केंद्रीय भूमि जल बोर्ड

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विभाग, जल शक्ति मंत्रालय

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

SARAIPALI BLOCK, MAHASAMUND DISTRICT, CHHATTISGARH

उत्तर मध्य छत्तीसगढ़ क्षेत्र, रायपुर

North Central Chhattisgarh Region, Raipur

स्वच्छ जल : स्वच्छ भारत

केन्द्रीयभूमिजलबोर्ड

उत्तर मध्य छत्तीसगढ़ क्षेत्र

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AQUIFER MAPS AND MANAGEMENT PLANS
SARAIPALI BLOCK, MAHASAMUND DISTRICT

1. Salient Information:

About the area: Saraipali Block is situated in the easternmost part of Mahasamund district of Chhattisgarh and is bounded on the north by Raigarhdistrict, in the west by Basna block of Chhattisgarh, in the east and in the south by Odisha state. The area lies between 21.10 and 21.48 N latitudes and 82.88 and 83.28 E longitudes. The geographical extension of the study area is 870 sq.km, representing around 17 % of the district's geographical area. Administrative map of the block is shown in Fig. 1. Geomorphology comprises of pediment and pediplains in the central and south-western part, denudational hills and slopes in the northern and eastern part. Geomorphology map shown in Figure 2. Suranginala flowingeastwards is a tributary of Ong riverand Lath nala, Kholtinala flowing northwards is a tributary of Mahanadi river. Drainage map shown in Fig.3.

Population: The total population of Saraipali block as per 2011 Census is194997out of which rural population is 174954while the urban population is 20043.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
Saraipali	194997	97189	97808	174954	20043

Source: CG Census, 2011

Growth rate: The decadal growth rate of the block is 25.76 as per 2011 census.

Rainfall: The study area receives rainfall mainly from south-west monsoon. 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. 2010 to 2015)1380.92 mm with 50 to 60 rainy days.

Table-2: Rainfall data in Saraipali block in mm

Year	2010-11	2011-12	2012-13	2013-14	2014-15
Annual rainfall	1176.80	1378.70	1407.40	971.20	1970.50

Source: IMD

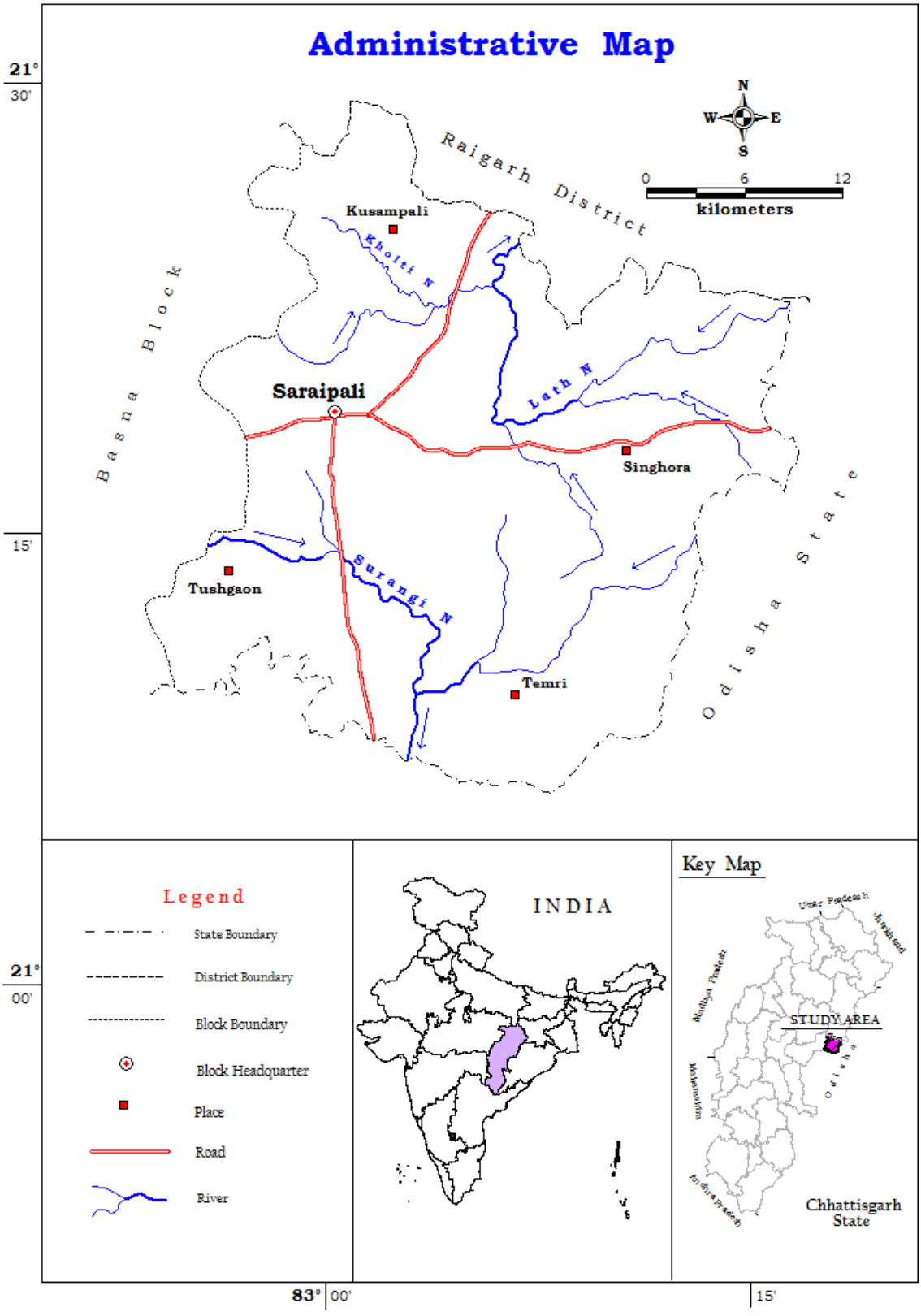


Figure: 1 Administrative Map of Saraipali Block

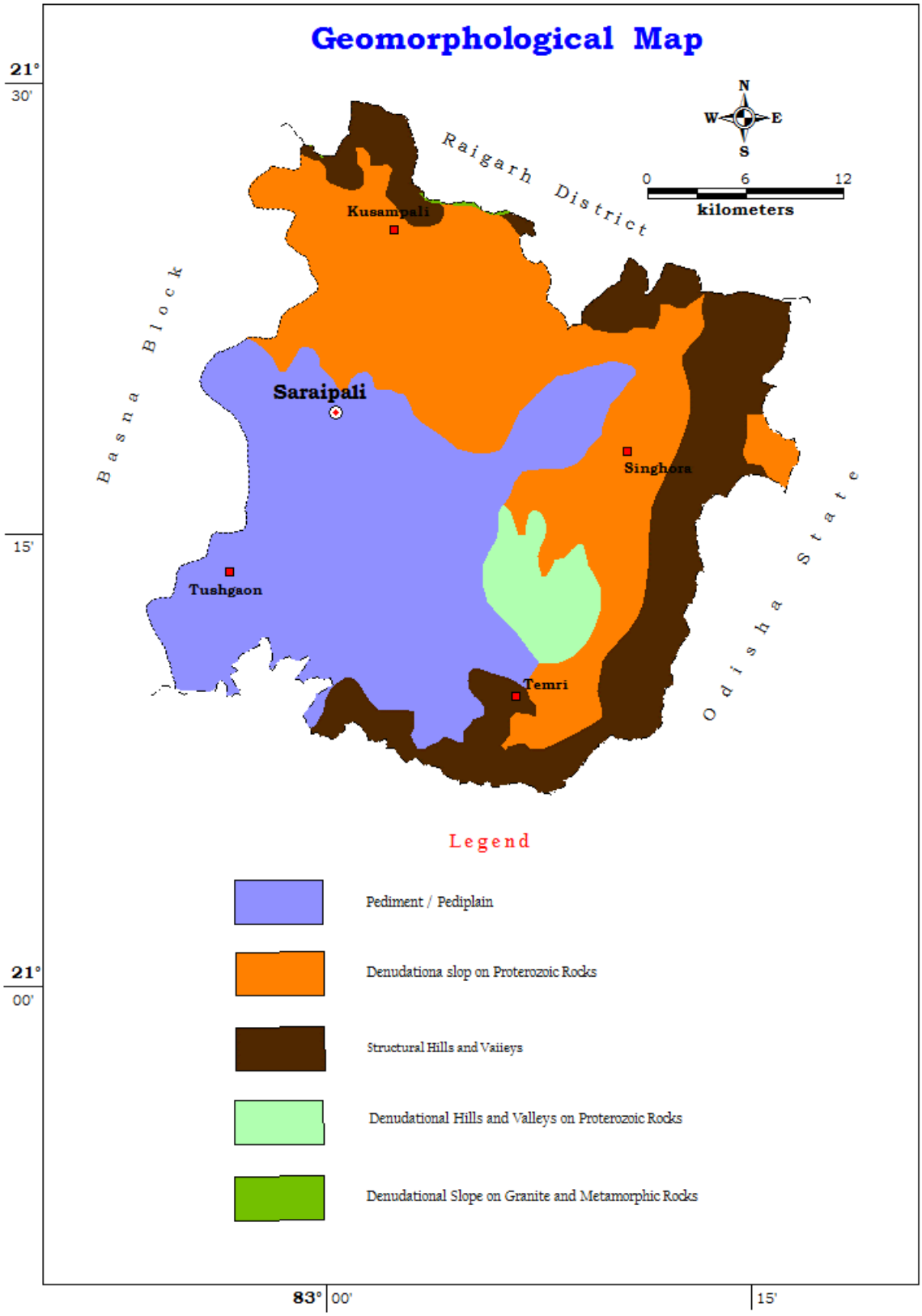


Figure 2: Geomorphology Map of Saraipali Block

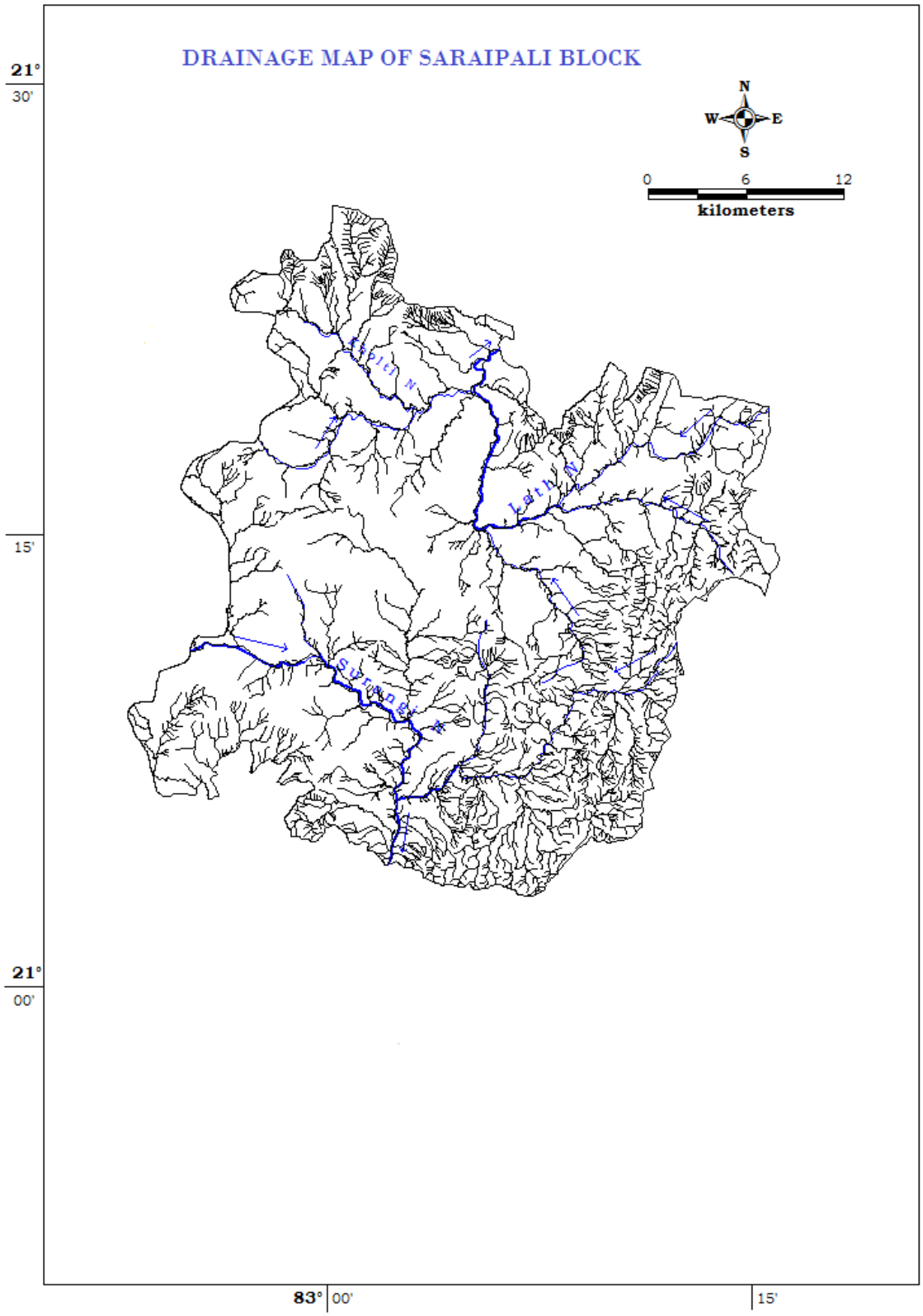


Figure 3: Drainage Map of Saraipali Block

Agriculture and Irrigation**:** Agriculture is practiced in the area during Kharifand 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, pulsesand vegetables.

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

Table 3 (A): Agricultural pattern (in ha)

Block	Total geographical area	Revenue forest area	Area not available for cultivation	Net sown area	Double cropped area	Gross cropped area
Saraipali	87000	29697	8232	53015	5215	58230

Table 3 (B): 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
Saraipali	87000	29697	8232	7556	1292	53015	5215	58230

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

Block	Kharif	Rabi	Cereal				Pulses	Tilhan	Fruits Vegetables	Resh	Mirch Masala	Sugar-cane
			Wheat	Rice	Jowar& Maize	Others						
Saraipali	53013	5217	600	51411	154	0	3800	2096	564	48	88	10

Table 3 (D): 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
21	2973	2810	8046	92	17	919	1892	4076	15522	17004	29 %

Table 3 (E): Statistics showing Agricultural land Irrigated

Block	Net Irrigated Area	Net Irrigated Area by ground water	Percentage of Area Irrigated by ground water
Saraipali	15522	8063	51.9

Groundwater Resource Availability and Extraction: Based on the resource assessment made, the resource availability in aquifer wise in Saraipali block upto 200 m depth is given in the table-4.

Table – 4: Ground Water Resources of Saraipali block in Ham

Block	**Dongargarh granite and gneiss**			
	Phreatic		Fractured	Total resource
	Dynamic	Static	In-storage	
Saraipali	1291.46	275.31	13.32	**1580.09**

Block	**Calcareous shale**			
	Phreatic		Fractured	Total resource
	Dynamic	Static	In-storage	
Saraipali	5835.86	1244.07	60.1	**7140.03**

Block	**Sandstone**			
	Phreatic		Fractured	Total resource
	Dynamic	Static	In-storage	
Saraipali	1310.88	279.45	13.52	**1603.85**

Existing and Future Water Demand (2025)*:* The existing demand for irrigation in the area is 2853.0 Ham while the same for domestic and industrial field is 432.62 Ham. To meet the future demand for ground water, a total quantity of 5585.21 ham of ground water is available for future use.

Water Level Behaviour: (i) Pre- monsoon water level: In the pre-monsoon period, it has been observed that the water level varies from 3.2 to 16.78 mbgl with an average of 7.75 mbglin phreatic aquifer. In fracturedformation, the pre monsoon water level variation range is 4.24 to 25.6 mbgl with average of 15.34 mbgl.

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

Block Name	Phreatic		
	Min	Max	Avg
Saraipali	3.2	16.78	7.75

Water Level (in mbgl)

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

Block Name	Fractured		
	Min	Max	Avg
Saraipali	4.24	25.6	15.34

(ii) Post- monsoon water level**:** In the post-monsoon period, it has been observed that the water level varies from 1.4 to 5.43 mbgl with an average of 3.42 mbglin phreatic aquifer. In fractured formation, the post monsoon water level variation range is 4.13 to 21.32 mbgl with average of 10.68 mbgl.

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

Block Name	Phreatic		
	Min	Max	Avg
Saraipali	1.4	5.43	3.42

Water Level (in mbgl)

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

Block Name	Fractured		
	Min	Max	Avg
Saraipali	4.13	21.32	10.68

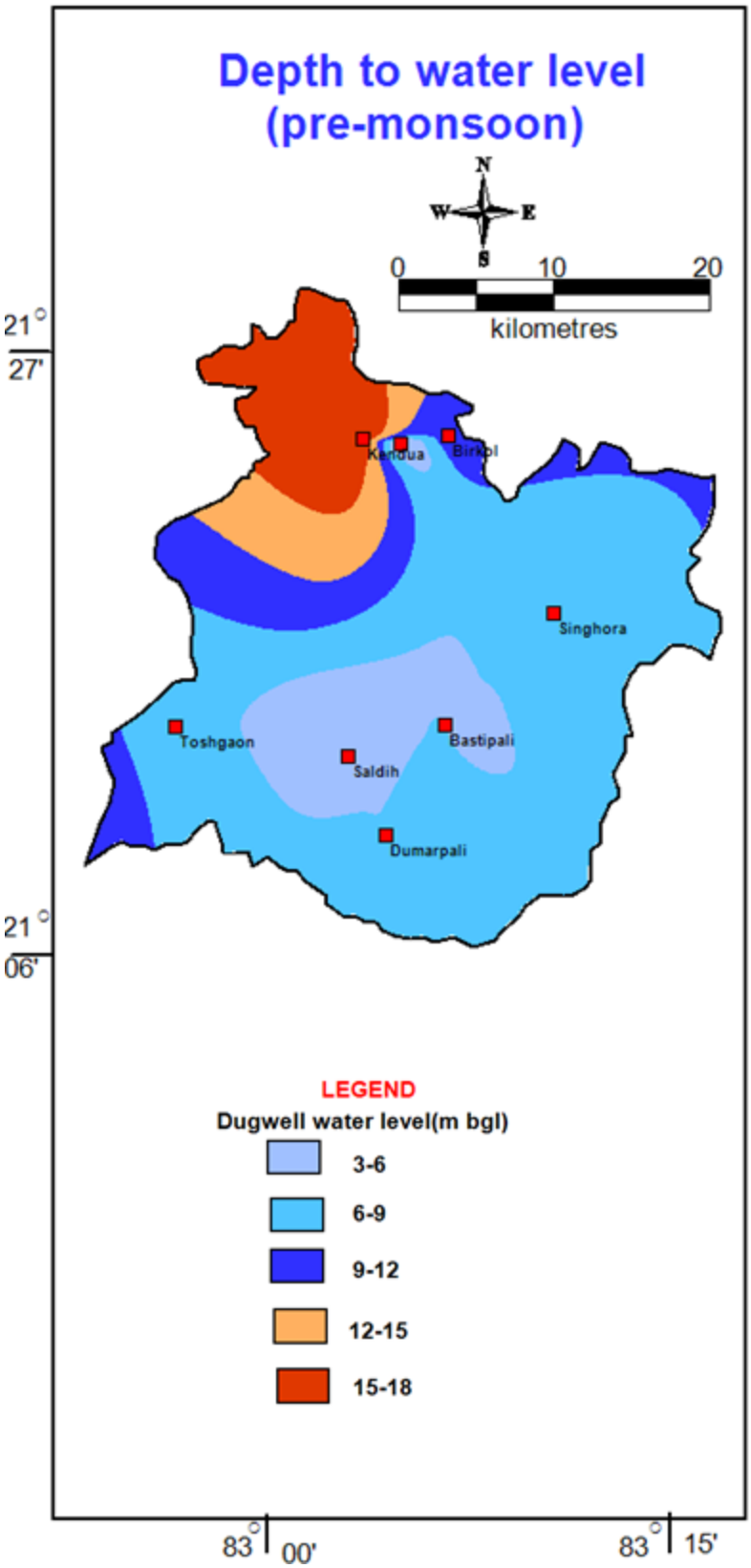


Figure-4: Depth to water level map Phreatic Aquifer (Pre-monsoon)

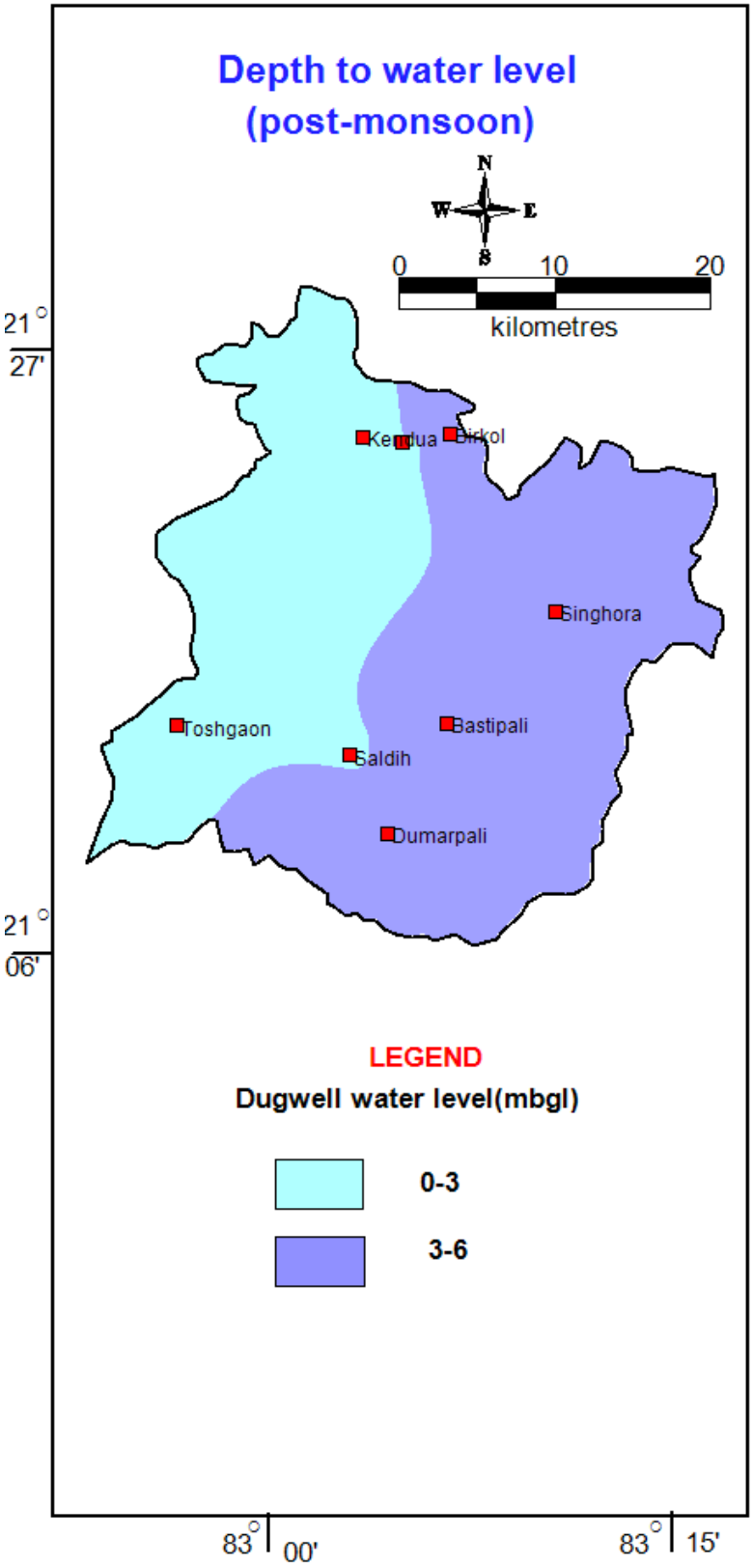


Figure 5: Depth to water level map Phreatic Aquifer (Post-monsoon)

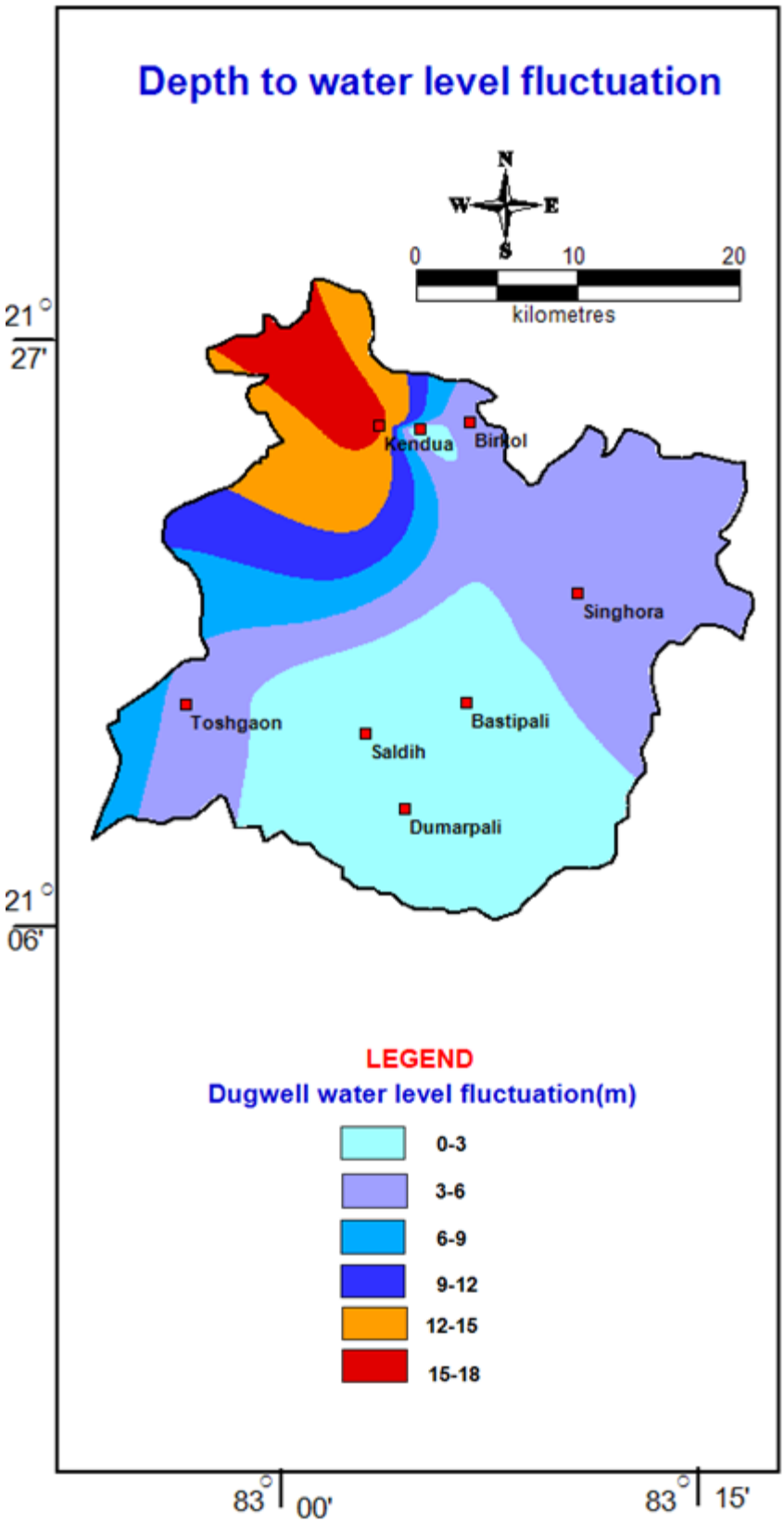


Figure 6: Depth to water level fluctuation map of Phreatic Aquifer

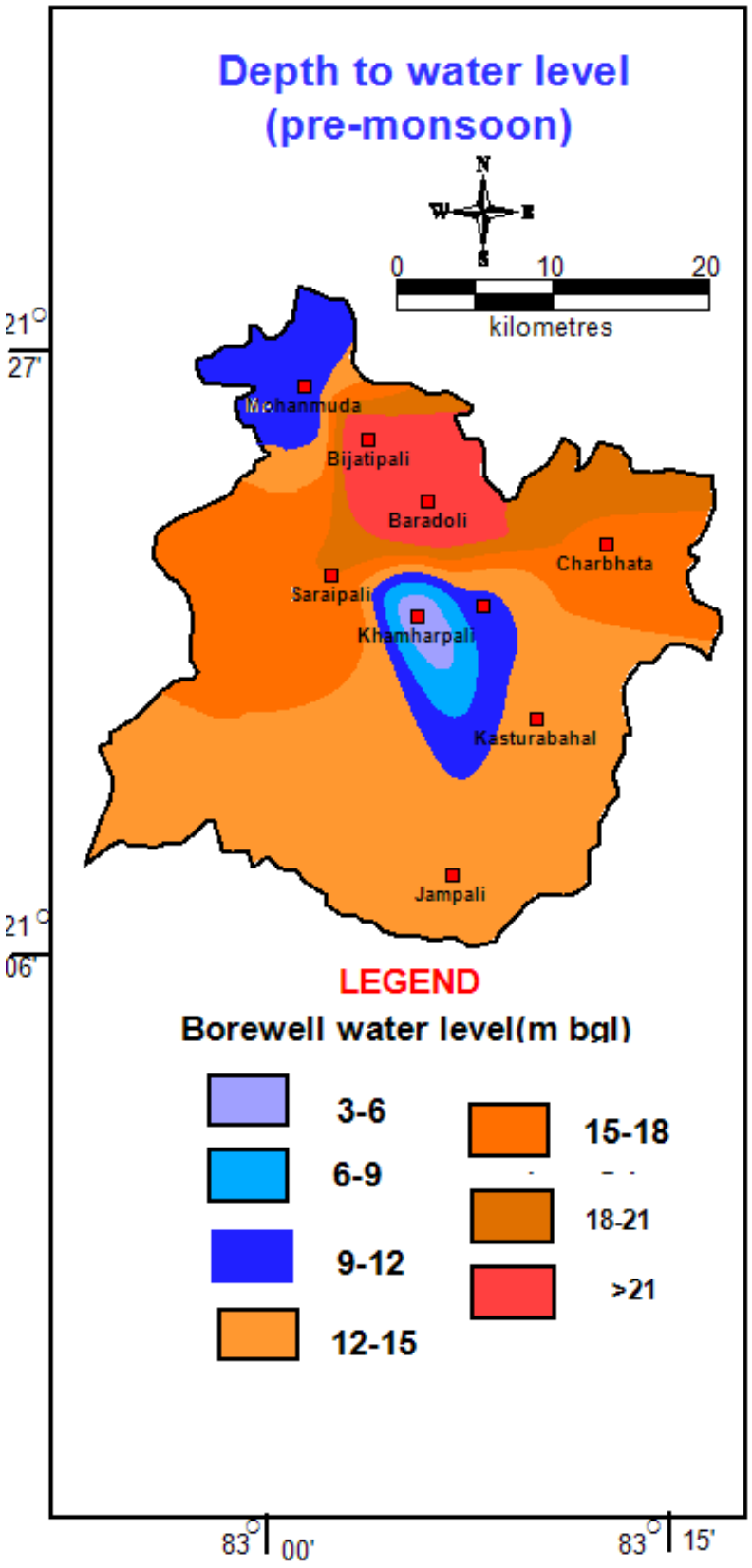


Figure-7: Depth to water level map Fractured Aquifer (Pre-monsoon)

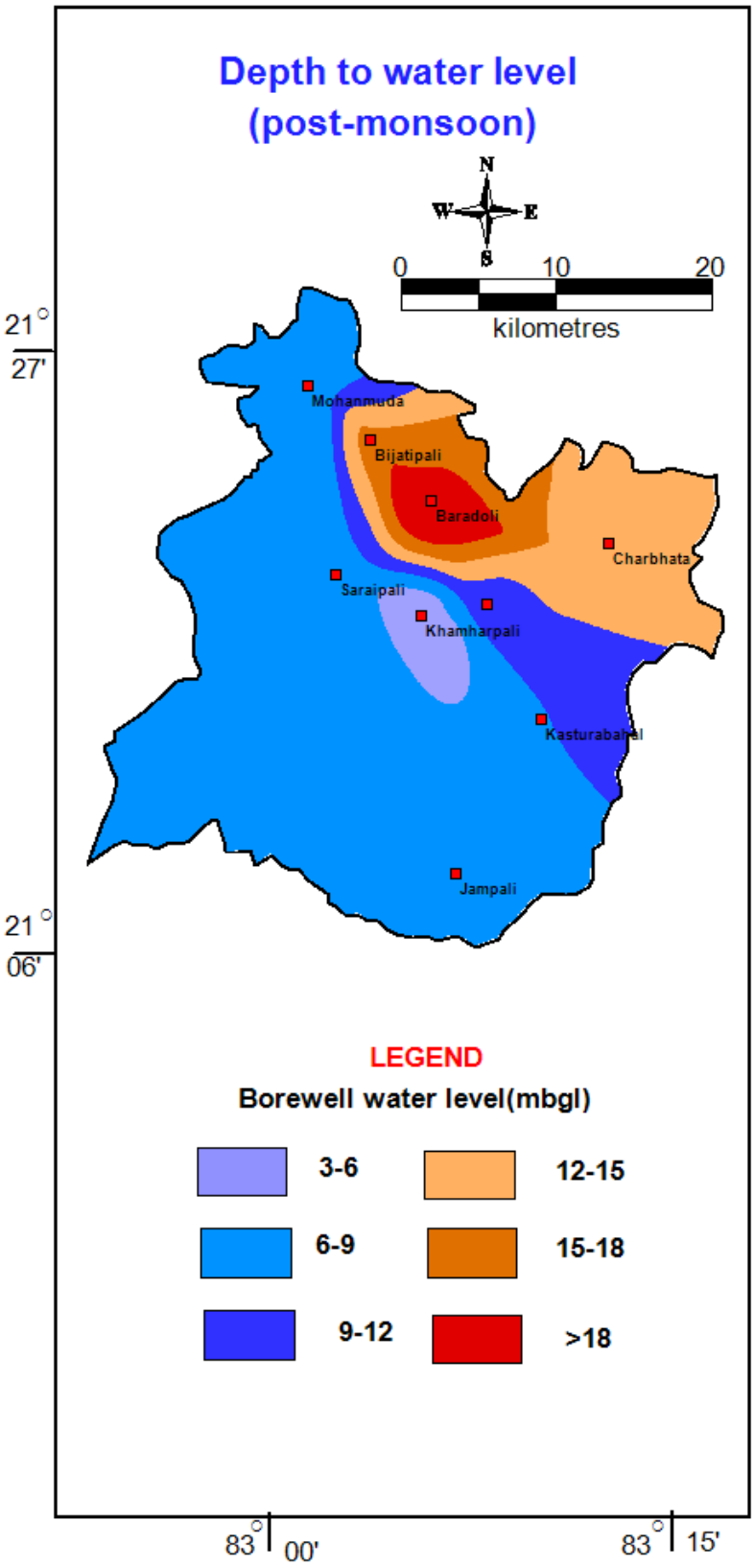


Figure-8: Depth to water level map Fractured Aquifer (Post-monsoon)

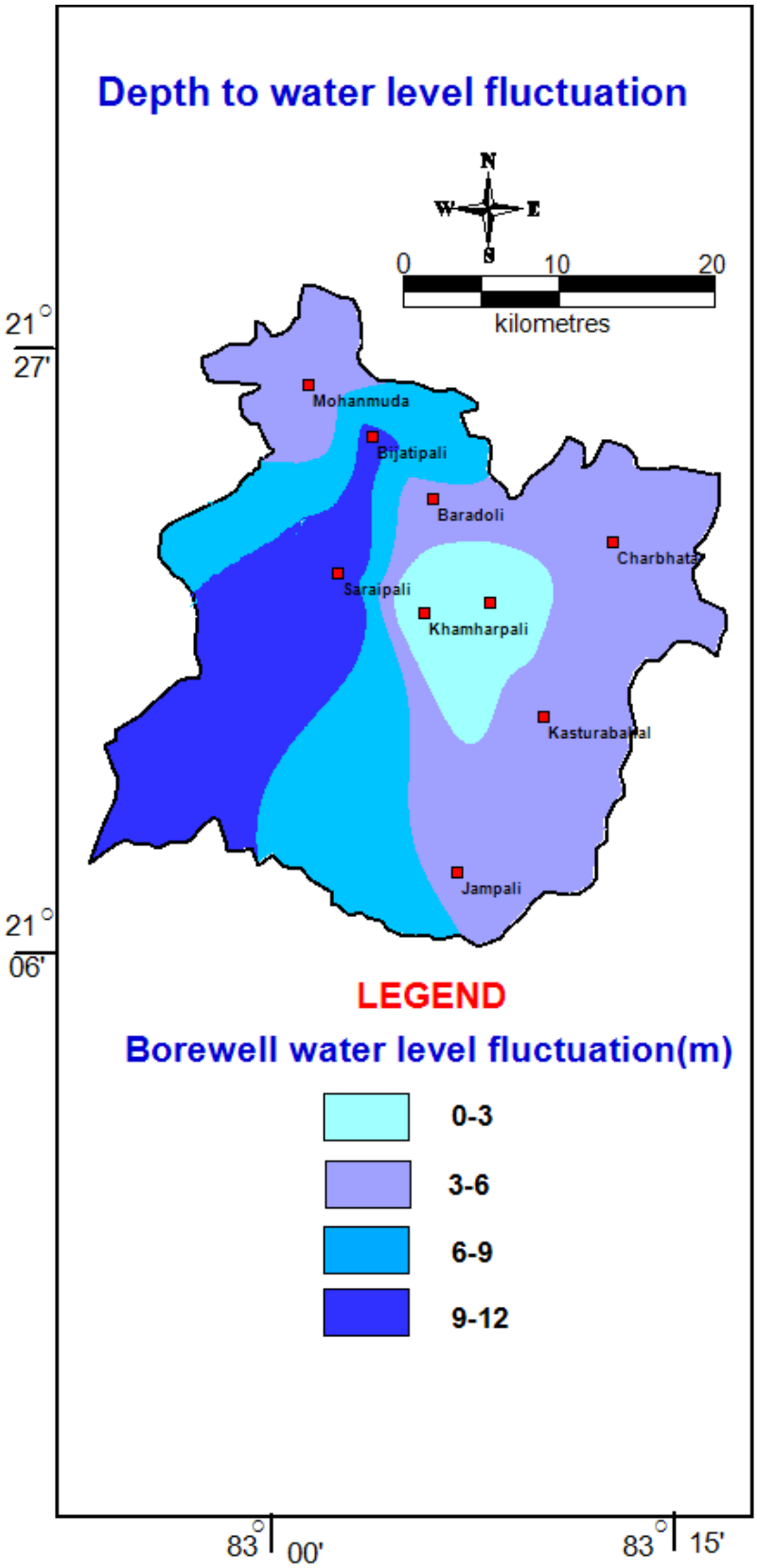


Figure 9: Depth to water level fluctuation map of Fractured Aquifer

(iii) Seasonal water level fluctuation: The water level fluctuation data indicates that in Saraipaliblock, water level fluctuationinphreaticaquifervaries from 0.44 to 15.38 m with an average fluctuation of 4.32 m. Water level fluctuationinfracturedaquifervaries from 0.11 to 10.51 m with an average fluctuation of 4.66 m.

Table 5E: Aquifer wise Depth to Water Level Fluctuation

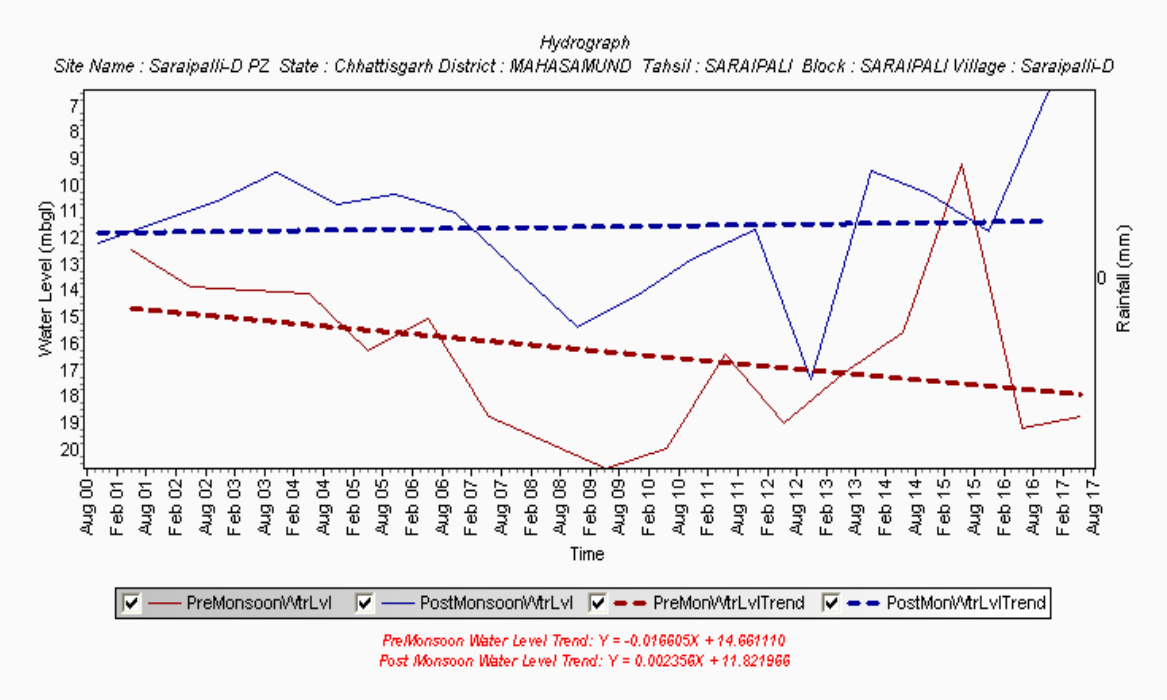
Block Name	Phreatic		
	Min	Max	Avg
Saraipali	0.44	15.38	4.32

Water Level (in m)

Table 5F: Aquifer wise Depth to Water Level Fluctuation

Block Name	Fractured		
	Min	Max	Avg
Saraipali	0.11	10.51	4.66

(iv) The long-term water level trend: During pre-monsoon period, there is decline in water



level (as indicated by dotted red trend line), about 2m over a 10-year period.

Figure 11: Hydrograph of Saraipali village, Saraipali block

2. Aquifer Disposition:

Number of Aquifers: There arethree major aquifers, viz. Singhora group (Calcareous shale), Singhora group (Sandstone) and Dongargarh granite and granitic gneiss, which in phreatic and fractured condition serve as major aquifer system in the block.

3-D aquifer disposition and basic characteristics of each aquifer:
Geology: Geologically the block exhibits lithology of Meso to Neo Proterozoic agedominated by Singhora group (Calcareous shale) and Singhora group (Sandstone).

(i) Singhora group - Singhora group is the oldest formation of Chhattisgarh super group. The sediments occurring in the block consist of Shale, Limestone, sandstone and siltstone. The ground water in this group of rocks occurs under phreatic/water table conditions in the weathered portion while semi-confined to confined conditions in deeper part consist of fractures. The average thickness of the weathered portion in the area is around 9.0 m. Generally, 1 to 2 sets of fractures are encountered within 60 m depth and 1 to 2sets of fractures are encountered within 60 to 200 m depth. The discharge is negligible(<1lps). At two places, namely Chhattigirola and Birkol, discharge of 4.0 lps and 5.50 lps were obtained respectively. The development in these formations is mostly by way of dug wells.

(ii) Dongargarh granite gneiss- Archean to Proterozoic age . The ground water in this group of rocks occurs under phreatic/water table conditions in the weathered portion while semi-confined to confined conditions in deeper part consist of fractures. The average thickness of the weathered portion in the area is around 10.30 m. The occurrences of fractures at depth in the area are not common and whenever occur are less potential in ground water point of view. Generally, 1 to 2 sets of fractures are encountered within 60 m depth and 2 to 3 sets of fractures are encountered within 60 to 200 m depth. The potential zones are present in less than 50 m depth below ground level. In general, the discharge varies from negligible to 3 lps with an average yield of 1.5 lps. The development in these formations is mostly by way of dug wells and shallow tubewells. The thickness of fractured aquifer is around 0.2 m.

Table 6: Distribution of Principal aquifer systems in Saraipali

Block	Phreatic and fractured calcareous shale (sq.km.)	Phreaticand fractured sandstone(sq.km.)	Phreaticand fractured granite gneiss (sq.km.)
Saraipali	601	135	133

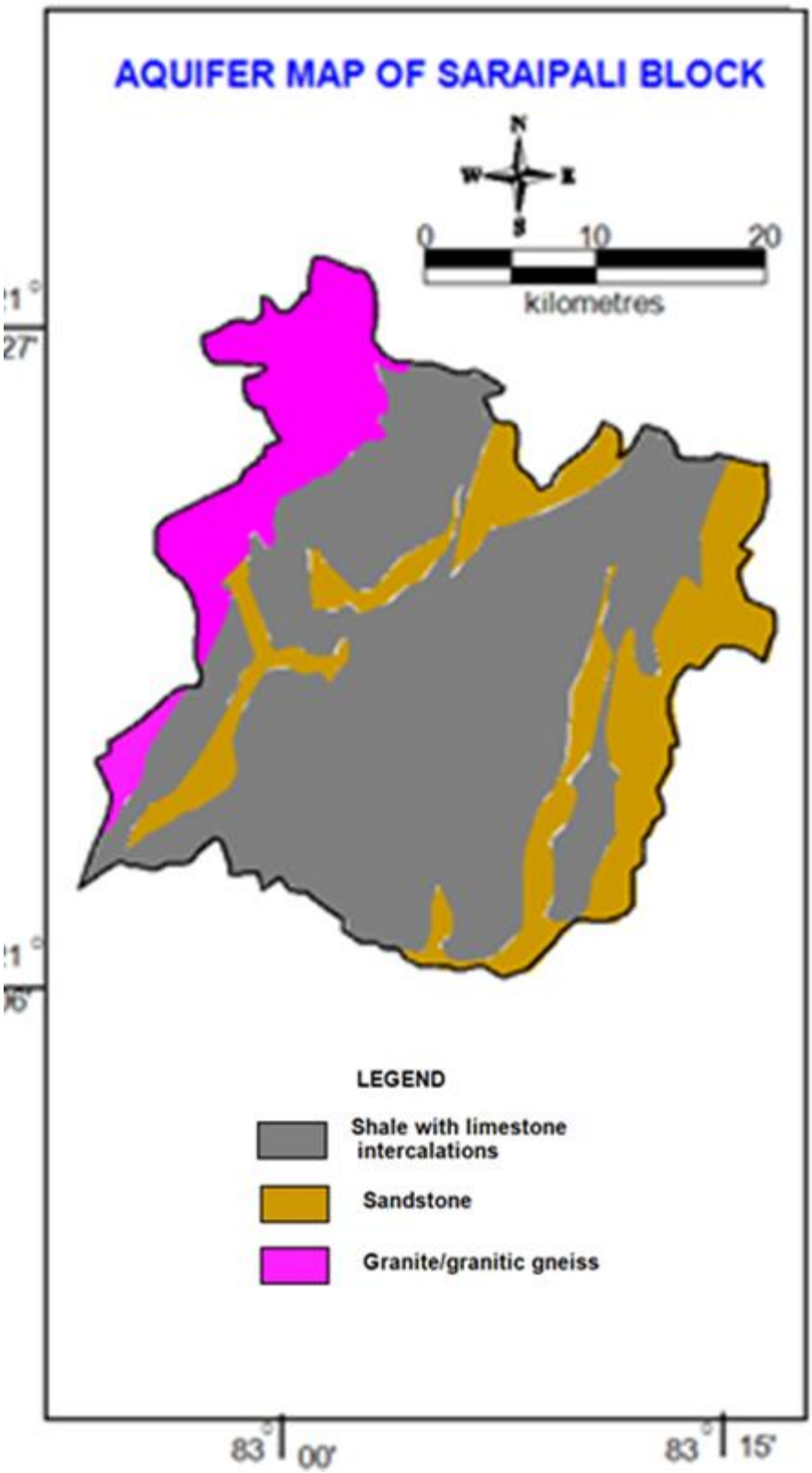
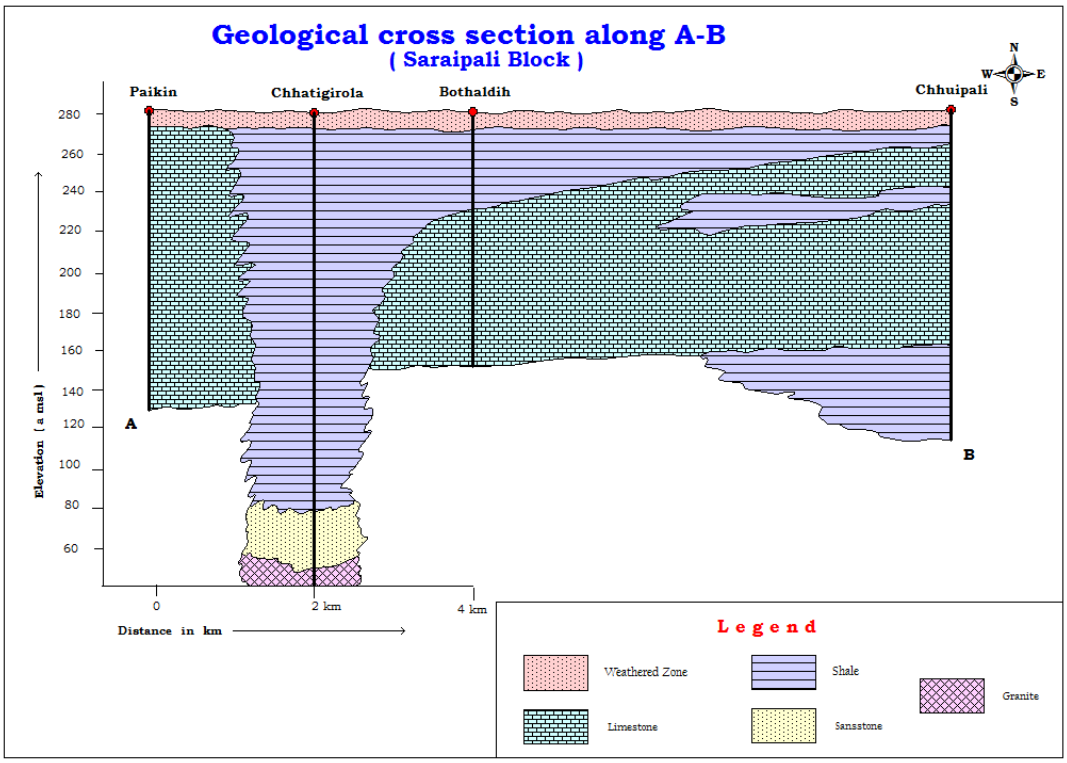


Figure 12: Aquifer map of Saraipali block



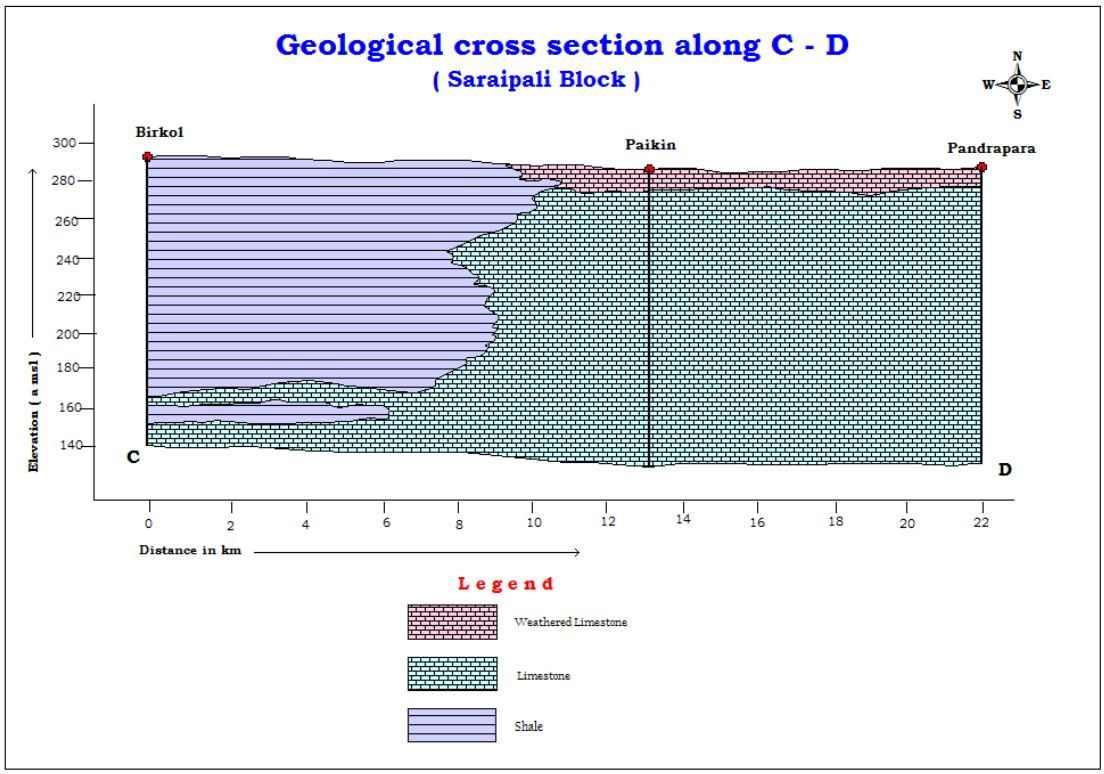


Figure-13: (a)Hydrogeological Cross Section(A-B),(b) Hydrogeological Cross Section(C-D),Saraipali Block

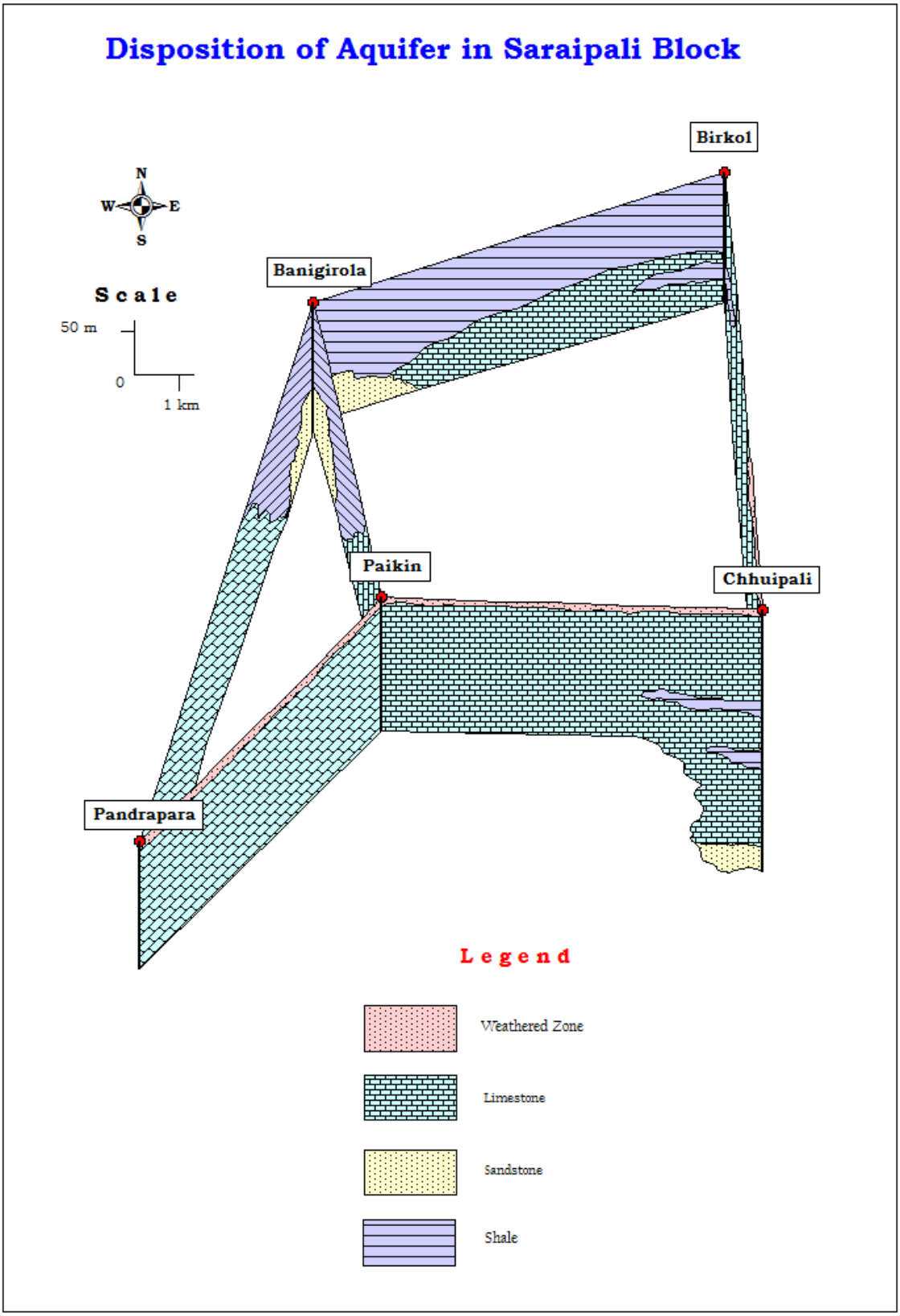


Figure-14: Disposition of aquifer in Saraipali block

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

Aquifer wise resource availability is given in the table -4 where the total resource available in Saraipali block is 8438. 21ham.The extraction details and the future scenario (2025) along with the categorisation is depicted in the table-7 & 8.

Table-7: Ground water Resources of Saraipaliblock

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)
Mahasamund	Saraipali	8438.21	2853.0	432.62	3285.62	467.55	5117.66

Table-8: Categorization of Assessment Unit

District	Block	Stage of Ground water development (%)	Categorisation
Mahasamund	Saraipali	38.94	Safe

Categorisation: TheSaraipali block falls in safe category. The stage of Ground water development is 38.94%. The Net Ground water availability is 8438.21 ham. The Ground water draft for all uses is 3285.62 Ham. The Ground water resources for future uses for Saraipali Block are5585.21Ham.

Chemical Quality of Ground water and Contamination**:** Throughout the study area, the water quality (phreatic and semi-confined aquifer) is good and all the parameters are within permissible limit. In conclusion it may be said that the groundwater in the block is suitable for drinking as well as for irrigation purposes.

4. Ground Water Resource enhancement:

Aquifer wise space available for recharge and proposed interventions:

Table -9: Summarised detail of Volume of porous space available for recharge (Aquifer wise)

Formation	Area (sq.m)	Available thickness of unsaturated zone (m)	Sp. Yield for the formation	Volume of unsaturated space available for recharge (m^3)
Limestone/Shale	$238*10^6$	1.5	0.03	10.71×10^6
Sandstone	$80*10^6$	1.5	0.03	3.6×10^6

5. Issues:

(i) The aquifer itself is a low yielding one due to which during summer, dugwells in almost all villages are dry except a few locations. Several handpumps also stop yielding water.

(ii) It has been observed during fieldwork in pre-monsoon period, there is colossal wastage of groundwater through public water supply system.

(iii) Poor stage of groundwater development.

6. Supply side interventions:

(i) Saraipali block experienced drought situation in 2017because of poor monsoon. Sanctuary wells may be constructed for drinking needs as a step towards crisis management.

(ii) It has been observed during fieldwork in pre-monsoon period, there is colossal wastage of groundwater through public water supply system. In this state, the Government has undertaken "Nal Jal Yojana" to provide water to villages. Under this scheme, the government has dug borewells of about 150-200feet depth, lowered a pump in the well to draw out water and constructed a small tank to hold water. Unfortunately, people do not switch off the pump once the tank is full. Also, the pipes are not fitted with taps to control the flow of water. So, Information, education and Communication (IEC) activities to be organized to sensitize people on the issues of depleting groundwater resource. Massive awareness campaigns are essential to understand people about the importance community participation in saving water.

(iii) 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.

(iv) It has been observed that though the long-term trend lines are declining in pre-monsoon, so 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-10.

Table-10: Types of ArtificialRecharge structures feasible

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
Saraipali	318	14.31	40	150	280	380
	Recharge Capacity		8.3	1.5	2.8	1.9
	Estimated cost (Appx.)		Rs. 16.88 crore			

(v) The practice of providing free electricity to operate irrigation borewells should be strictly monitored and put to an end in case of overconsumption. After a simple

calculation it has been found that Rs 16000/ hectare is the expenses of electricity (@Rs. 2.5/unit) for paddy field. So, monitoring mechanism for electricity consumption should be strengthened for farmers taking summer rice. Even if farmers use solar pump or other method of ground water irrigation for summer paddy, it should not be flooding method. Proper pipes are to be used to transfer water from one plot to another.

(vi) Govt. may set up network of grids to purchase electricity generated from solar panels. This will encourage the farmers not to waste electricity by extracting groundwater unnecessarily and also provide alternative income.

(vii) Since the stage of development in the block is 38.94 %. So, there is scope of development. In order to achieve 60% stage of ground water withdrawal in the block, development may be taken up as per the following table:

Table-11: Number of structures recommended in block for 60 % stage of development

Block	Net groundwater availability (ham)	Stage of GW development (%)	Present GW draft (ham)	Groundwater draft at 60% stage of development (ham)	Surplus groundwater at present stage of development (ham)	No. of TW recommernded in each block (assuming unit draft as 2 ham/structure/year)	No. of DW recommended in block (assuming unit draft as 0.72ham/structure/year)
Saraipali	8438.21	38.4	3285.72	5062.93	1777.31	889	2468

7. Demand side interventions:

(i) To arrest the declining groundwater levels during pre-monsoon period, change in cropping pattern & irrigation pattern is suggested for Rabi season, as per the following table:

Table 12: Detail of groundwater saved through change in cropping pattern

Block	Paddy cultivation area during Rabi season (ha)	Water required for cultivation (in m) per ha		Difference (m) per ha	Total saving of water (ham)	Existing gross groundwater draft for all uses in ham	Available resource (ham)	Improved status in Stage of groundwater development
		Paddy	Maize					
Saraipali	4992	0.9	0.5	0.4	1996.8	3285.62	8438.21	15.27

In command or non-command area wherever ground water has been used for field irrigation of pulses and vegetables should be replaced with micro irrigation methods such as sprinklers, drip irrigation etc. which may save 30 to 40% ground water.

Table 13: Detail of groundwater saved through change in irrigation pattern

block	irrigated crop area under rabi 2016(ha)	water required for ultivation of pulses(m)	30 % groundwater saved through microrrigation	water saved through microirrigation (ham)
Saraipali	5217	0.3	0.3	181.8

Table 14: Proposed sites for artificial recharge of groundwater in Saraipali block

PT (Percolation Tank)	NB & CD (Nala bund & Check dam)	RS (Recharge Shaft)	GB (Gabbion structure)
Bhuthiya	Kanpal	Paterapali	Kena
Balouda	Jangalbeda	Bhothaldih	Kurludhudha (Kurluda
Bhothaldih	Kisdi	Kurludhudha (Kurluda	Bastipali
Temri	Palidih	Dewanpali	Sukda
Manpali	Palsapali	Antarjhala	Bajibahal
Sargunabhata	Jampali	Kokdi	Pudagarh
Daugudi	Jamadalkha	Amaldih	Belmundi
Nawagarh	Bajibahal	Gaurbahali	Pujaripali
Batki	Samdaraha	Dongarrakasa	Pelagarh
Dongaripali	Kasturabahal	Dongarrakasa	Debrigarh
Charbhatha	Palsapali	Birkol	Chiwarakuta
	Majarmati	Saraipali (Bhagta)(Sa	Banjhapali
	Paraskol	Raksha	
	Kalenda (Kelenda)	Sagarpali	
	Chhindpali	Dewangudi	
	Bormal	Banjhapali	
	Singbahal	Murmuri	
	Ghatkachhar		

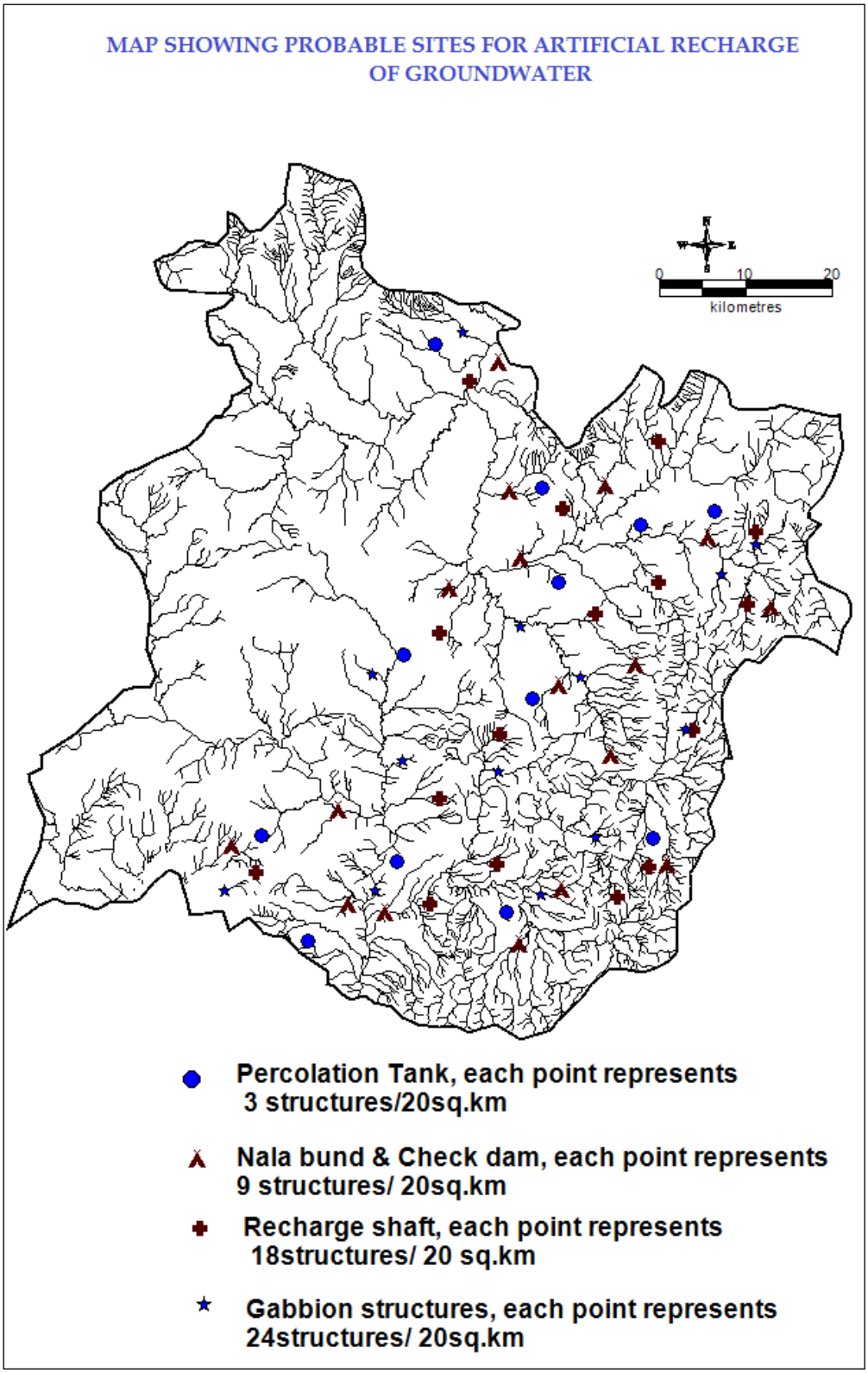


Figure 15: Map of proposed sites for artificial recharge of groundwater in Saraipali block

7. CONCLUSIONS:

An area of 870 sq.km of Saraipali block of Mahasamund district has been considered for Aquifer Mapping and Management Plans. The total g.w resource is 8438.21 Ham with stage of g.w development 38.94 % and categorized as “safe”. 51.9 % of the irrigated area is uses groundwater for irrigation. The major aquifer groupsareSinghora Group calcareous shale, limestone and Dongargarh Granite and Granite gneiss, in terms of Demand side management, by change in cropping and irrigation pattern (micro irrigation methods) 1996.8Ham and 181 Ham water can be saved respectively. In terms of Supply side management, by constructing artificial recharge structure 14.31 MCM water can be recharged and constructing of tubewell at suitable locations, drinking water needs may be fulfilled.