTRICT, CHHATTISGARH

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AQUIFER MAPPING AND MANAGEMENT PLAN
FOR BARAMKELA BLOCK, RAIGARH DISTRICT, CHHATTISGARH

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BARAMKELA BLOCK AQUIFER MAPS AND MANAGEMENT PLANS

1. Salient Information:

About the area: The Baramkela Block of Raigarh District is situated in the southern part of Raigarh district of Chhattisgarh and is bounded on the north by Janjgir Champa district and pussore block of Raigarh District, in the west by Sarangarh block, in the south by Mahasamund district and in the East by Odisha state. The area lies between 21.3405 and 21.7024 N latitudes and 83.2217 and 83.4712 E longitudes. The geographical extension of the study area is 462 sq.km representing around 6.75 % of the district's geographical area. The area is served by a good road network from the District Headquarter Raigarh. The administrative map of Baramkela block is shown in Fig. 1

Population: The total population of Baramkela block as per 2011 Census is24739 out of which rural population is 23225& the urban population is only 1514. 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
Baramkela	24739	12357	12382	23225	1514

Source: CG Census, 2011

Growth rate: The decadal growth rate of the block is 15.49 as per 2011 census.

Rainfall: The study area receives rainfall mainly from south-west monsoon. It sets in third/fourth week of June and continues till mid-August/September with heaviest showers in the months of July and August. The months of July and August are the heaviest rainfall months and nearly 95% of the annual rainfall is received during June to September months. Average annual rainfall in the study area is (Average of the last five years i.e. 2008 to 2012)1033.54 mm

Table-2: Rainfall data in Baramkela block in mm

Year	2011	2012	2013	2014	2015
Monsoon rainfall	957.00	1186.5	799.70	1215.8	1008.70

Source: Statistical Hand Book

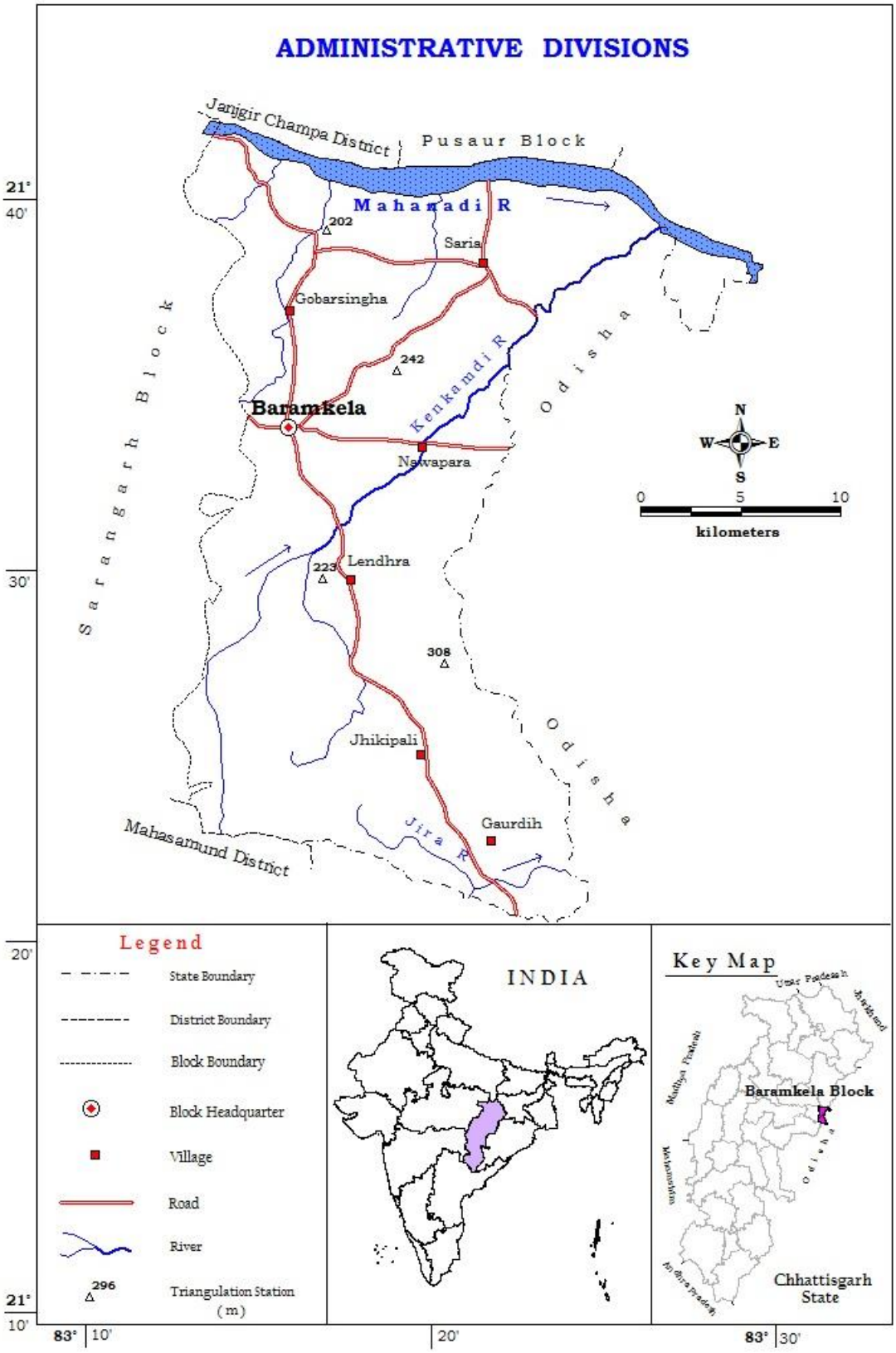


Fig.1 Administrative Map of Baramkela Block

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 ponds and other sources. The groundwater abstraction structures are generally Dugwells, Borewells /tubewells. The principal crops in the block are Paddy, Wheat and Gram.

. In some areas, double cropping is also practiced. The agricultural pattern, cropping pattern and area irrigated data of Baramkela block is given in Table3 (A, B, C, D).

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

Block	Total geographical area	Revenue forest area	Area not available for cultivation	Non-agricultural & Fallow land	Agricultural Fallow land	Net sown area	Double cropped area	Gross cropped area
Baramkela	46319	526	6445	5015	2242	32091	7997	40088

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

Block	Kharif	Rabi	Cereal				Pulses	Tilhan	Fruits Vegetables	Reshe	Mirch Masala	Sugar-cane
			Wheat	Rice	Jowar & Maize	Others						
Baramkela	32063	8025	3411	30027	61	0	2179	2416	1104	35	579	276

Table 3 (C): 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 Irri-gated area	Gross irrigated area	% of irrigated area wrt. Net sown area
Baramkela	4007	3202	13250	292	30	601	1124	1475	17421	19891	54.28

Table 3 (D): Contribution of Groundwater in Irrigation Pattern (ha)

Block	Area irrigated through Borewell/ Tubewell	Area irrigated through Dugwell	Area irrigated through Groundwater	Net area irrigated through all sources	GW contribution in Irrigation (%)
Baramkela	13250	30	13280	17421	76.22

Water Level Behavior: (i) Pre- monsoon water level: In the pre-monsoon period, it has been observed that in Baramkela block, in Limestone, the maximum water level is 7.3 m at Kandola, the average water level is 5.27 mbgl. In sandstone, the maximum water level is 9.0 m at Jhikipali, the average water level is 7.85 mbgl.

Table 4: Aquifer wise Depth to Water Level (Pre-monsoon)

Block Name	Phreatic Limestone			Phreatic Sandstone		
	Min	Max	Avg	Min	Max	Avg
Baramkela	2.05	7.3	5.27	6.7	9.0	7.85

Water Level (in mbgl)

(ii) Post- monsoon water level: In the post-monsoon period, it has been observed that the water level varies from 1.5 to 6.7 mbgl with an average of 3.4 mbgl in Limestone area. In sandstone terrain, the post monsoon water level varies from 4.5 to 7.3 mbgl.

Table 5: Aquifer wise Depth to Water Level (Post-monsoon)

Block Name	Phreatic Limestone			Phreatic Sandstone		
	Min	Max	Avg	Min	Max	Avg
Baramkela	1.5	6.7	3.4	4.5	7.3	5.9

Water Level (in mbgl)

(iii) Seasonal water level fluctuation: The water level fluctuation data indicates that in Baramkela block, water level fluctuation varies from 0.3 to 3.5 m with an average fluctuation of 1.87 in Limestone area. However, in sandstone areas, the fluctuation does not vary much which is in the order of 1.95 m (varies from 1.7 to 2.2m).

Table 6: Aquifer wise Depth to Water Level Fluctuation

Block Name	Phreatic Limestone			Phreatic Sandstone		
	Min	Max	Avg	Min	Max	Avg
Baramkela	0.3	3.5	1.87	1.7	2.2	1.95

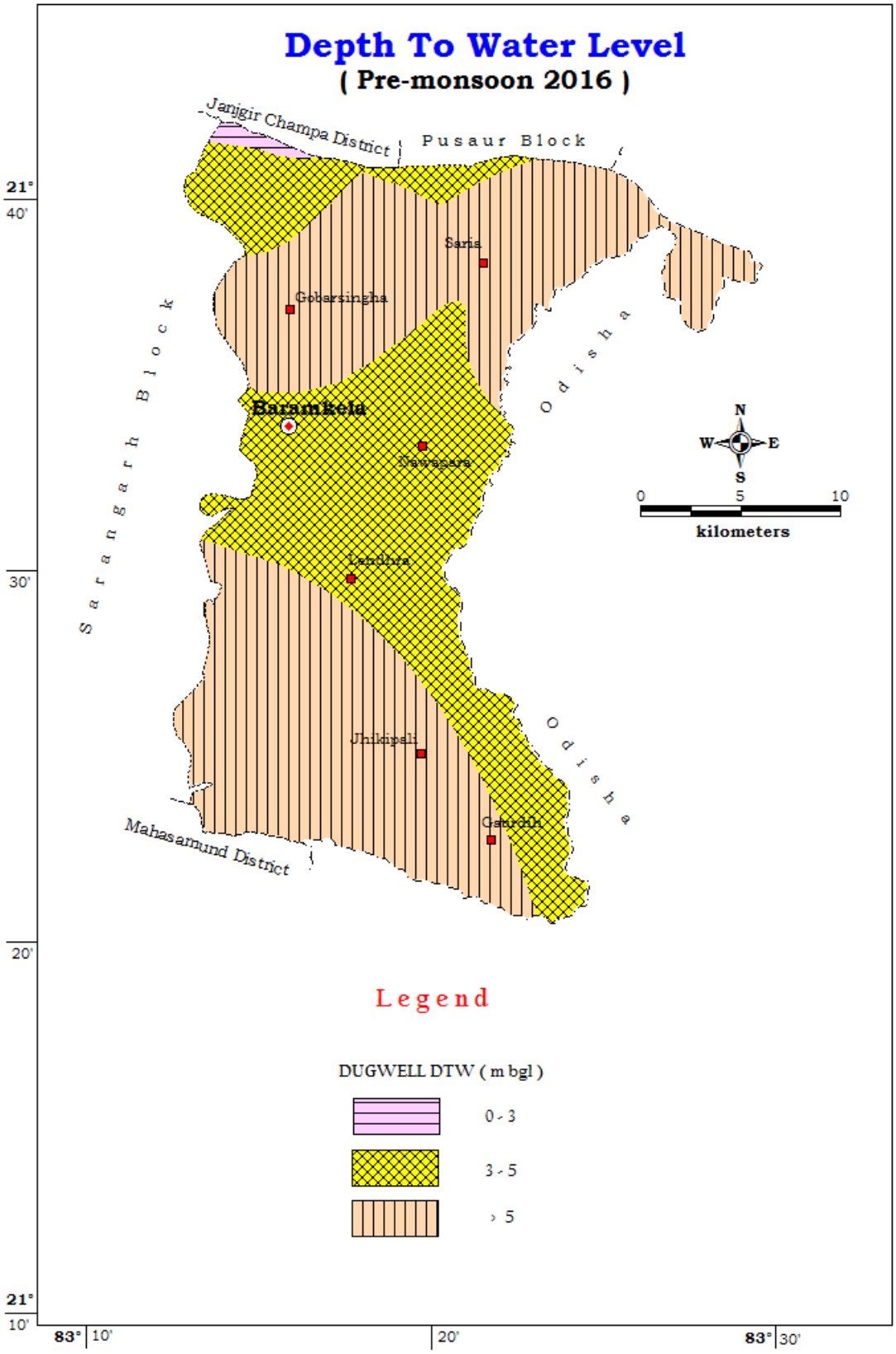


Fig 2 Pre- monsoon Depth to water level Map (Phreatic aquifer)

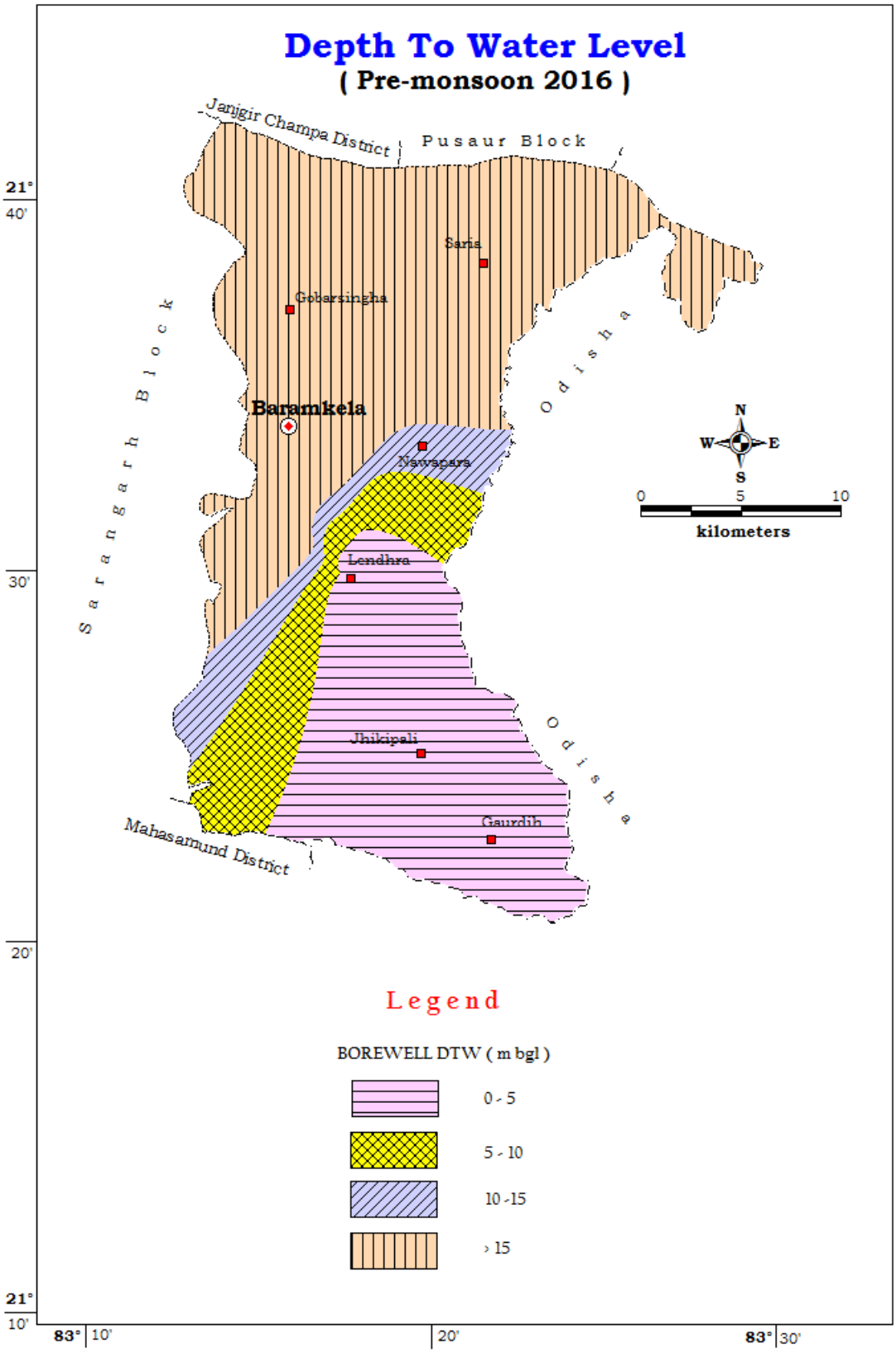


Fig 3 Pre- monsoon Depth to water level Map (Deeper aquifer)

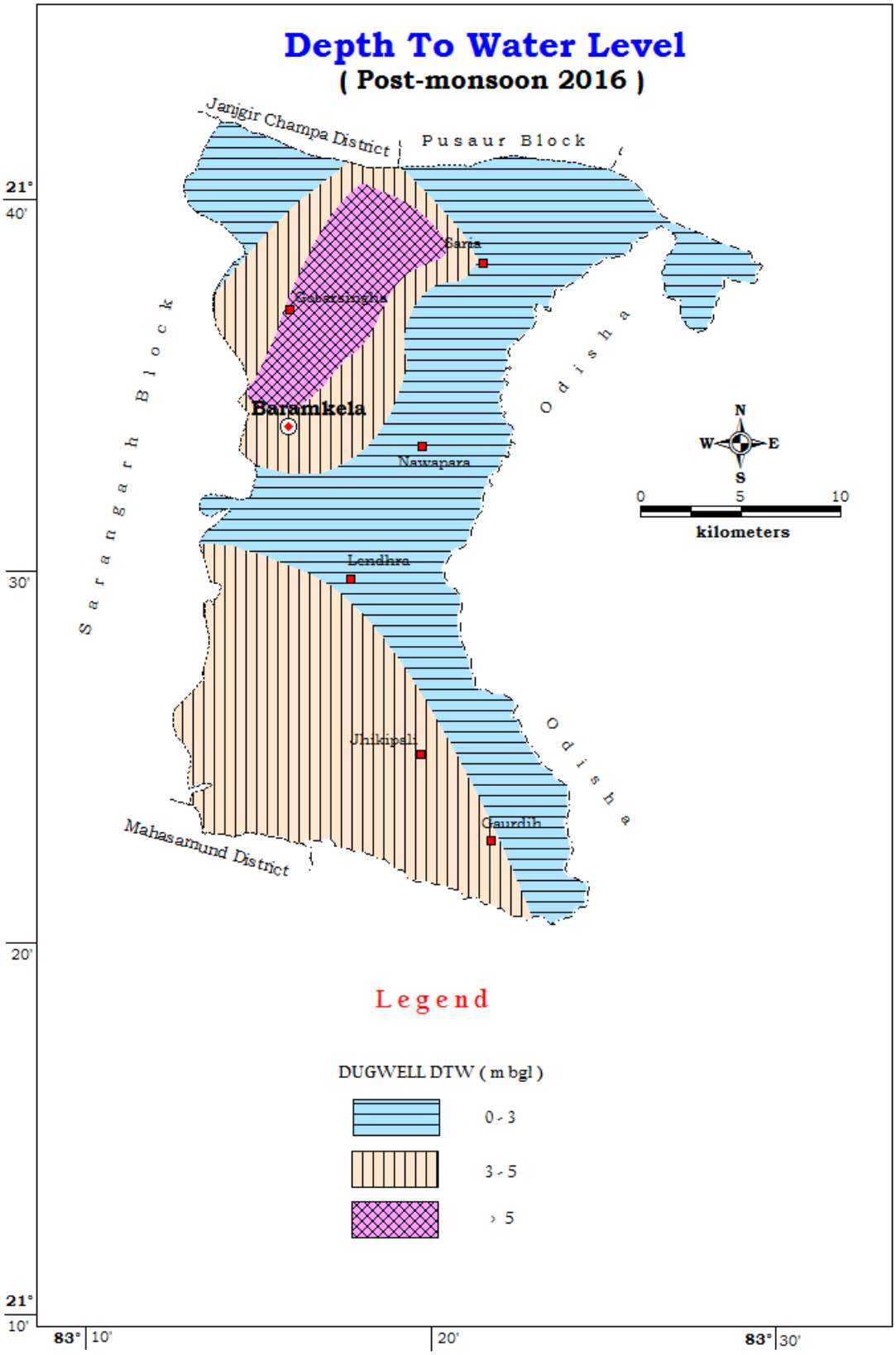


Fig 4 Post- monsoon Depth to water level Map (Phreatic aquifer)

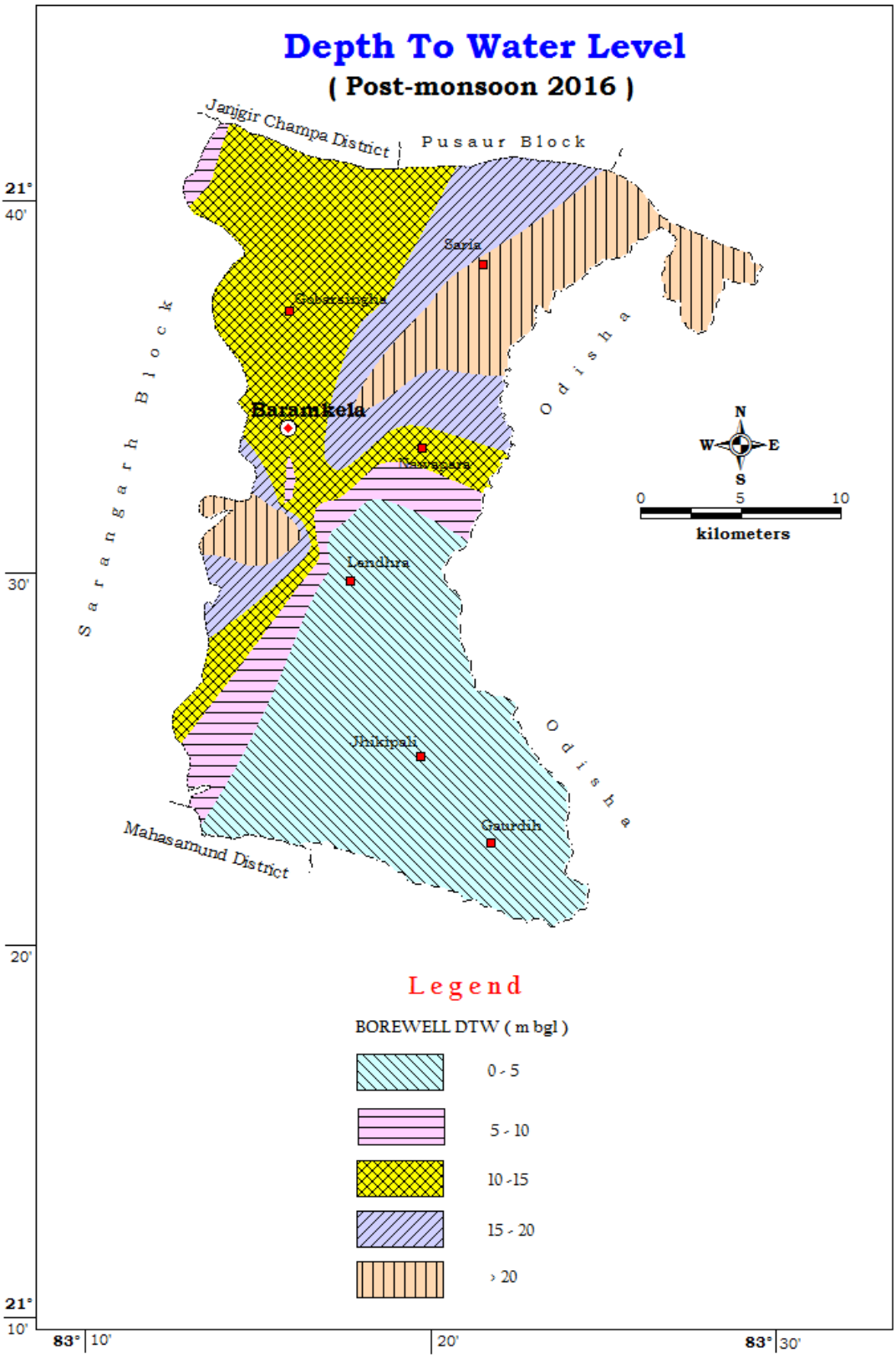


Fig 5 Post- monsoon Depth to water level Map (Deeper aquifer)

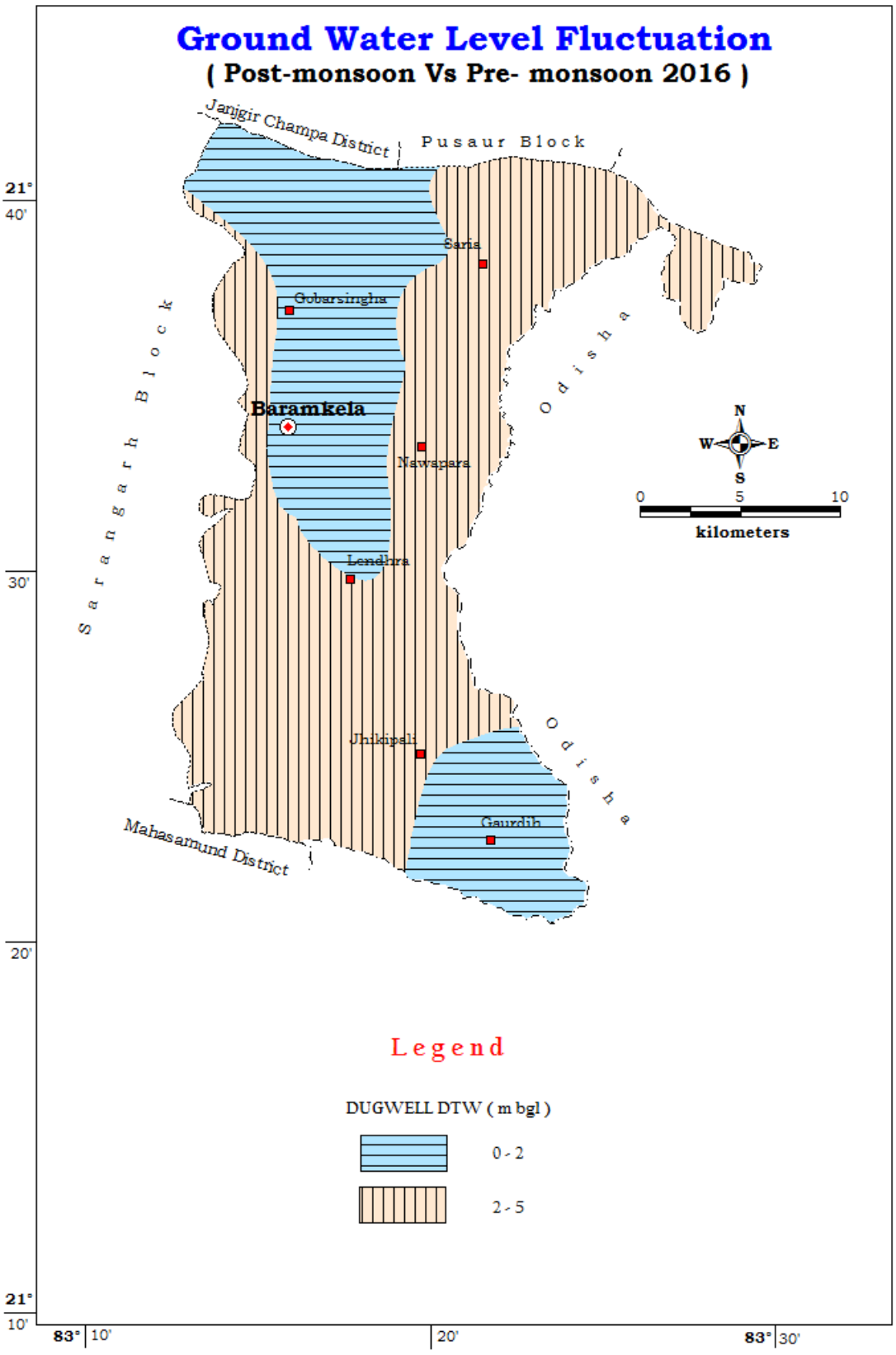


Fig 6 Water level fluctuation Map (Pre Vs Post) (Phreatic aquifer)

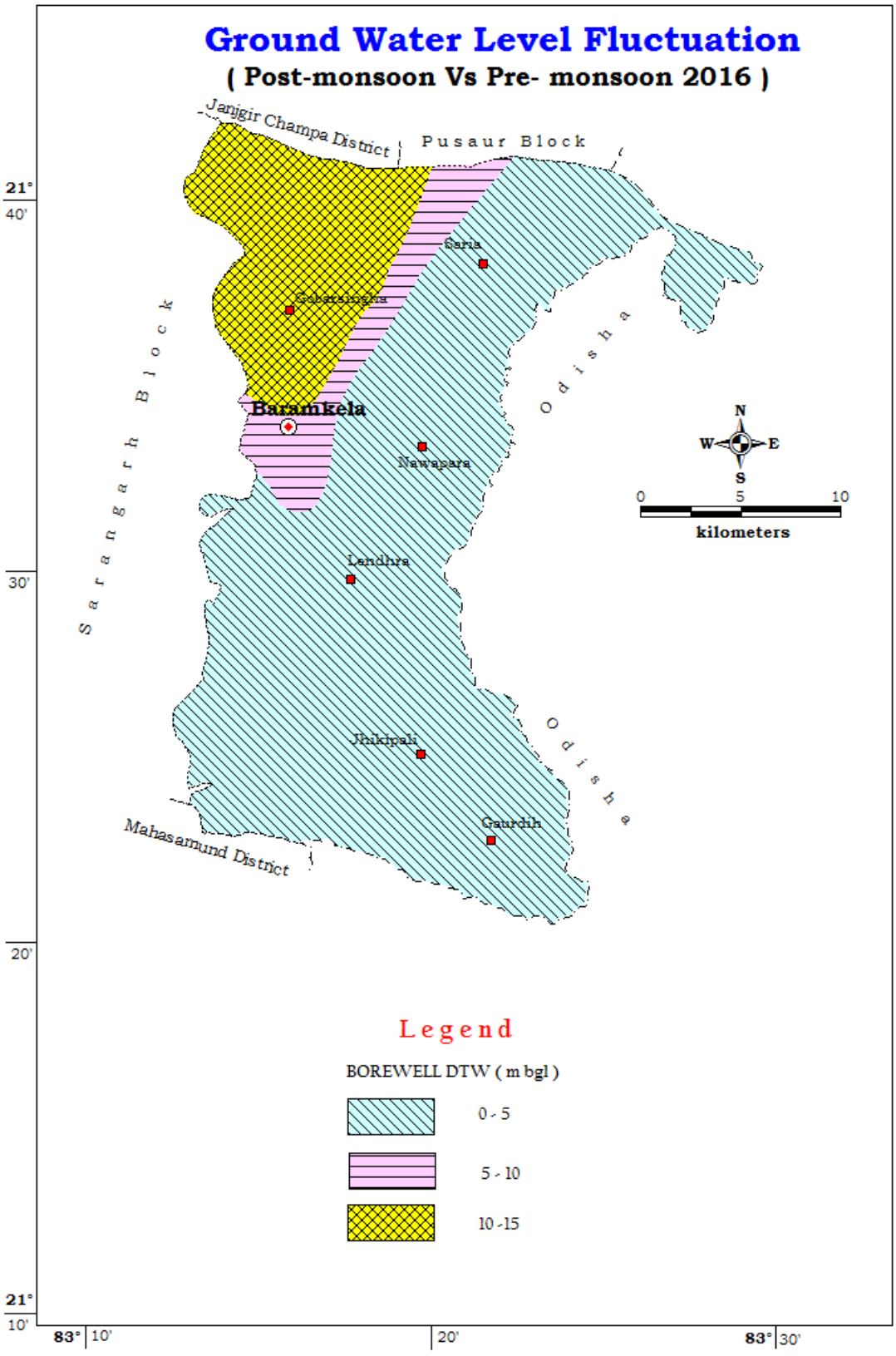
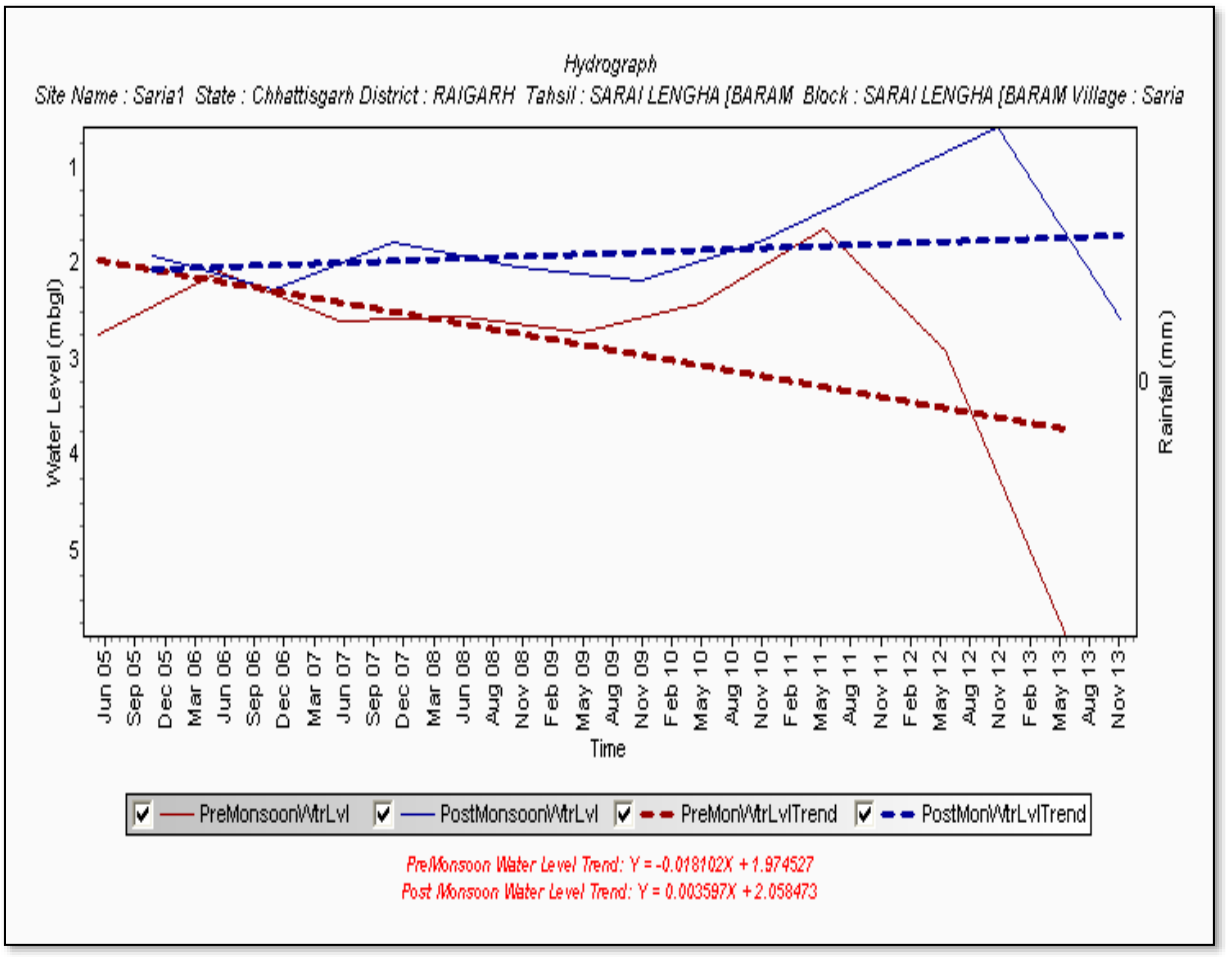
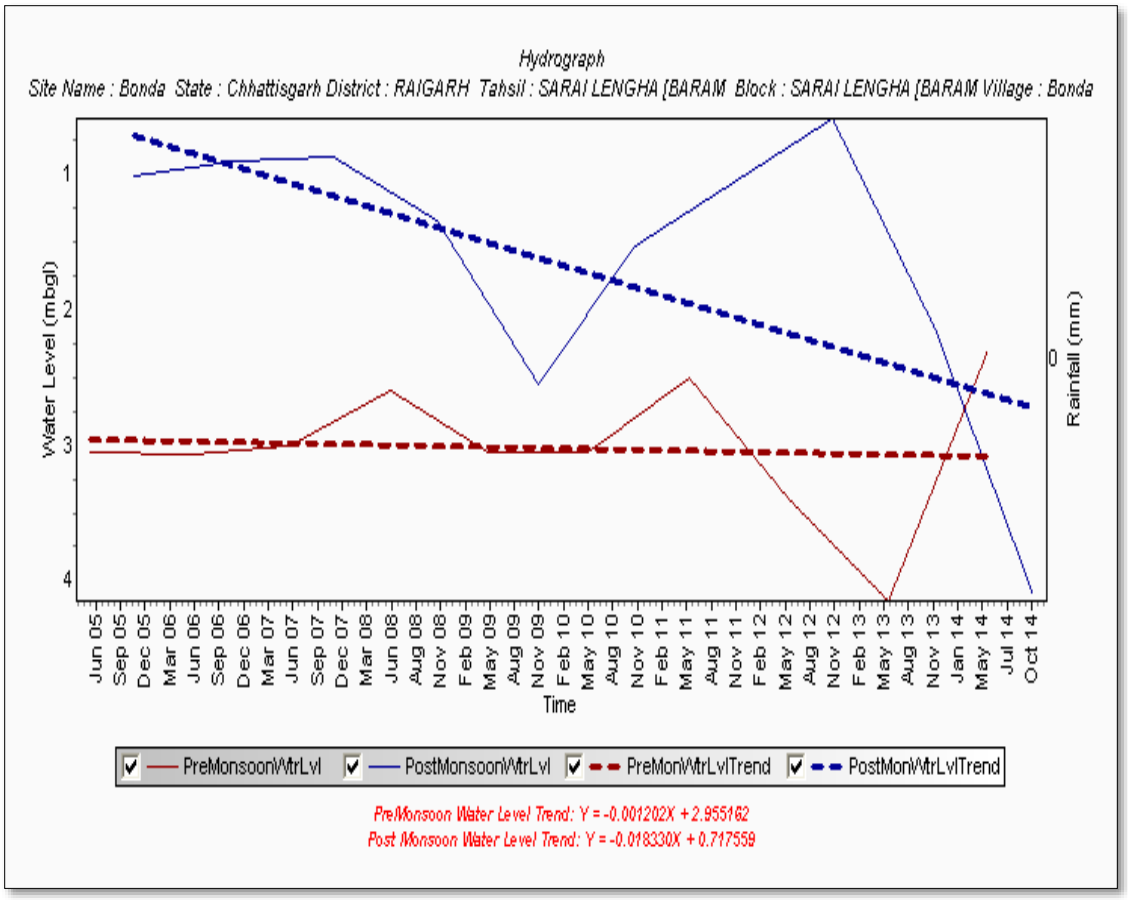


Fig 7 Water level fluctuation Map (Pre Vs Post) (Deeper aquifer)

(iv) The long term water level trend: It indicates that there is fall in water level both in pre-monsoon and post-monsoon period.





2. Aquifer Disposition:

Number of Aquifers: There are two aquifers viz. (i) Limestone (Raigarh Group) & (ii) Sandstone (Chandrapur Formation). The above two rock types both in phreatic and fractured condition serves as aquifer system in Baramkela block. Geologically there are two rock types in Baramkela Block, i.e. Raigarh limestone and. Chandrapur sandstone.

Chandrapur Group: This group is of Mesoproterozoic age represented by the arkosic and orthoquarzite arenites/sandstones. This is the oldest formation lying at the bottom of the Hirri sub basin and unconformably overlying the crystalline basement.

Raigarh Formation: The Raigarh Formation is mainly composed of shale-limestone-dolomite. These are generally horizontally bedded, unmetamorphosed, thinly laminated intruded by series of dolerite dyke. Thea rea around Baramkela- Saria- Gobarsingha- Katangpali is occupied by black coloured, course grained, bedded, non stromatolitic dolomite. These are facies variation of Raigarh shale and occupies the upper part of sequence. In the transition zone, the dolomites are purple coloured and massive in nature. The outcrop of massive purple argillaceous dolomite can be seen along the Kinkari nala around Kankidipa and Manipura. The outcrop of black dolomite can be seen in Katang nala section near Katangpali and Kariganthi.

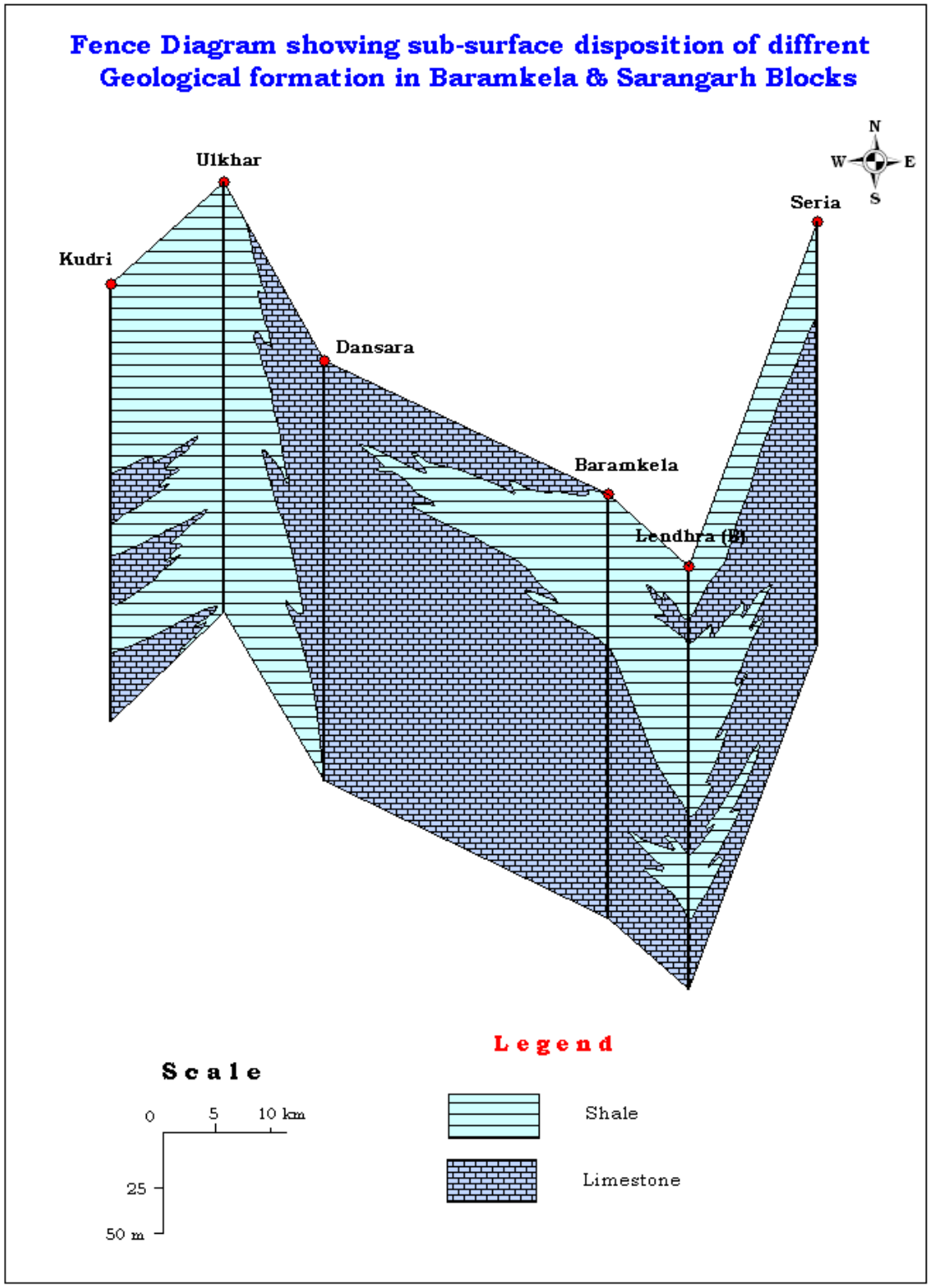


Fig 8- Fence Diagram of Subsurface Geological formation in Baramkela and Sarangarh Blocks.

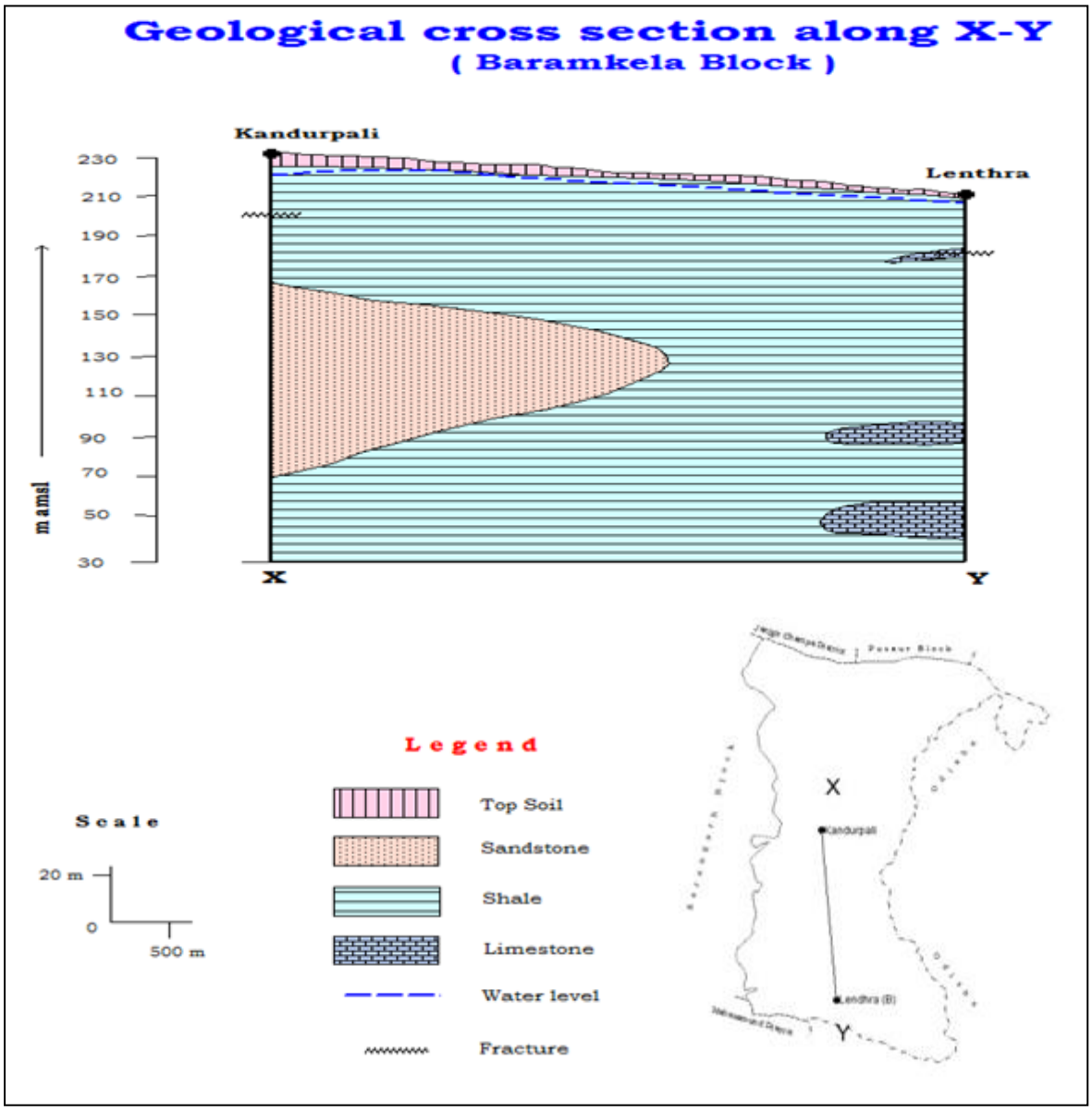


Fig 9 Hydro-geological cross section along Kandurpali and Lendhra(X-Y) of Baramkela Block

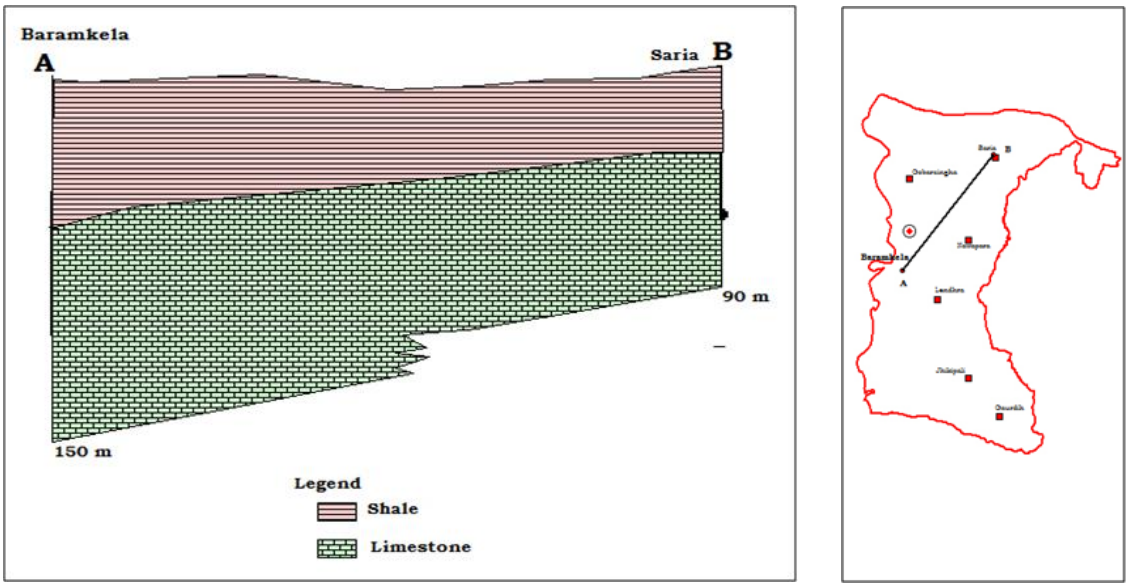


Fig.10 Hydro-geological cross section along Baramkela and Saria (A-B) of Baramkela Block

Aquifer wise characteristics:

a) Chandrapur Group: - The Chandrapur Group of rock mainly consist of sandstone which is massive, hard and compact with almost no primary porosity. 01 set of fractures has been encountered in Chandrapur Sandstone in the depth 50 to 200 m (potential zone). No fractures have been encountered below 50m. The average thickness of the weathered portion in the area is around 10.73 m. The transmissivity of the aquifer is very low and drawdown goes upto 30. 78m.The discharge in this formation ranges from dry to 1.0 lps. The thickness of fractured sandstone is 0.3 m. These formations are mostly developed by the way of shallow tube wells and bore wells.

b) Raigarh Formation: The Raigarh Formation is mainly composed of shale-limestone-dolomite. These are generally horizontally bedded, unmetamorphosed, thinly laminated intruded by series of dolerite dyke. In this area1-2 sets of fracture are encountered in the depth less than 50m (most of the potential zone). Also 01 set of fracture may encounter in the depth 50-200m. The transmissivity ranges from 2 to 35 m2/ day. The drawdown ranges from 2.3 to 20.7m with an average drawdown of 11.25m. The discharge in this formation ranges from 0.5 to 19.0 lps having an average discharge of 10.38 lps. The thickness of fracture limestone in this formation is 0.24m. The development in these formation is by the way of tubewells and borewells. The aquifer map of Baramkela Block is depicted in Fig 9

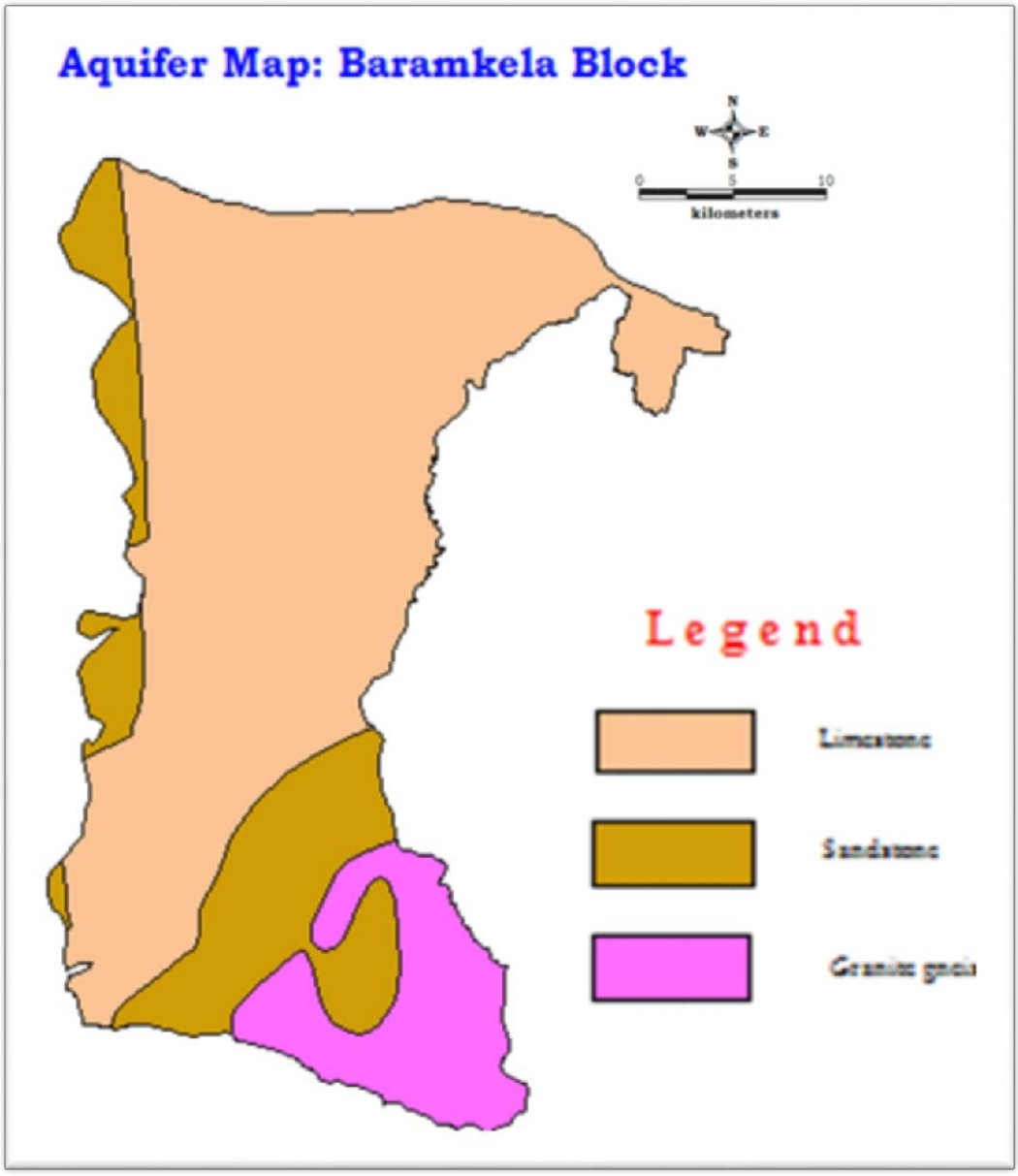


Fig. 11 Aquifer Map of Baramkela Block

Table 7: Distribution of Principal Aquifer Systems in Baramkela

Block	Phreatic and fractured Limestone	%	Phreatic and fractured sandstone	%	Total Area (sq.km)
Baramkela	352	80.18	87	19.81	439

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

Aquifer wise resource availability is given in the Table-8 where the total resource available in Baramkela block is 5890.07 ham out of which the resource available with Limestone area is 4744.16 ham and with Sandstone is 1145.91 ham. The dynamic resource of the block is 3508.08 ham out of which the Limestone area contributes 2836.32 ham and the Sandstone terrain contributes 671.76 ham. The extraction details and the future scenario (2025) along with the categorisation is depicted in the Table-9 and10

Table-8 Total Resources in Baramkela Block

Details	Aquifer 1(A & B) Limestone	Aquifer 2 (A & B) Sandstone	Total
Area (Ha)	35200	8700	43900
GW Draft (Ham)	2800.42	663.26	3463.69
Dynamic GW Resource (Ham)	3060.29	671.76	3732.05
In Storage GW Resource (Ham)	1907.84	474.15	2381.99
Total GW Resource (Ham)	4744.16	1145.91	6114.04

Table-9: Ground water Resources of Baramkela block

District	Assessment Unit / Block	Net Ground Water Availability in Ham	Existing Gross Ground Water Draft for Irrigation in Ham	Existing Gross Ground Water Draft for Domestic & Industrial Water Supply in Ham	Existing Gross Ground Water Draft for All Uses in Ham	Allocation For Domestic & Industrial Water Supply in Ham (2025)	Net Ground Water Availability for Future Irrigation Development in Ham(2025)
Raigarh	Baramkela	3732.05	3340.93	343.84	3684.77	386.71	44.25

Table-10: Categorization of assessment

District	Block	Stage of Ground water development (%)	Categorisation
Raigarh	Baramkela	98.73	Critical

Categorisation: The Baramkela block falls in Critical category. The stage of Ground water development is 98.73%. The Net Ground water availability is 6678.9Ham. The Ground water draft for all uses is 3732.05 Ham. The Ground water resources for future uses for Baramkela Block is 44.25 Ham.

Chemical Quality of Ground water and Contamination**:** Throughout the study area, the water quality is good and all the parameters are within permissible limit. Except in two villages namely Lendhra (0.58), Mahuapali (0.59) where the Iron content is above permissible limits. All the other parameters are within permissible limits. In conclusion it may be said that the groundwater in the Block is suitable for drinking as well as for irrigation purposes.

4. Issues and Management plan

ISSUES

1. High stage of ground water development of due to over exploitation of resource.
2. Poor Sustenance of wells due to Inherent character of aquifers having low yield.
3. Growing of high water consuming crops in-spite of critical stage of GW development.
4. Declining of water levels.

MANAGEMENT PLAN

1. Artificial Recharge structures may be constructed in 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 to augment the ground water storage in the area.
2. The farmers may be encouraged to adopt less water consuming cropping pattern Like Maize, Zawar, Groundnut, Sunflower especially in Rabi season. Farmers should be encouraged to adopt Drip irrigation techniques.
3. The water user association body should be strengthened so that there will be balance between cropping time and availability of surface water through canal.
4. Stage of GW development can be brought down by limited use of Ground water in command area and more use of surface water through canal system.
5. The irrigation through canal system must be made effective so that the farmers will prefer to use canal water instead of ground water.

As stage of GW development is 98.73% in Baramkela Block, we have to go for artificial recharge in a long term sustaining basis.

Table 11 Feasible artificial Recharge structure structures in Baramkela Block

Name of Block	Area Feasible for recharge (sq.km)	Volume of Sub Surface Potential to be recharged through other methods (MCM)	Types of Structures Feasible and their Numbers			
			P	NB & CD	RS	G
Baramkela	289	23	76	252	454	606
Recharge capacity (MCM)			4.6	0.76	2.52	2.27
Estimated cost Approx)			RS 19 Crore			
Stage of Development to be lowered			11%			

P-Percolation tank, NB-Nalla bund, CD-Check dam, Rs-Recharge shaft, G-Gabion structure

In Baramkela block of Raigarh district where stage of development is more than 98%, the farmers may be encouraged to adopt less water consuming cropping pattern Like maize instead of paddy especially in Rabi season.

Table 12 A: Saving of water due to change in cropping pattern from rice to maize

Paddy cultivation area in Rabi season (ha)	Water required (m per ha)		Difference (m per ha)	Total saving of water (ham)
	Paddy	Maize		
6500	1.5	0.5	1	6500

Table 12 B: Improvement in stage of groundwater development due to change in cropping pattern from rice to maize

Net Draft (Ham)	Available Resource (Ham)	Improved Resource (Ham)	Initial status (%)	Improved status (%)
3684.77	3732.05	10232.05	98.73	36.01

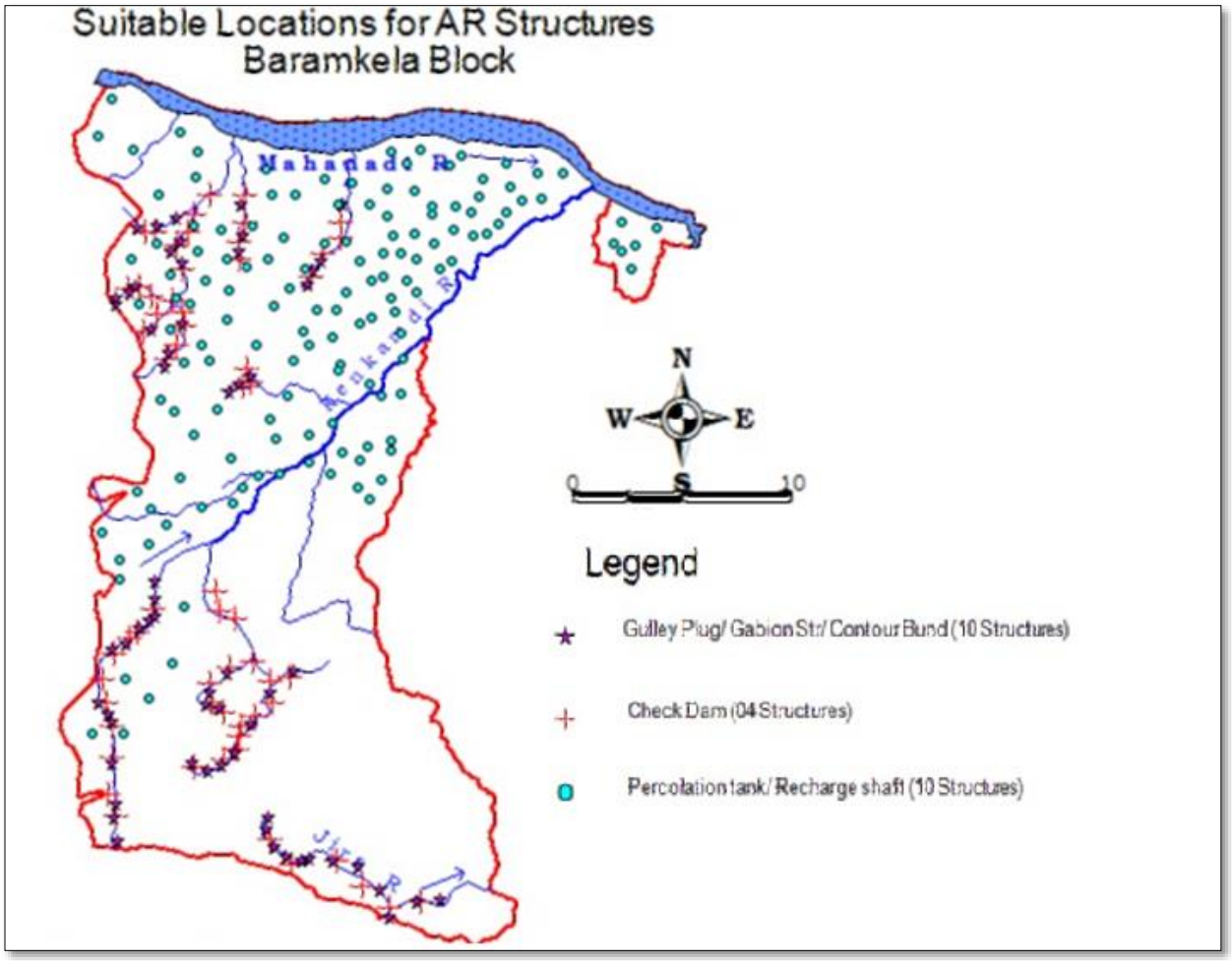


Fig 12 Location of Artificial Recharge structures in Baramkela Block