केंद्रीय भूमि जल बोर्ड

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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

PITHORA 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
PITHORA BLOCK, MAHASAMUND DISTRICT

1. Salient Information:

About the area: Pithora Block is situated in the central part of Mahasamund district of Chhattisgarh and is bounded on the north by Baloda Bazar and Raigarhdistrict, in the west by Mahasamund block of Chhattisgarh, in the east by Basna block, in the south west by Bagbahara block and in the south by Odisha state. The area lies between 21.05 and 21.50 N latitudes and 82.25 and 82.83 E longitudes. The geographical extension of the study area is 1060 sq.km representing around 21 % of the district's geographical area. Administrative map of the block is shown in Fig. 1. Geomorphology dominantly comprises of pediment and pediplains with some denudational hills and slopes in the northern part. Geomorphology map shown in Figure 2. Baghnala, Jonknala and Mechkanala flowing north-westwards are tributaries of Mahanadi river. Drainage map shown in Fig.3.

Population: The total population of Pithora block as per 2011 Census is204666out of which rural population is 196238while the urban population is 8428.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
Pithora	204666	100746	103920	196238	8428

Source: CG Census, 2011

Growth rate: The decadal growth rate of the block is 17.46 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. Average annual rainfall in the study area is (Average of the last five years i.e. 2010 to 2015)1434.38 mm with 50 to 60 rainy days.

Table-2: Rainfall data in Pithora block in mm

Year	2010-11	2011-12	2012-13	2013-14	2014-15
Annual rainfall	1237.20	1434.20	1128..80	1857.60	1514.10

Source: IMD

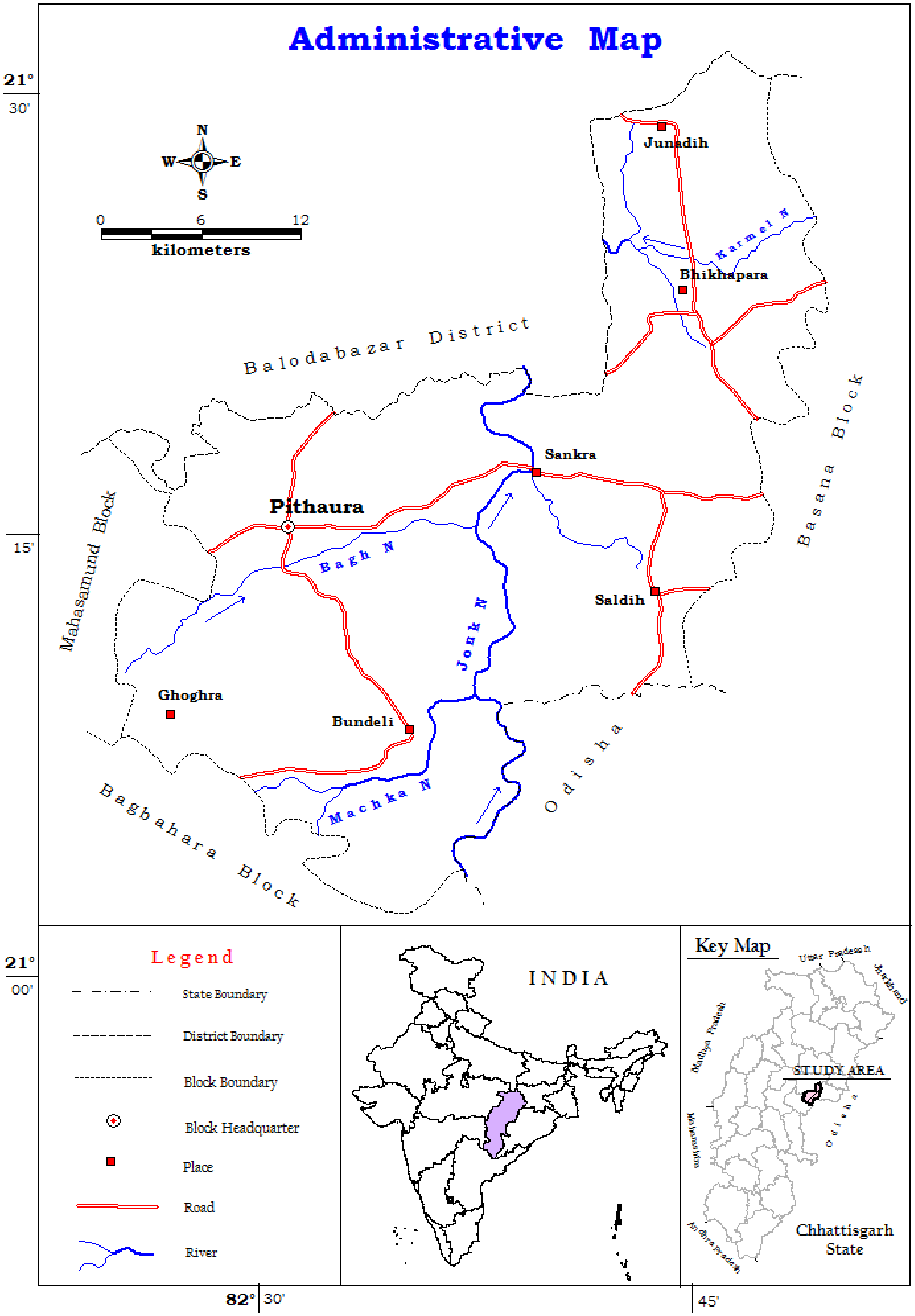

Figure: 1 Administrative Map of Pithora Block

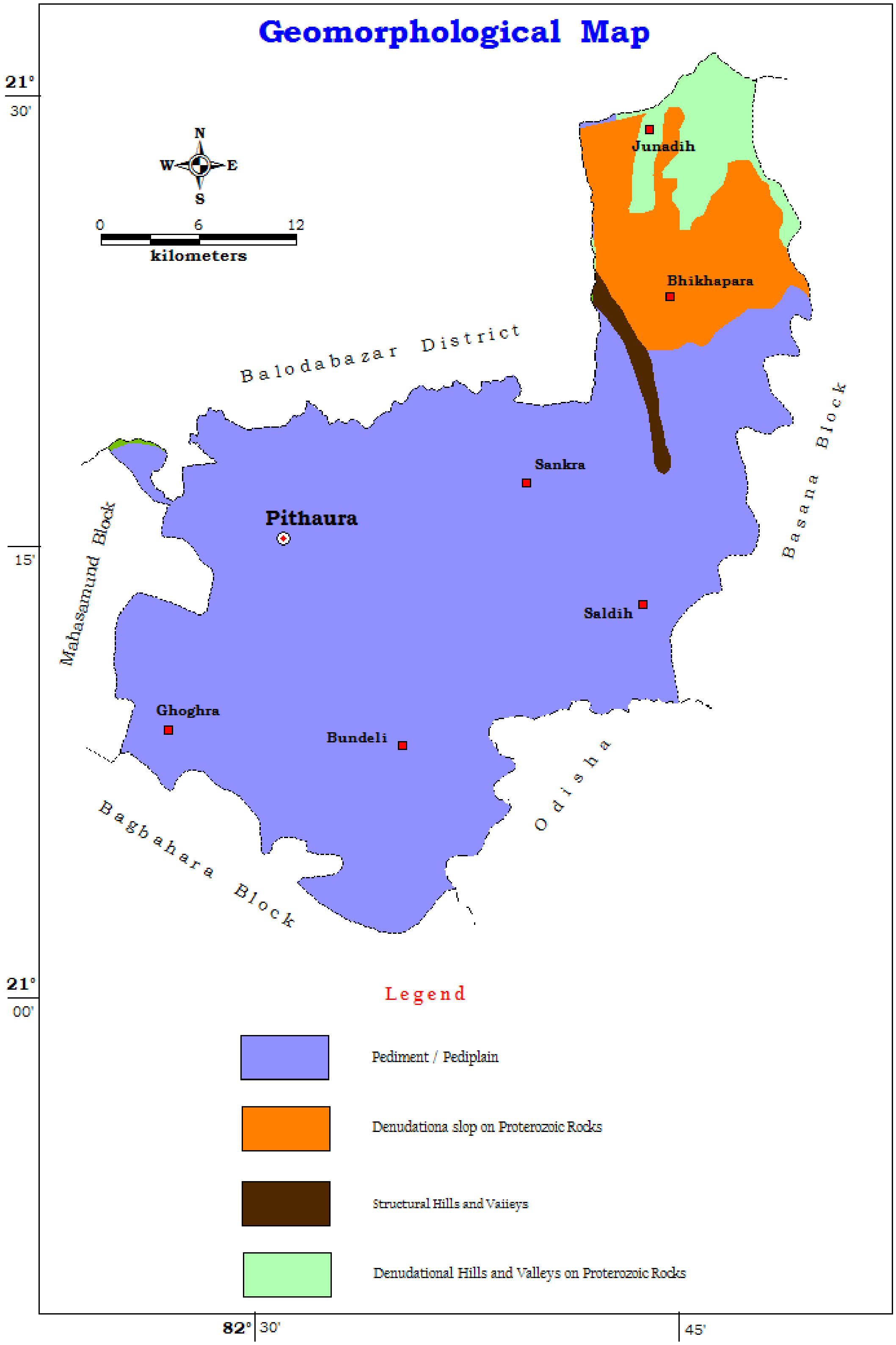

Figure 2: Geomorphology Map of Pithora Block

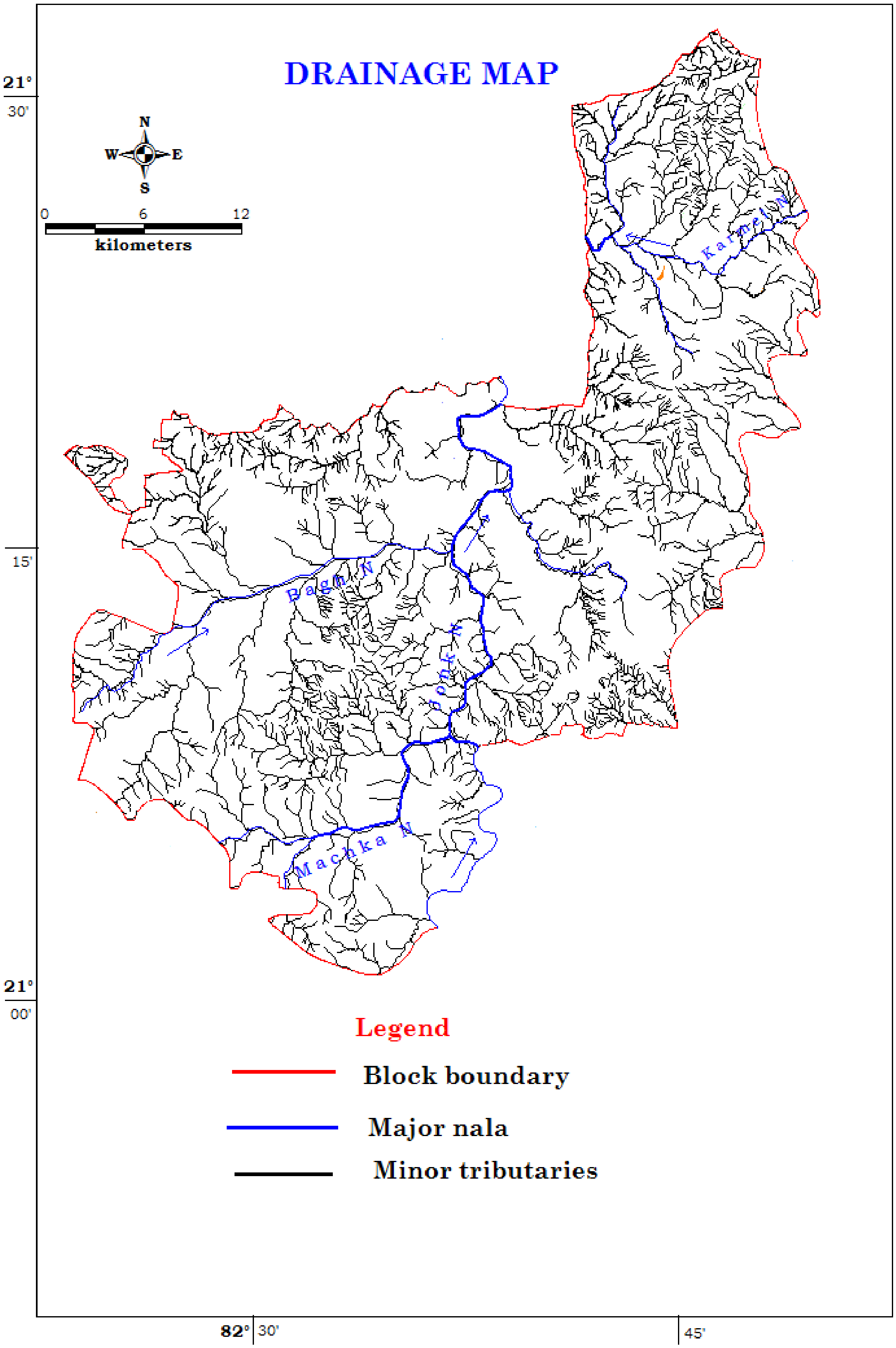

Figure 3: Drainage Map of Pithora Block

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 Dug wells, Bore wells /tube wells. The principal crops in the block are Paddy, Wheat, Kodokutki, pulses and vegetables.

In some areas, double cropping is also practiced. The agricultural pattern, cropping pattern and area irrigated data of Pithora block 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
Pithora	10600	19149	8795	62674	7294	69968

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

Block	Total geographical area	Revenue forest area	Area not available for cultivation	Non agricultural land	Fallow land	Net sown area	Double cropped area	Gross cropped area
Pithora	10600	19149	8795	3912	1468	62674	7294	69968

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

Block	Kharif	Rabi	Cereal				Pulses	Tilhan	Fruits Vegetables	Reshe	Mirch Masala	Sugar-cane
			Wheat	Rice	Jowar& Maize	Kodo, Kutki						
Pithora	62358	7610	287	61388	36	96	5720	1586	586	104	157	8

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
7	4672	3091	10817	1652	258	669	1580	654	14372	17981	26 %

Table 3 (E): Statistics showing Agricultural land Irrigated

Block	Gross Irrigated Area	Area Irrigated by ground water	Percentage of Area Irrigated by ground water
Pithora	17981	11075	61.05

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

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

Block	**Dongargarh granite and gneiss**			
	Phreatic		Fractured	Total resource
	Dynamic	Static	In-storage	
Pithora	**11102.47**	**840.36**	**89.4**	**12032.23**

Block	**Basalt/Amphibolite gneiss**			
	Phreatic		Fractured	Total resource
	Dynamic	Static	In-storage	
Pithora	2061.53	156.04	16.6	**2234.17**

Existing and Future Water Demand (2025): The existing demand for irrigation in the area is 6822 Ham while the same for domestic and industrial field is 453.95 Ham. To meet the future demand for ground water, a total quantity of 5851.39 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 the water level varies from 6.02 to 10.76mbgl with an average of 8.46mbglin phreatic aquifer. In fractured formation, the pre monsoon water level variation range is 3.8 to 15.9mbgl with average of 12.74mbgl.

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

Block Name	Phreatic		
	Min	Max	Average
Pithora	6.02	10.76	8.46

Water Level (in mbgl)

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

Block Name	Fractured		
	Min	Max	Average
Pithora	3.8	15.9	12.74

(ii) Post- monsoon water level**:** In the post-monsoon period, it has been observed that the water level varies from 1.94 to 5.99mbgl with an average of 3.83mbglin phreatic aquifer. In fractured formation, the post monsoon water level variation range is 3.2 to 6.75mbgl with average of 5.11mbgl.

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

Block Name	Phreatic		
	Min	Max	Avg
Pithora	1.94	5.99	3.83

Water Level (in mbgl)

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

Block Name	Fractured		
	Min	Max	Avg
Pithora	3.2	6.75	5.11

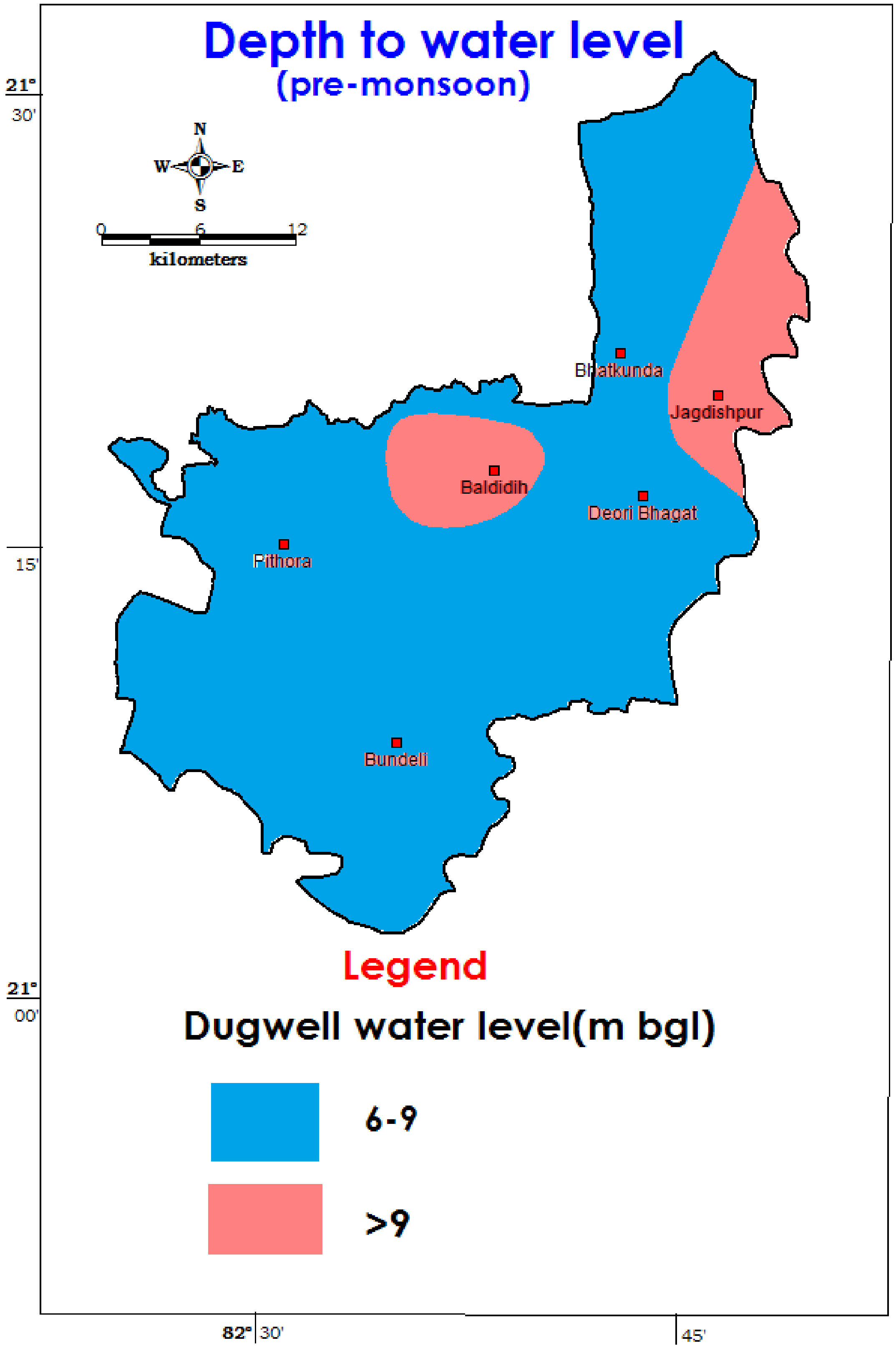

Figure-4: Depth to water level map Phreatic Aquifer (Pre-monsoon)

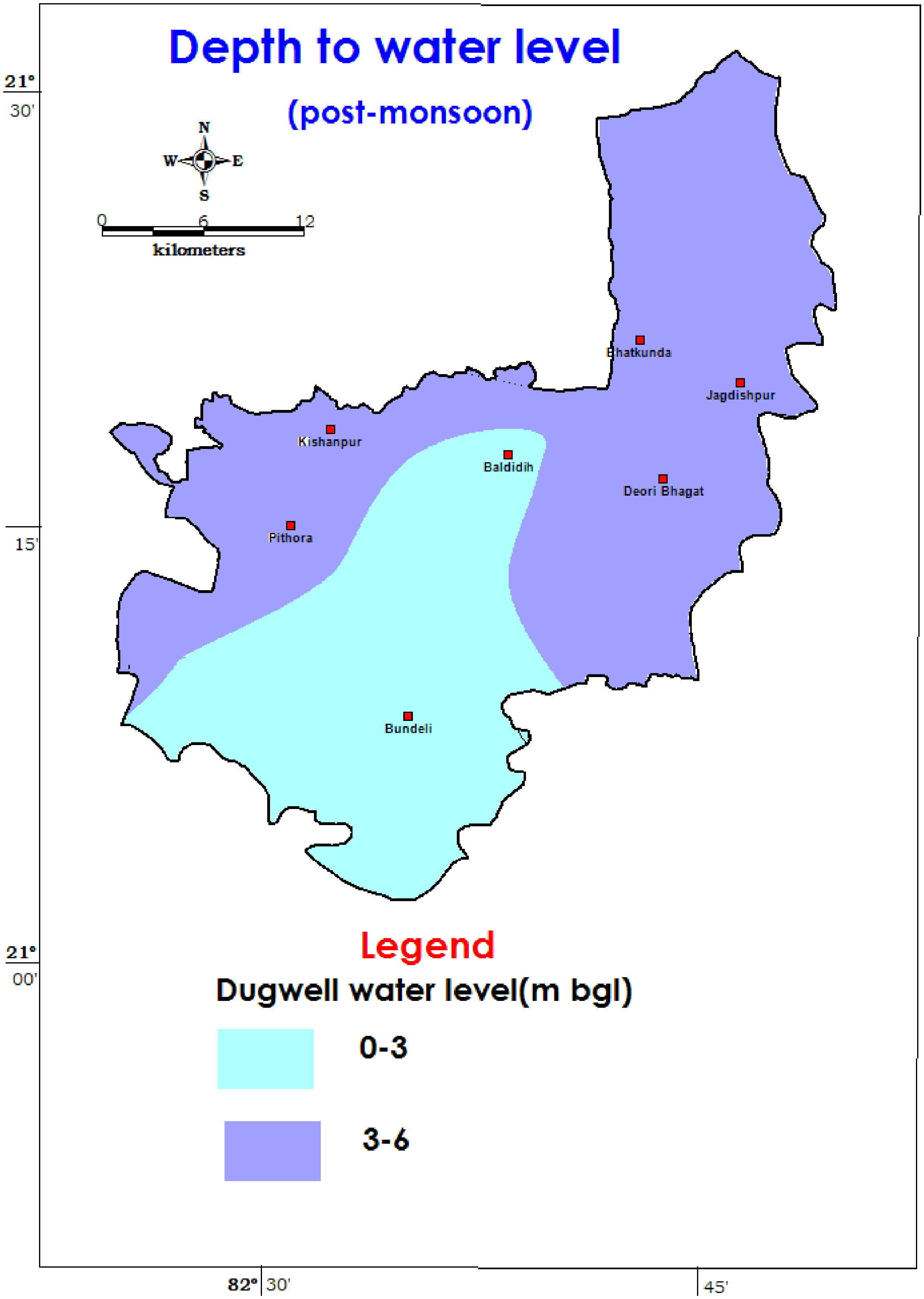

Figure 5: Depth to water level map Phreatic Aquifer (Post-monsoon)

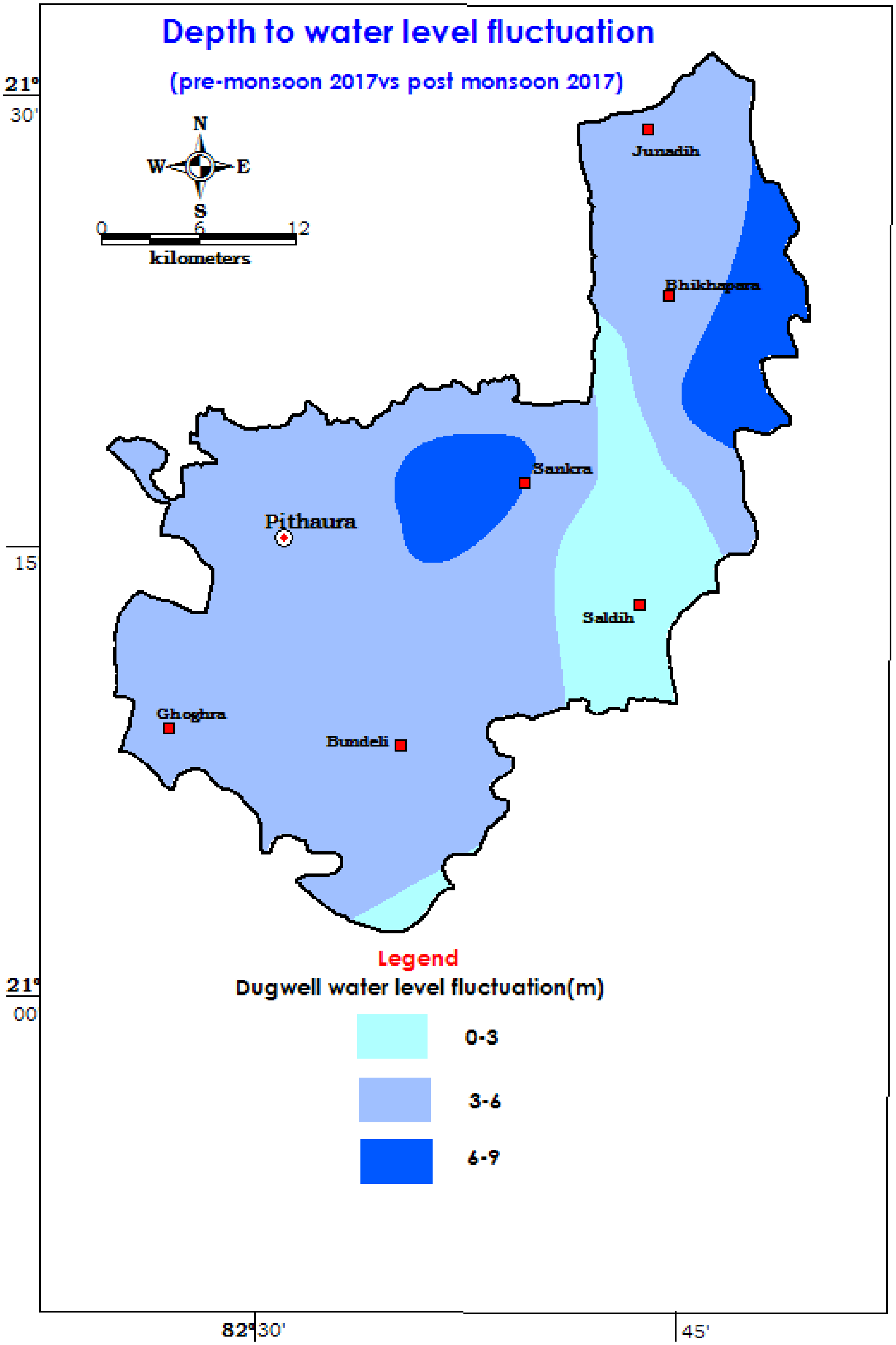

Figure 6: Depth to water level fluctuation map of Phreatic Aquifer

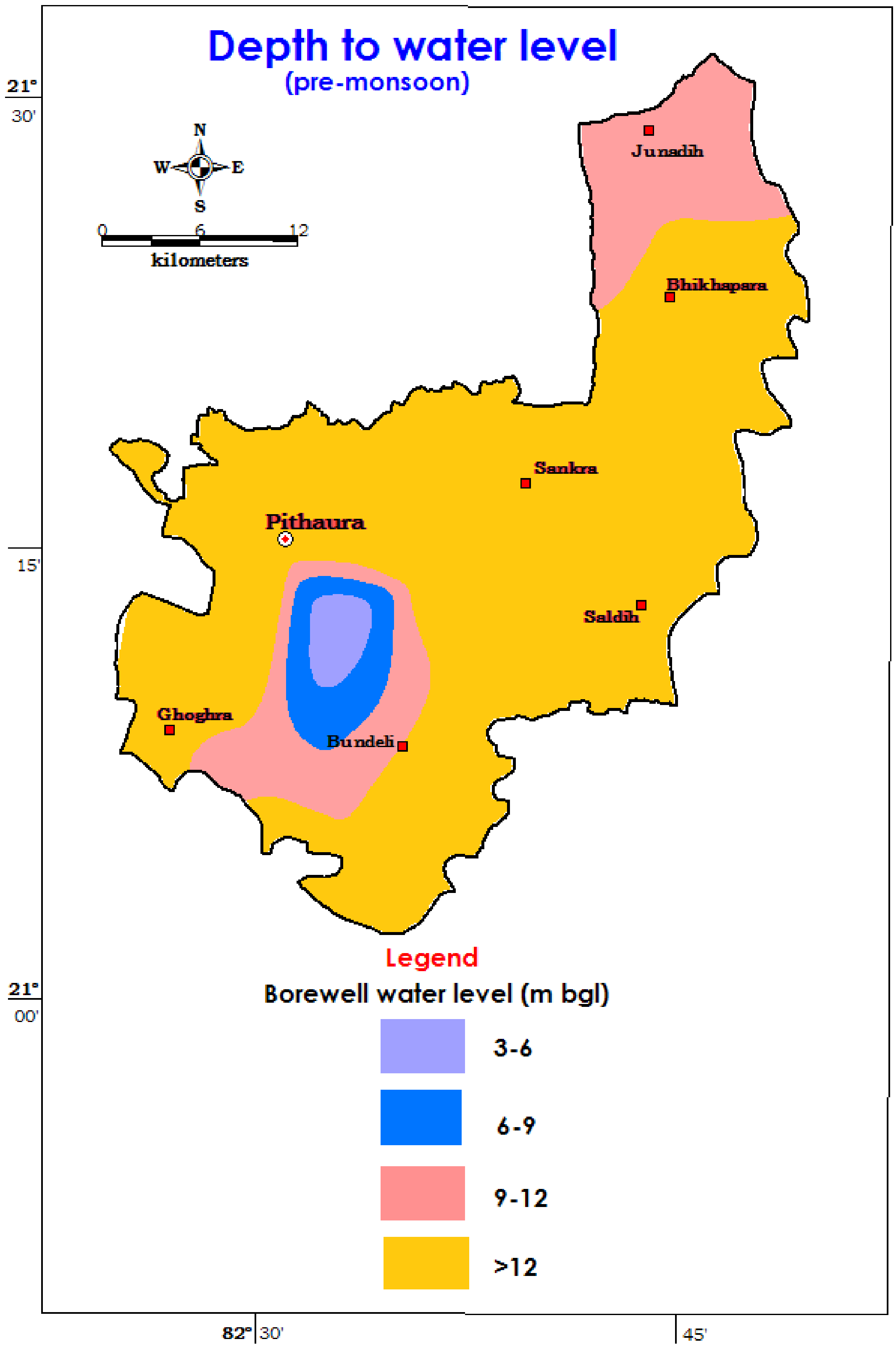

Figure-7: Depth to water level map Fractured Aquifer (Pre-monsoon)

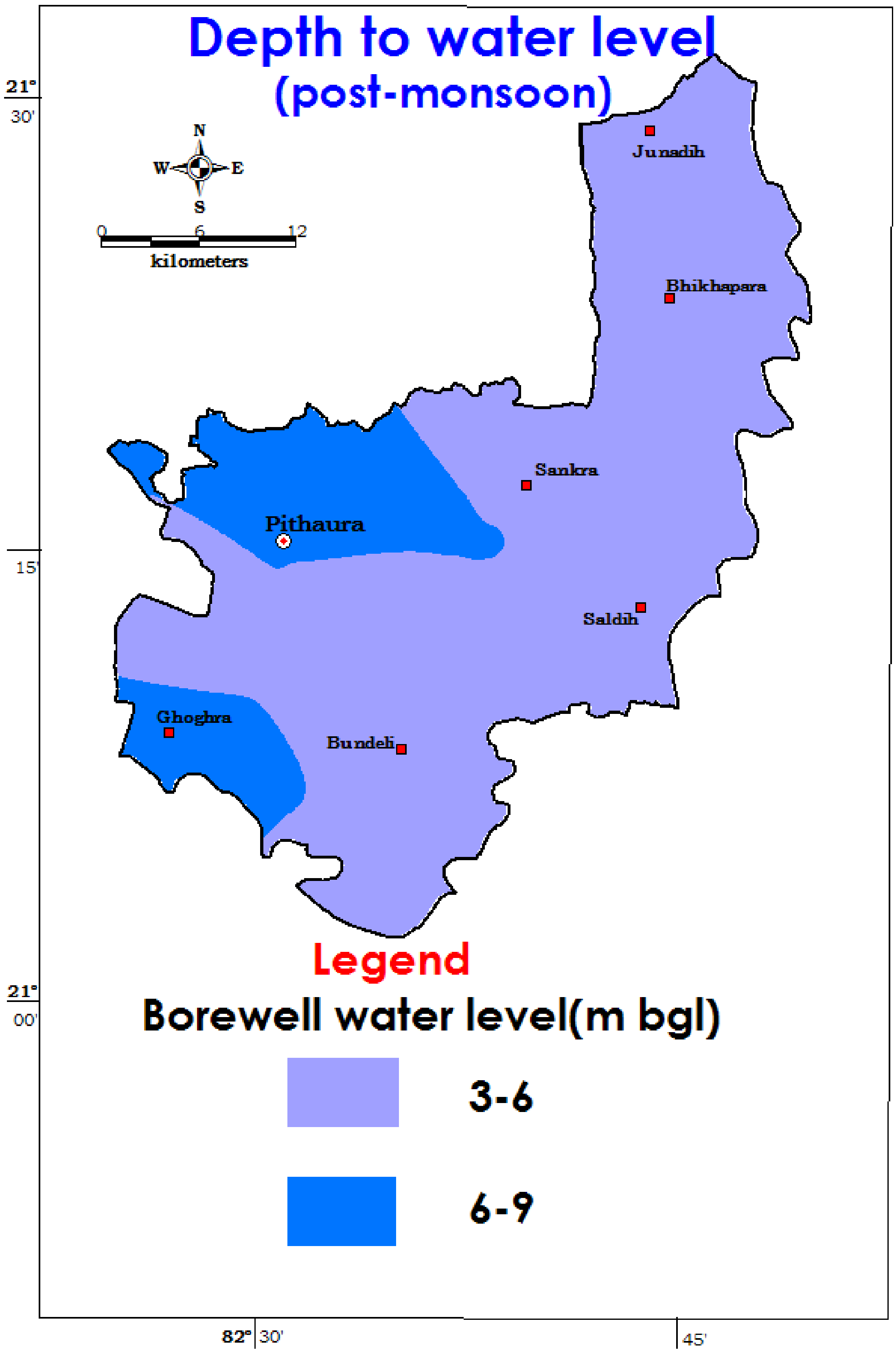

Figure-8: Depth to water level map Fractured Aquifer (Post-monsoon)

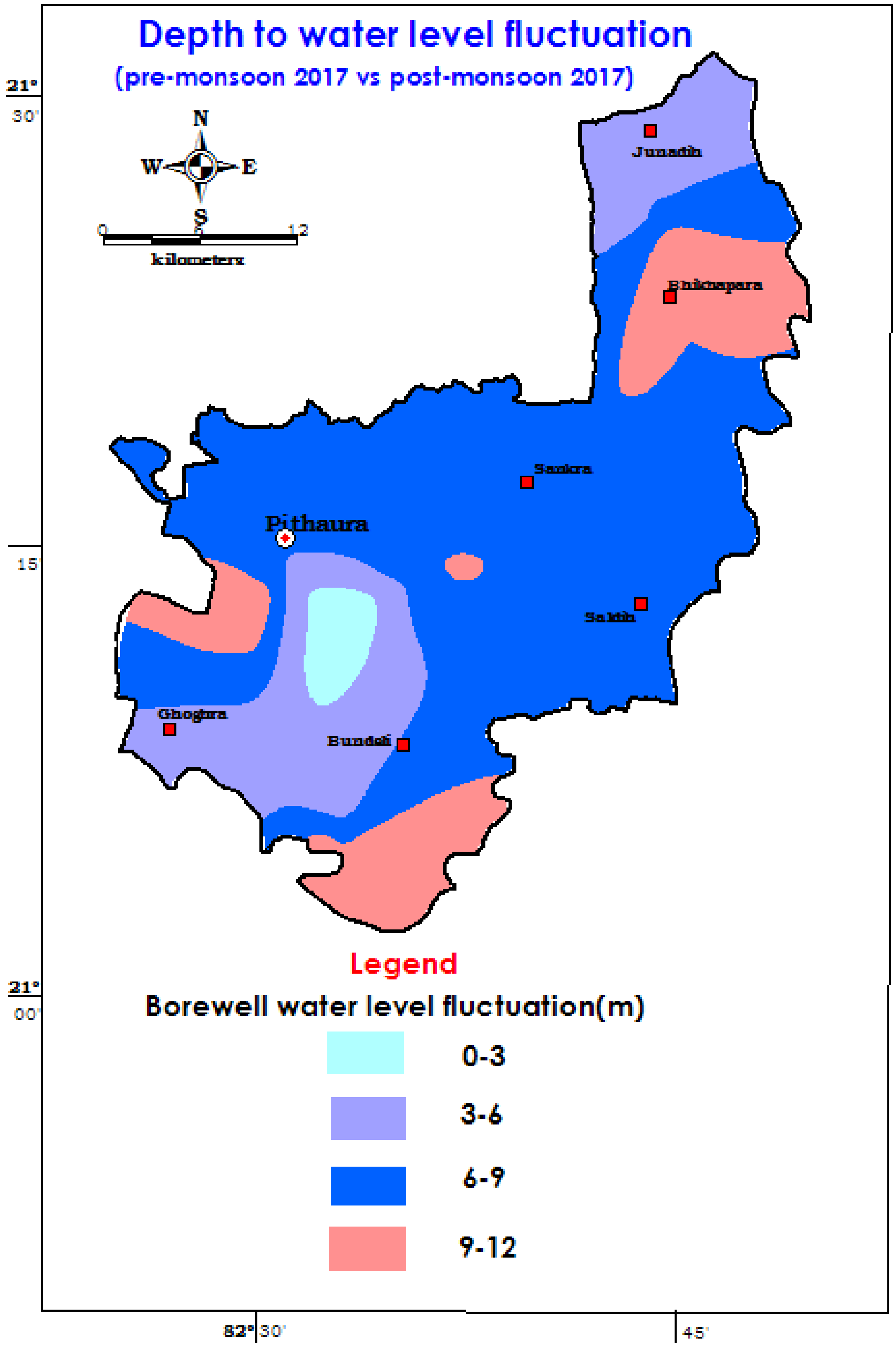

Figure 9: Depth to water level fluctuation map of Fractured Aquifer

(iii) Seasonal water level fluctuation: The water level fluctuation data indicates that in Pithora block, water level fluctuation in phreatic aquifer varies from 1.91 to 7.37 m with an average fluctuation of 4.71m. Water level fluctuation in fractured aquifer varies from 0.6 to 12.66 m with an average fluctuation of 7.63 m.

Table 5E: Aquifer wise Depth to Water Level Fluctuation

Block Name	Phreatic		
	Min	Max	Average
Pithora	1.91	7.37	4.71

Water Level (in m)

Table 5F: Aquifer wise Depth to Water Level Fluctuation

Block Name	Fractured		
	Min	Max	Average
Pithora	0.6	12.66	7.63

(iv) The long term water level trend: It indicates that there is no significant decline in water level in pre-monsoon as well as post-mosoon period.

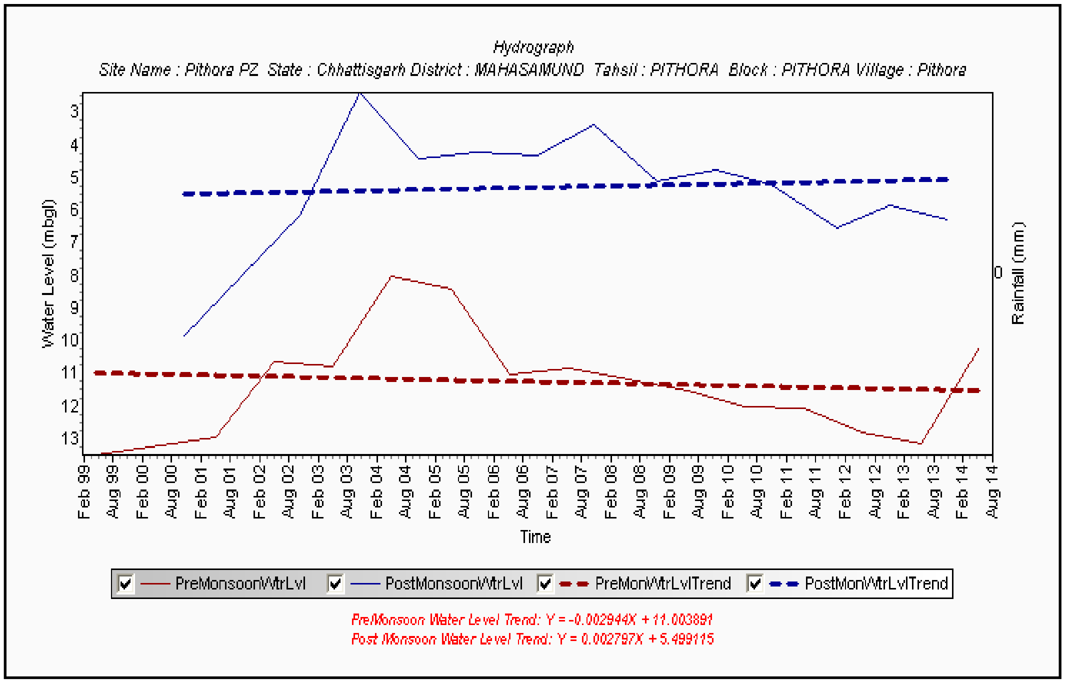

Figure 10: Hydrograph of Pithoratown, Pithora block

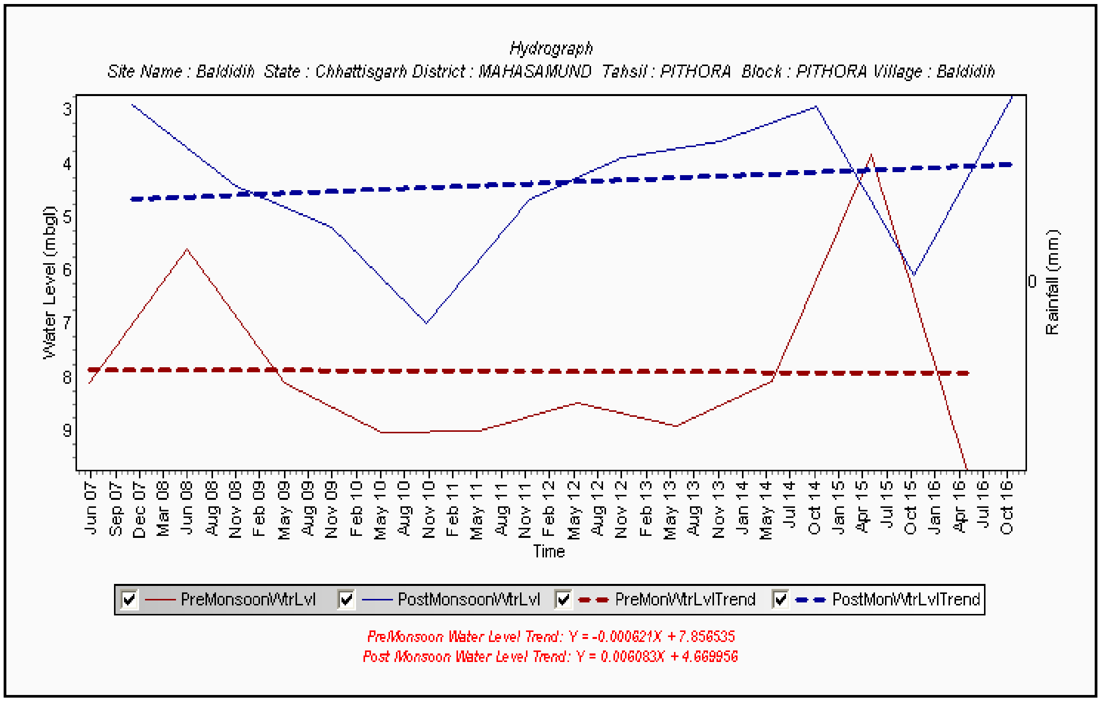

Figure 11: Hydrograph of Baldidih village, Pithora block

2. Aquifer Disposition:

Number of Aquifers: There aretwo major aquifers, viz. Dongargarh granite and granitic gneiss and Sonakhan group basalt and amphibolites 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:

(A) Geology: Geologically the block exhibits lithology of Meso to Neo Proterozoic agedominated by Dongargarh granite and granitic gneiss and Sonakhan groupbasalt and amphibolites gneiss.

(i) Dongargarh granite and granitic gneiss: 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 transmissivity of the formation is around 6 m^2 per day with an average drawdown of 27 m. The thickness of fractured aquifer is around 0.2 m.

(ii) Sonakhan group of Archean to Proterozoic age consists of basalt and amphibolite and metasediments. 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 12.75 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 1 to 2sets of fractures are encountered within 60 to 200 m depth. The discharge is negligible(<1lps). The development in these formations is mostly by way of dug wells.

Table 6: Distribution of Principal aquifer systems in Pithora

Block	Phreaticand fractured granite gneiss (sq.km.)	Phreaticand fractured basalt, amphibolite(sq.km.)
Pithora	894	166

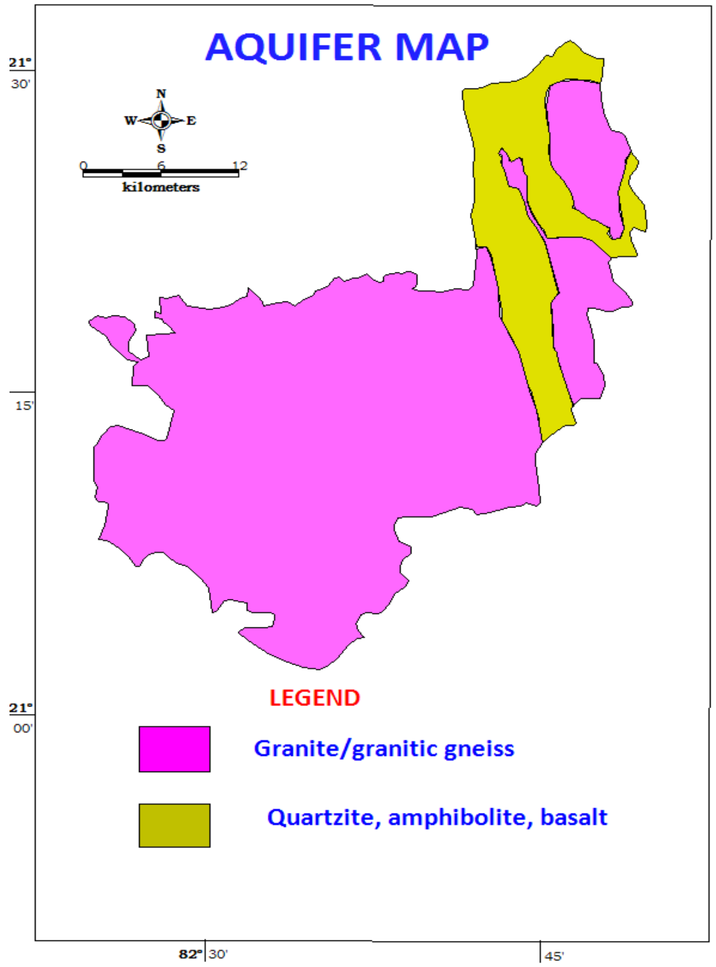

Figure 12: Aquifer map of Pithora block

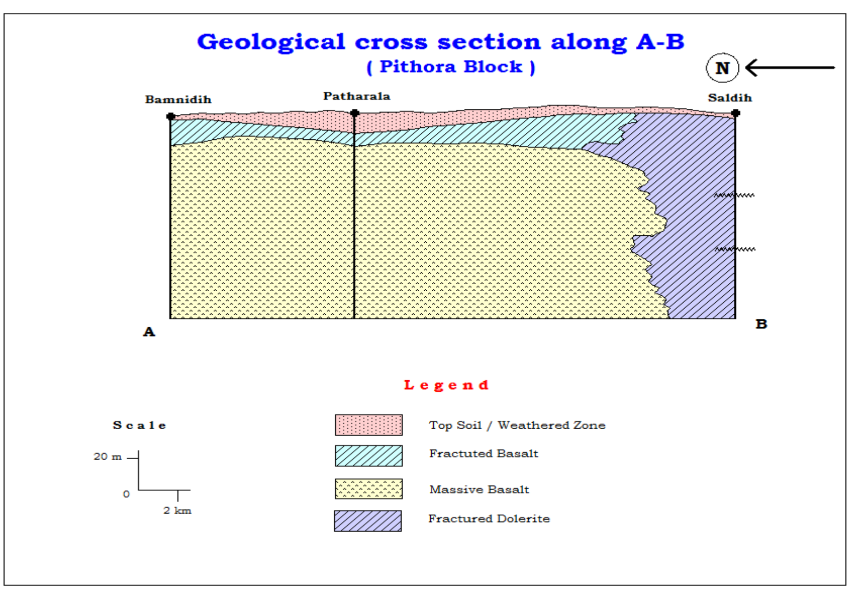

Figure-13: (a)Hydrogeological Cross Section(A-B) Pithora Block

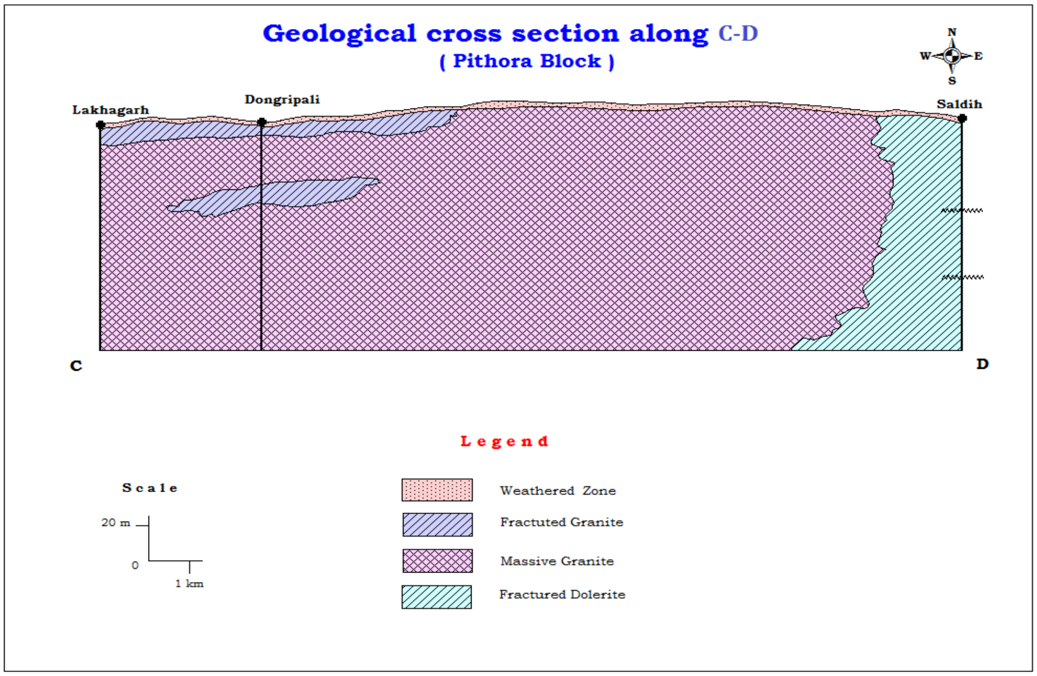

Figure 13: (b) Hydrogeological Cross Section(C-D), Pithora Block

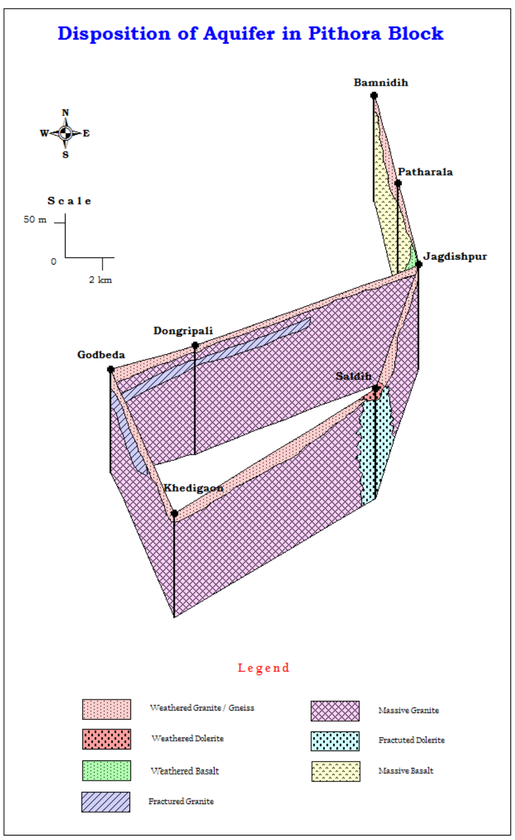

Figure-14: Disposition of aquifer in Pithora block

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 Pithora block is 13164. 0ham.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 Pithora 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)
Mahasamund	Pithora	13164.0	6822.0	453.95	7275.95	490.61	5851.39

Table-8: Categorization of Assessment Unit

District	Block	Stage of Ground water development (%)	Categorization
Mahasamund	Pithora	55.27	Safe

Categorization: The Pithora block falls in safe category. The stage of Ground water development is 55.27%. The Net Ground water availability is 13164.0ham. The Ground water draft for all uses is 7275.95 Ham. The Ground water resources for future uses for PithoraBlock is6342.0Ham.

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)
Granite-gneiss	$378*10^6$	1.5	0.03	17.01×10^6
Basalt/ Amphibolite	$130*10^6$	1.5	0.03	$\times 10^6$

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) There is further scope of groundwater development.

6. Supply side interventions:

(i) Pithora 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 insignificant, still 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
Pithora	508	22.04	70	190	340	457
	Recharge Capacity		14.43	1.89	3.43	2.29
	Estimated cost (Appx.)		Rs. 22.36 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 55.27 %. 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 ground water Development (%)	Present ground water draft (ham)	Ground water draft at 60% stage of development (ham)	Surplus ground water at present Stage of Development (ham)	Number of TW Recommended in each block (Assuming unit draft as 2 ham/structure/ year)	Number of DW Recommended in each block (Assuming unit draft as 0.72 ham/structure/ year)
Pithora	13856.84	55.27	7275.95	7898.4	622.45	311	865

7. Demand side interventions:

(i) Change in cropping pattern & irrigation pattern can lead to groundwater savings, 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					
Pithora	5978	0.9	0.5	0.4	2391.2	7275.95	13164.0	37%

(ii) In command or non-command area wherever ground water has been used for field irrigation 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 cultivation of pulses(m)	30 % groundwater saved through micro irrigation	water saved through microirrigation (ham)
Pithora	5978	0.3	0.3	347.67

Water thus saved can help arrest declining groundwater levels during summer. This may lead to ample drinking water resource in months of May-June.

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

PT (Percolation tank)	NB & CD (Nala bund and Check dam)	RS (Recharge shaft)	GB (Gabbion structure)
Patparpali	Bagarpali	Kokobhatha	Saraipali
Sona silli	Dadargaon	Bagarpali	Janghora
Thakurdayakalan	Badgaon	Kotadadar	Lahraud
Ghoghra	Lakhagarh	Gadbeda	Bhitidih
Kotadadar	Rampur	Kasahibahara	Charbhatha
Laxmipur	Khairkhuta	Bagarpali	Kishanpur (Kisanpur)
Charbhatha	Dongripali	Dhanora	Gabaud
Atharagudi	Charbhatha	Laxmipur	Kurmadih
Kurmadih	SalheTarai	Thakurdiyakhurd	Ansula
Pilawapali	Rampur tukda	Gopalpur	Badetemri
Dewalgarh	Gardih	Ansula	Dhabakhar
Sankara	Pandripani	Dhabakhar	SalheTarai
Saldih	Jabalpur takdanaya	Deosaral	Khursipahar
Jamjuda	Rampur	Bijemal	Padakipali
BadetemriNaktinala	NarsaiyaPallam (Nars	Chhuwalipatera (Chhu	Dhodarkasa
Thelkodadar	Gadbeda	Bahadurpur	Saisaraipali
Jadamuda	Santemri	Sankarpur	Arangi
Bamhanpuritukda (Vir	Pendrawan	Arangi	Rajpalpurtukda
Jhagrandih	Bhatkhunda	Khamhan	Kesharpur
Rajpur	LohrinDongani	Pirda	Rampur
Pardhiyasaraipali	Jarabharan	Bamhani	
Dalalkhar	Utekel	Rajpalpur	
Lawamauha (Lawamauta)	Chhoteloramtukda N		
	Burodih		
	Durugpali		

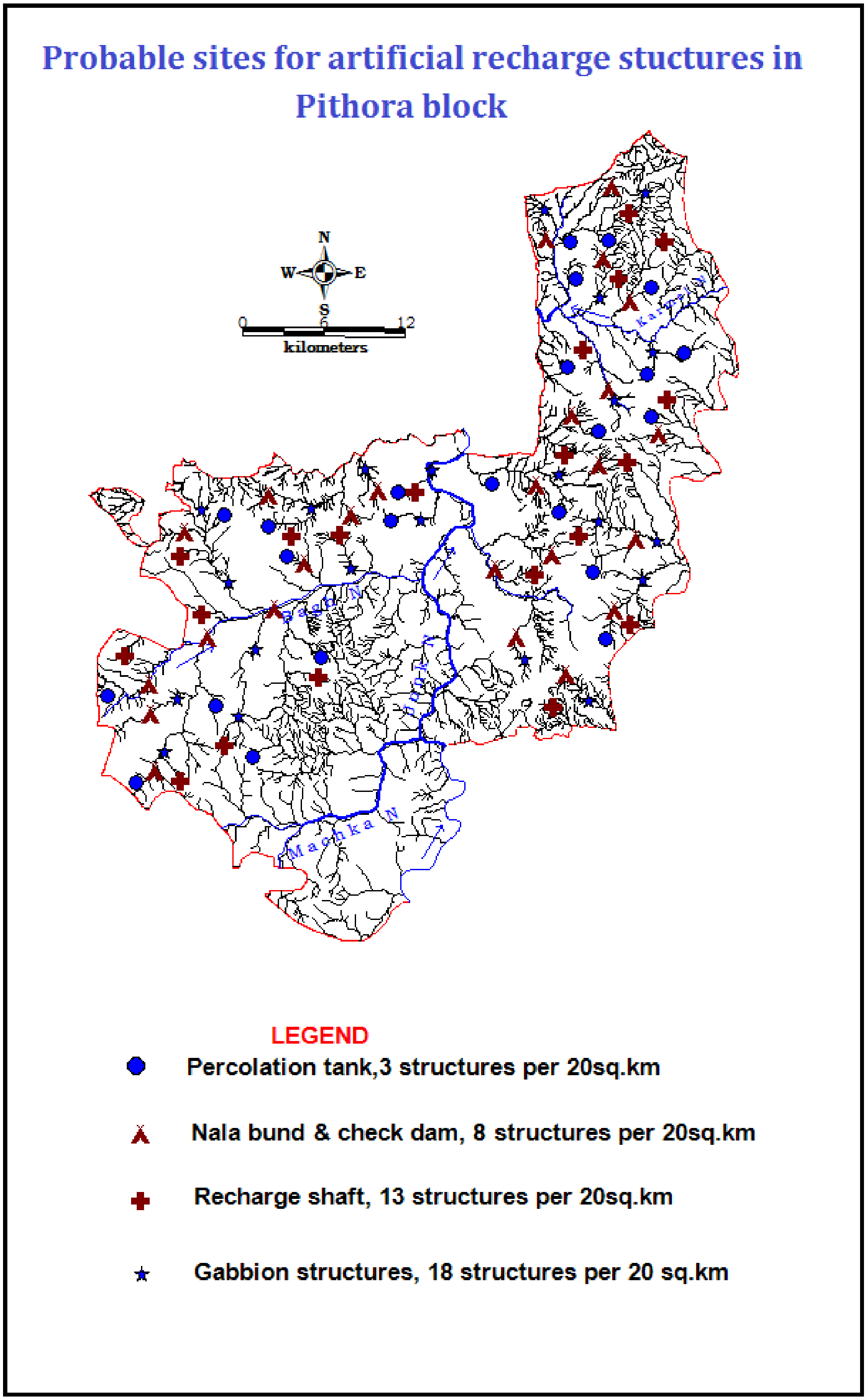

Figure 15: Map of proposed sites for artificial recharge of groundwater in Pithora block

8. CONCLUSIONS:

An area of 1060 sq.km of Pithora block of Mahasamund district has been considered for Aquifer Mapping and Management Plans. The total G.W resource is 13164.0 Ham with stage of G.W development 55.27 % and categorized as “safe”. 61.05 % of the irrigated area is uses groundwater for irrigation. The major aquifer groupsareDongargarh Granite and Granite gneiss and Sonakhan Group Amphibolite gneiss and basalt. In terms of Demand side management, by change in cropping and irrigation pattern (micro irrigation methods) 2391.2Ham and 347.67 Ham water can be saved respectively. In terms of Supply side management, by constructing artificial recharge structure 22.04 MCM water can be recharged and constructing of tubewell at suitable locations, drinking water needs may be fulfilled.