



केंद्रीय भूमि जल बोर्ड

जल संसाधन, नदी विकास और गंगा संरक्षण

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 RAJNANDGAON BLOCK, RAJNANDGAON DISTRICT, CHHATTISGARH

उत्तर मध्य छत्तीसगढ़ क्षेत्र, रायपुर

North Central Chhattisgarh Region, Raipur

**AQUIFER MAPS AND GROUND WATER MANAGEMENT PLAN,
RAJNANDGAON BLOCK, RAJNANDGAON DISTRICT,
CHHATTISGARH**

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BLOCK-WISE AQUIFER MAPS AND MANAGEMENT PLANS RAJNANDGAON BLOCK, RAJNANDGAON DISTRICT

1. SALIENT INFORMATION

1.1 About the area:

Name of the Block	Rajnandgaon
Area	743 Sq. km.
District	Rajnandgaon
State	Chhattisgarh

Administrative Map

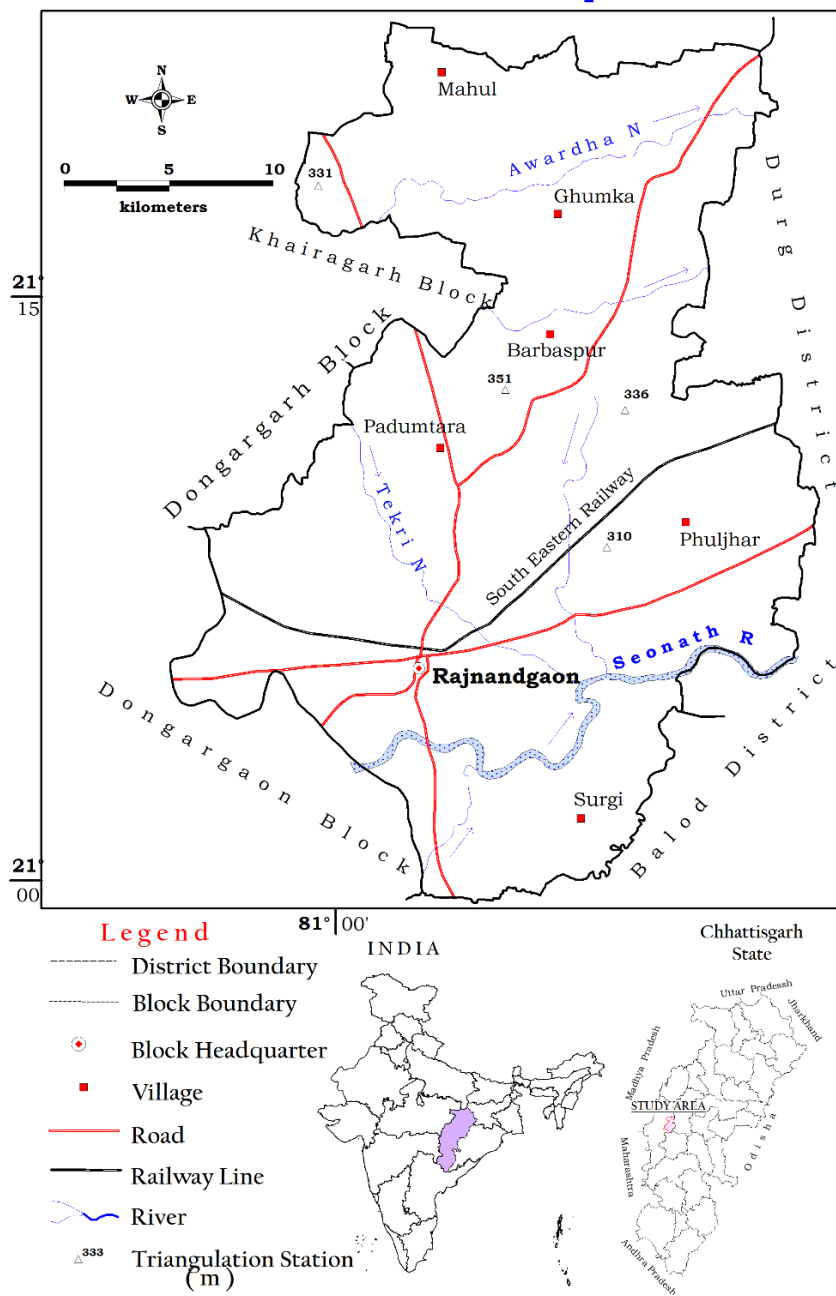


Figure 1 Administrative Map

1.2 Population:

The total population of Rajnandgaon block as per 2011 Census is 3,63,352. 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
Rajnandgaon	3,63,352	1,82,141	1,81,211	2,00,238	1,63,114

Source: CG Census, 2011

1.3 Population Growth rate:

The decadal growth rate of this block is 79.94 as per 2011 census.

1.4 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. 2012-13 to 2016-17) 1204.78mm

Table 2 Rainfall data in Rajnandgaon block (in mm)

Year	2012-13	2013-14	2014-15	2015-16	2016-17
Monsoon rainfall	1184.4	1292.4	1044.8	1245.6	1256.7

Source: Statistical Hand Book Rajnandgaon District, 2016-17

1.5 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. The agricultural pattern, cropping pattern and area irrigated data of Rajnandgaon block is given in Table No. 3 (A, B, C, and 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
Rajnandgaon	74261	25	9731	6191	5714	49865	18777	68642

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						
Rajnandgaon	45889	22753	2357	40295	18	48292	13063	2835	3634	4	90	9

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 Irrigated area	Gross irrigated area	% of irrigated area wrt. Net sown area
6	4173	3032	12380	850	1102	7	779	685	19119	19119	38.34

Table 3(D) Contribution of Groundwater in Irrigation Pattern (in 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 (%)
Rajnandgaon		1102	13482	19119	70.51

Drainage Map

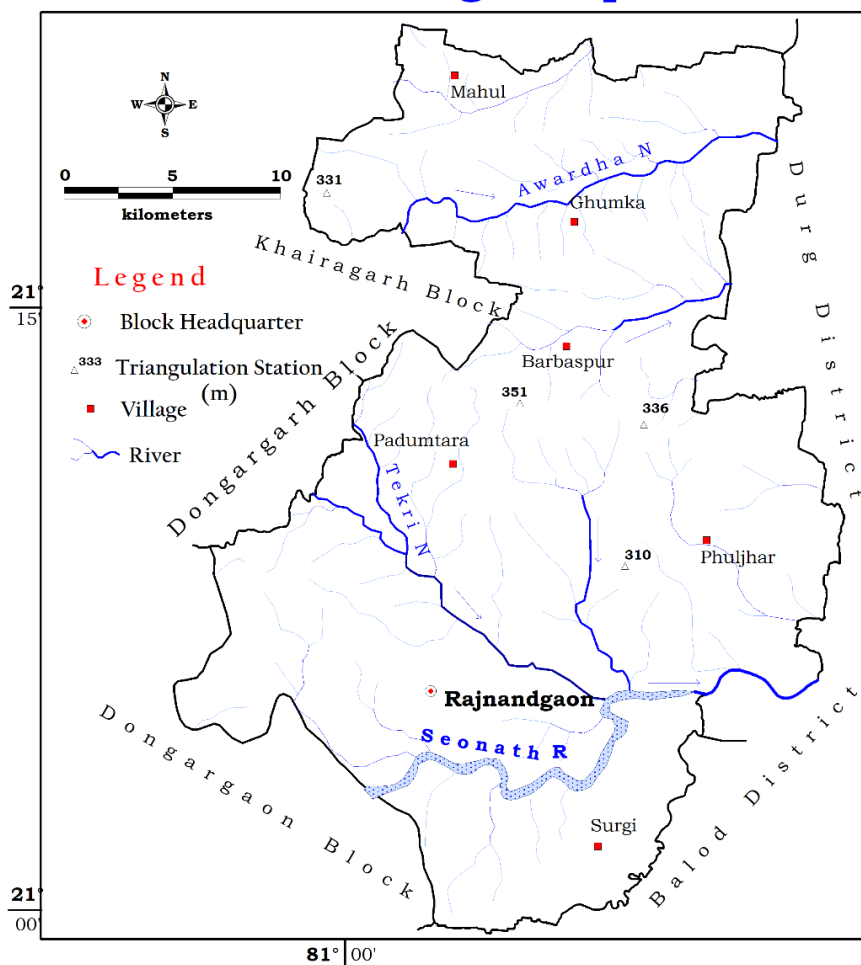


Figure 2 Drainage Map

Geomorphological Map

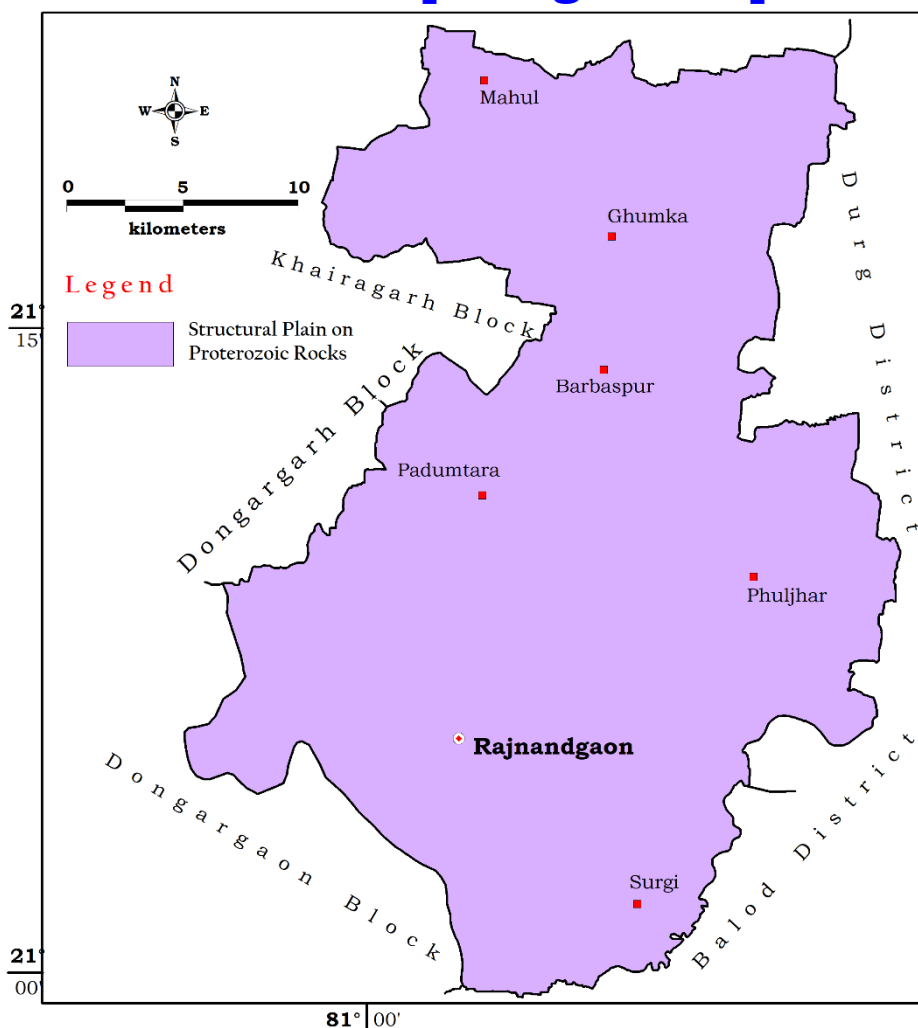


Figure 3 Geomorphological Map

Geomorphology of the Rajnandgaon block implies that whole area of the block is covered by structural plain on Proterozoic rock.

1.6 Groundwater Resource Availability:

Based on the resource assessment made, the resource availability in Rajnandgaon block is given in the Table No. 4.

Table 4 Ground Water Resources of Rajnandgaon block in Ham

Name of Block	Ground Water Recharge (Ham)				Total Annual Ground Water (Ham) Recharge (5=1+2+3+4)	Total Natural Discharge (Ham)	Net Ground Water Availability (Ham) (7=5-6)
	Monsoon Season		Non-monsoon season				
	Recharge from Rainfall	Recharge from Other Sources	Recharge from Rainfall	Recharge from Other Sources			
	1	2	3	4	5	6	7
Dongargaon	2867.23	1639.44	324.34	2082.44	6913.45	691.35	6222.10

1.7 Water Level Behavior:

1.7.1 Pre- monsoon water level (May 2018):

In the pre-monsoon period, it has been observed that in Rajnandgaon block, water level in Phreatic aquifer varies between 2 to 12.4 m bgl with average water level of 6.04m bgl shown in Table No. 5(A). In deeper semi-confined aquifer, water level varies between 11.61 to 27.84 m bgl with average water level of 19.38 m bgl shown in Table No. 5(B).

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

Block Name	Phreatic Aquifer		
	Min	Max	Avg
Dongargarh	2	12.4	6.04

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

Block Name	Semi-confined Aquifer		
	Min	Max	Avg
Dongargarh	11.61	27.84	19.38

Depth To Water Level of Phreatic Aquifer (Pre-monsoon 2018)

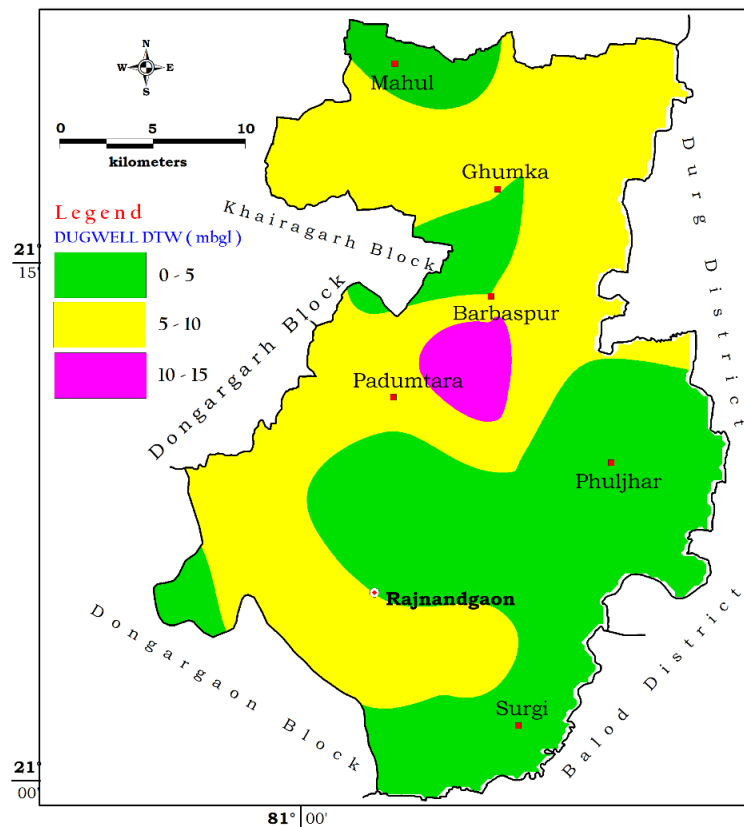


Figure 4 Pre monsoon Depth to Water level of Phreatic Aquifer

Depth To Water Level of Semi confined Aquifer (Pre-monsoon 2018)

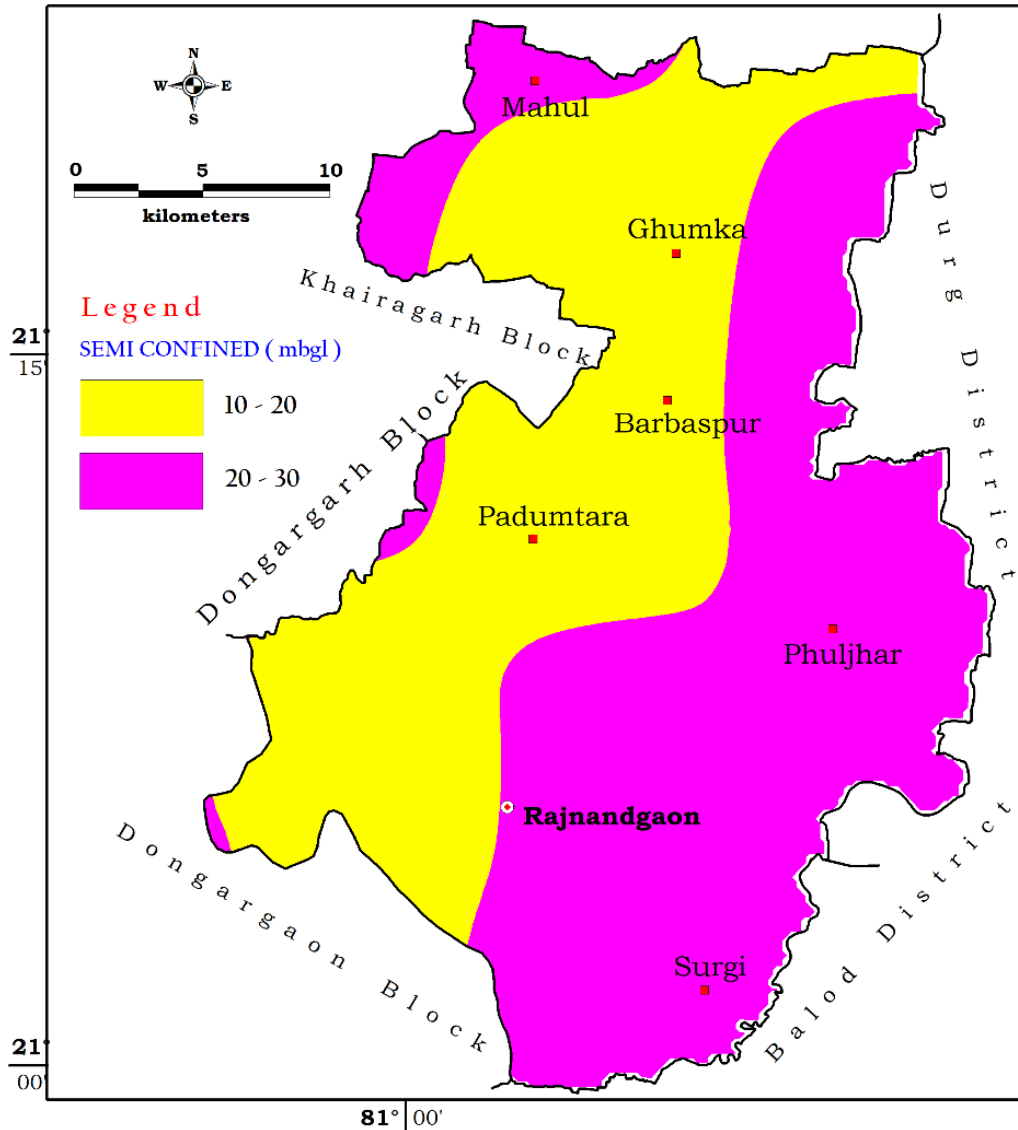


Figure 5 Pre monsoon Depth to Water level of Semiconfined Aquifer

1.7.2 Post- monsoon water level (Nov 2018):

In the post-monsoon period, it has been observed that in Rajnandgaon block, water level in Phreatic aquifer vary between 1.67 to 9.03 m bgl with average water level of 4.83 m bgl shown in Table No. 5(C). In deeper semi-confined aquifer, water level varies between 4.87 to 18 m bgl with average water level of 10.33 m bgl shown in Table No. 5(D).

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

Block Name	Phreatic Aquifer		
	Min	Max	Avg
Dongargarh	1.67	9.03	4.83

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

Block Name	Semi-confined Aquifer		
	Min	Max	Avg
Dongargarh	4.87	18	10.33

**Depth To Water Level of Phreatic Aquifer
(Post-monsoon 2018)**

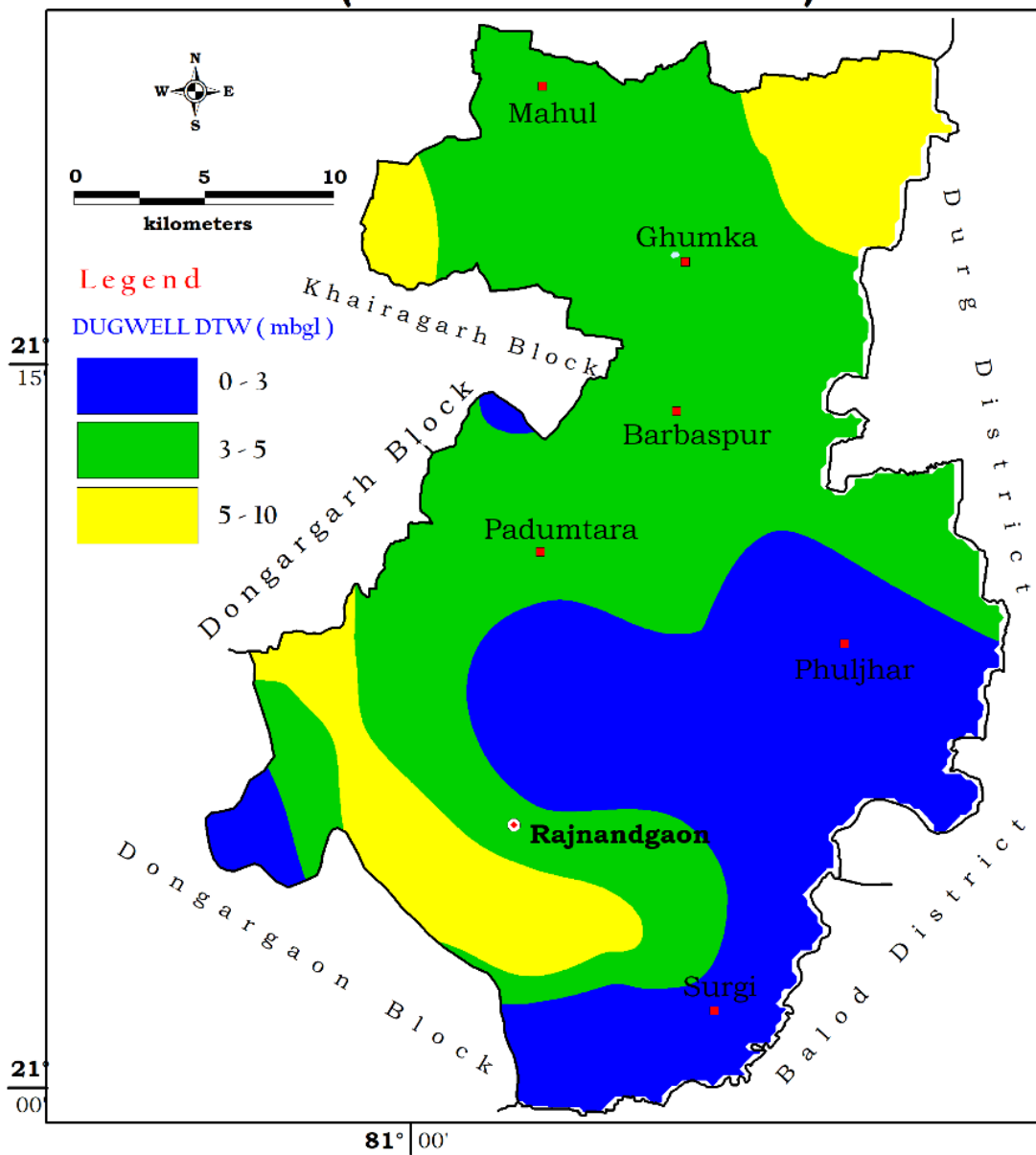


Figure 6 Post monsoon Depth to Water level of Phreatic Aquifer

**Depth To Water Level of Semi confined Aquifer
(Post-monsoon 2018)**

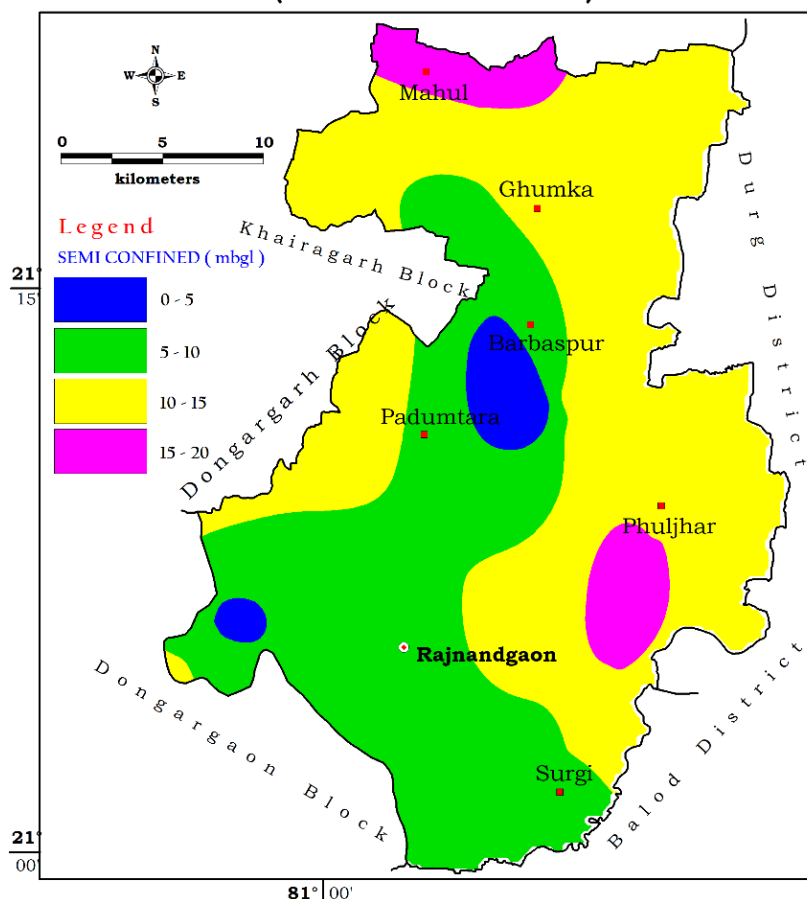


Figure 7 Post monsoon Depth to Water level of Semiconfined Aquifer

1.7.3 Seasonal water level fluctuation:

The water level fluctuation data indicates that in Rajnandgaon block, water level fluctuation in phreatic aquifer varies from 0.3 to 2.98m with an average fluctuation of 1.61m shown in Table No. 5(E). Water level fluctuation in semi-confined aquifer varies from 2.27 to 16.09m with an average fluctuation of 9.05m shown in Table No. 5(F).

Table 5(E) Aquifer wise Depth to Water Level Fluctuation (Phreatic aquifer)

Block Name	Phreatic Aquifer		
	Min	Max	Avg
Dongargarh	0.3	2.98	1.61

Table 5(F) Aquifer wise Depth to Water Level Fluctuation (Semi-confined aquifer)

Block Name	Semi-confined Aquifer		
	Min	Max	Avg
Dongargarh	2.27	16.09	9.05

**Ground Water Level Fluctuation of Phreatic Aquifer
(Post-monsoon Vs Pre-monsoon 2018)**

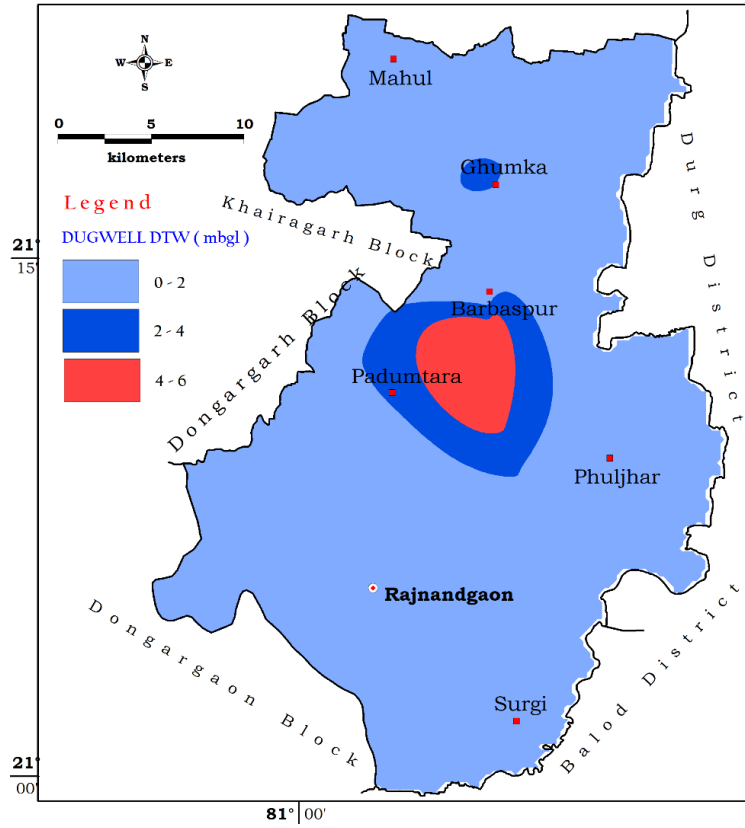


Figure 8 Ground water level fluctuation in Phreatic Aquifer

**Ground Water Level Fluctuation of Semiconfined Aquifer
(Post-monsoon Vs Pre-monsoon 2018)**

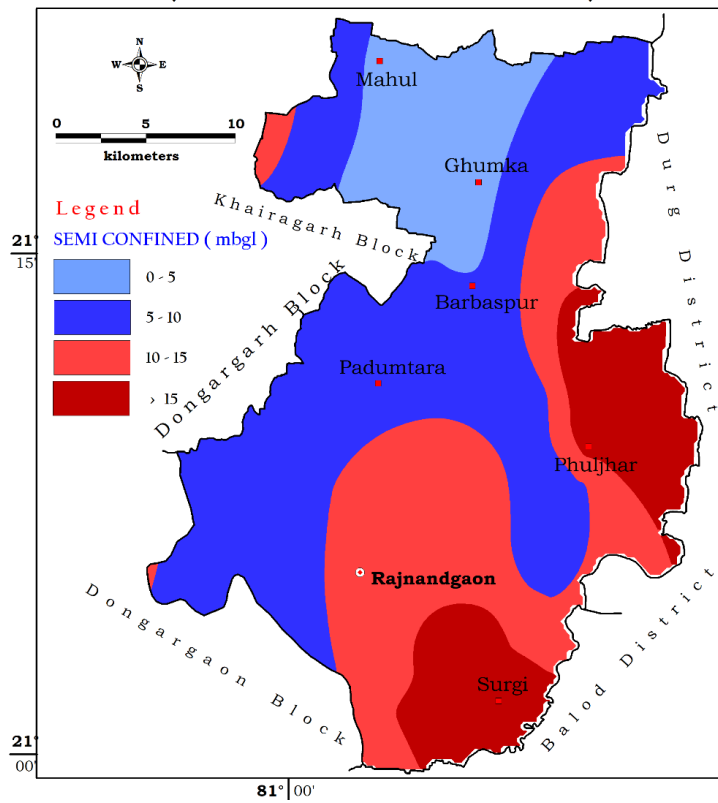
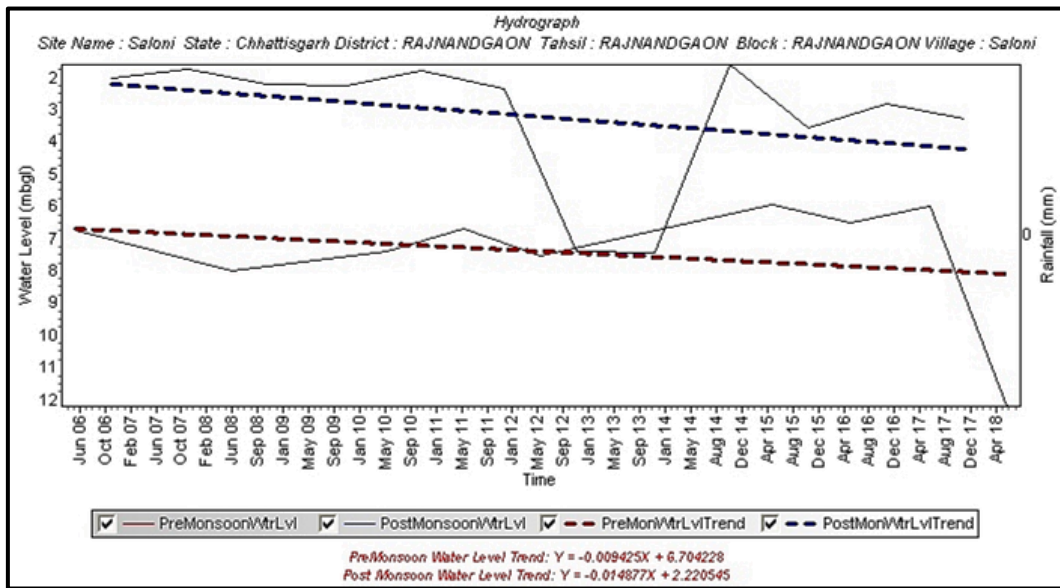
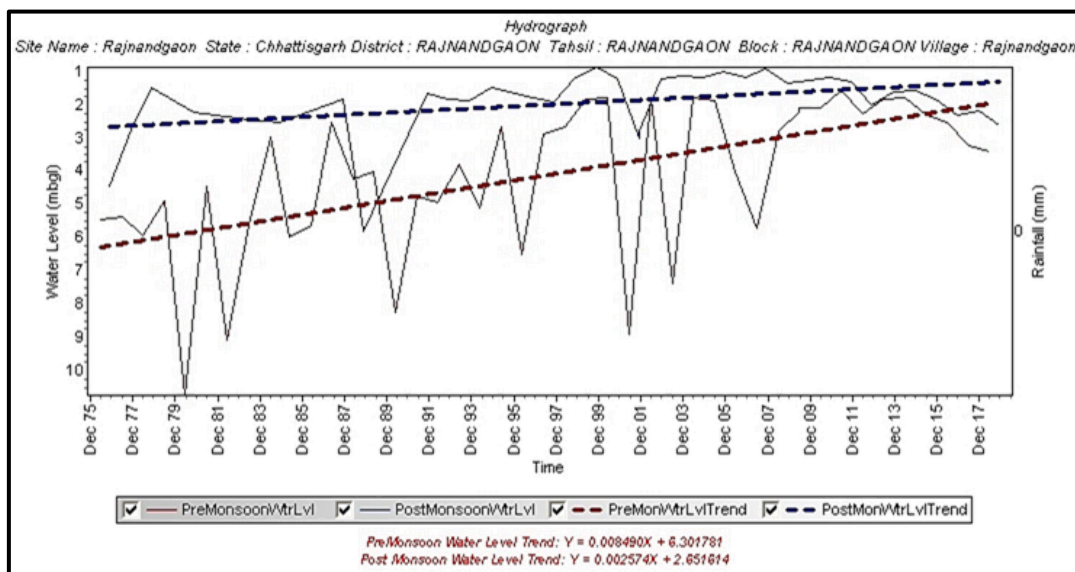


Figure 9 Ground water level fluctuation in Semiconfined Aquifer

1.7.4 The long-term water level trend:



In last decades from 2006 to 2018 there was fall in pre-monsoon and post-monsoon water level trend which implies the extraction of ground water was increased.



From 1975 to 2017 it is showing rising trend for both Pre-monsoon and Post-monsoon water level which indicate more recharge with less extraction during these decades.

2. AQUIFER DISPOSITION:

2.1 Number of Aquifers:

There are three major aquifers present in this block. As the aquifers are Consolidated in nature, so further those aquifers are divided in to two sub aquifers in Z-direction. One is Aquifer-I, which represents the Phreatic Aquifer or Weathered zone and another one is Aquifer-II, which represents Fractured Aquifer or Semi-confined aquifer as the fractures are connected to the weathered zone.

Table 6 Details of Aquifer

Geological Formation	Aquifer	Area Covered (Sq. k. m.)
Gunderdehi Formation	Shale <i>Aquifer-I (Phreatic Aquifer)</i> <i>Aquifer-II (Fractured aquifer)</i>	355
Charmuria Formation	Limestone <i>Aquifer-I (Phreatic Aquifer)</i> <i>Aquifer-II (Fractured aquifer)</i>	330
Chandi Sandstone	Sandstone <i>Aquifer-I (Phreatic Aquifer)</i> <i>Aquifer-II (Fractured aquifer)</i>	65

Aquifer Map

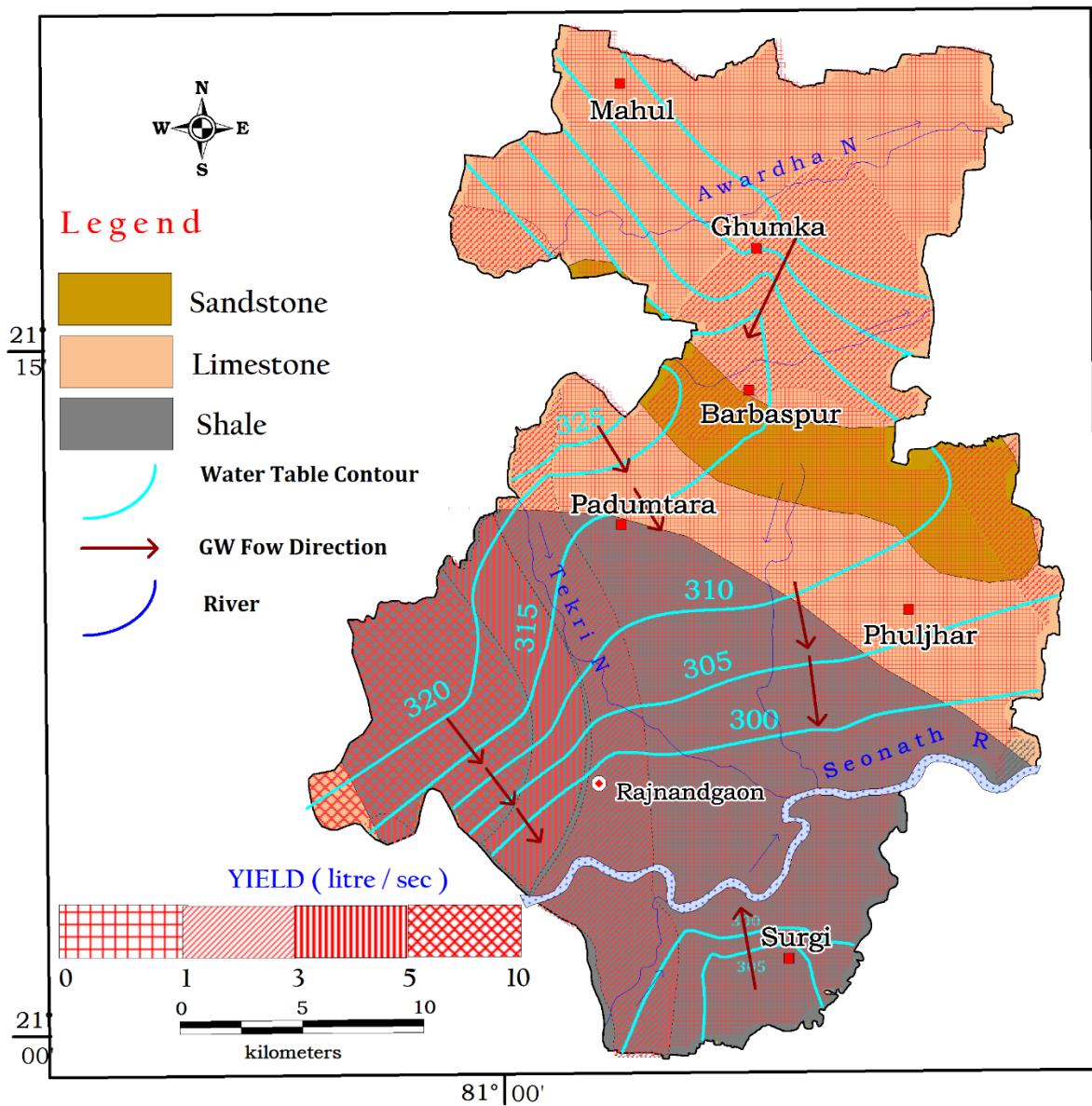
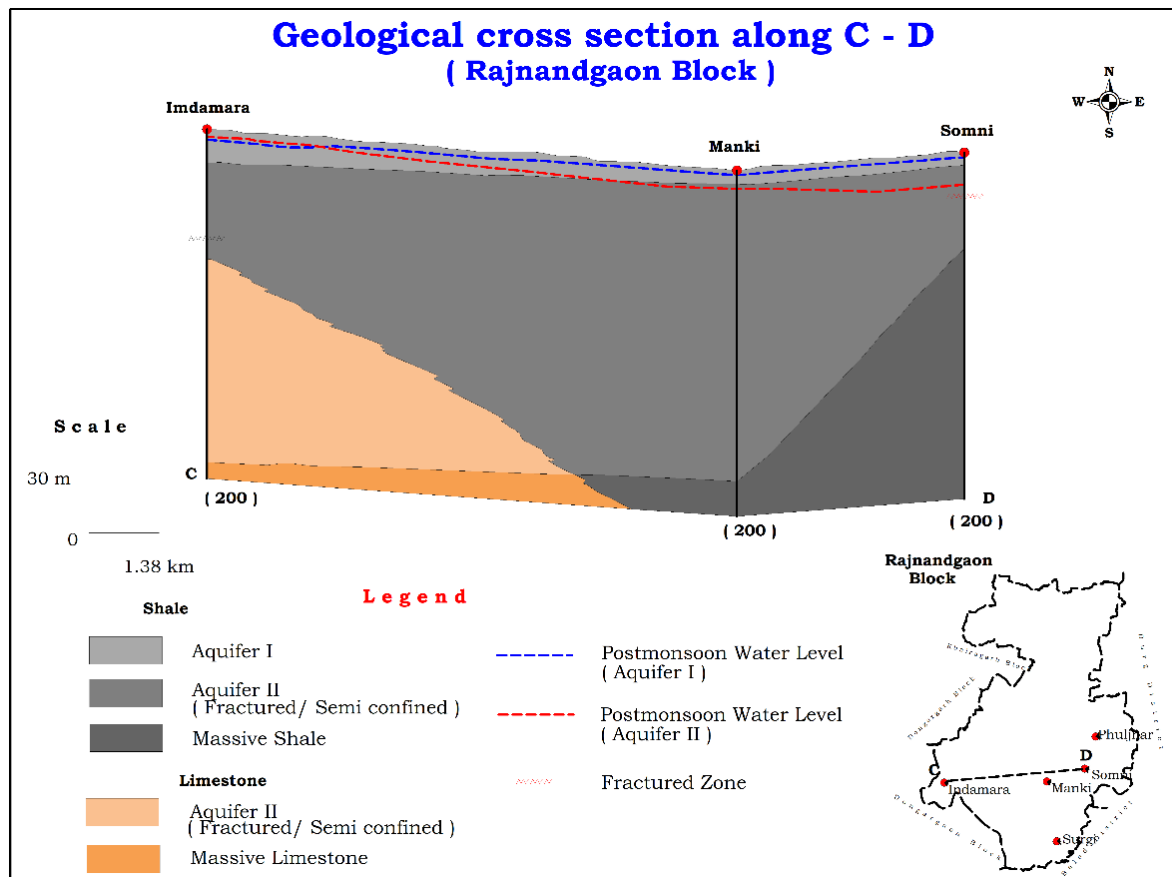
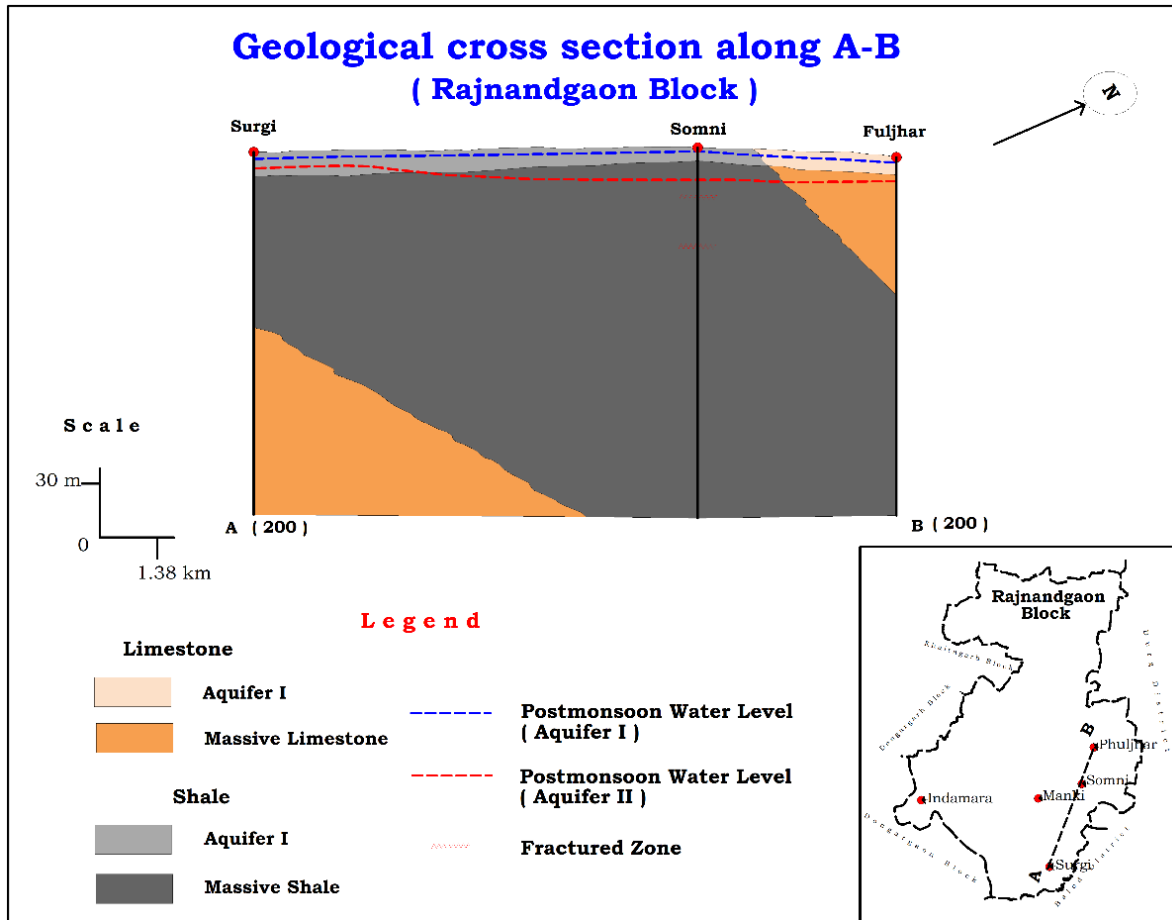


Figure 10 Aquifer Map of Rajnandgaon Block

2.2 3-d aquifer disposition and basic characteristics of each aquifer:



Disposition of Aquifer in Rajnandgaon Block

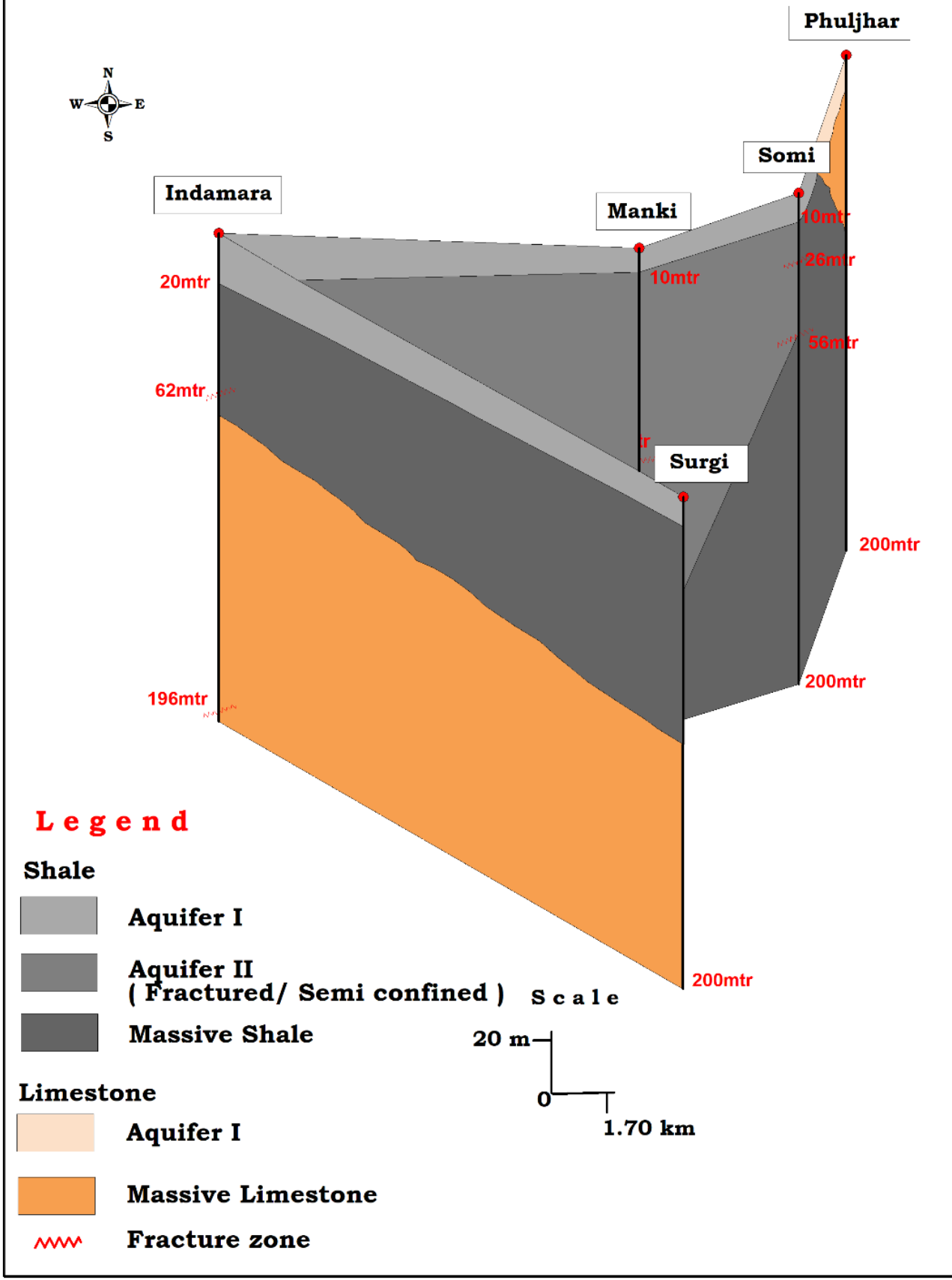


Figure 11 Cross section and Fence diagram of Rajnandgaon Block

Table 7 Aquifer Characteristics of Rajnandgaon Block

Places		Surgi	Indamara	Manki	Somni	Phuljhar
Major Formation		Limestone, Shale	Limestone, Shale	Shale	Shale	Limestone, Shale
Thickness (in m)	Aquifer-I	12	7.85	6.05	7.85	11
No of potential zone	Aquifer-II	-	2(58m-62m, 187m-192m)	3(7m-9m, 88m-93m, 177m-180m)	2(24m-27m, 55m-58m)	-
Yield (lps)		Dry	2.15	0.441	0.731	Dry
Transmissivity (m²/day)		-	13.41	0.362	0.2	-
Drawdown (m)		-	14.56	36.8	24.17	-

3. GROUND WATER RESOURCE, EXTRACTION, CONTAMINATION AND OTHER ISSUES

Aquifer wise resource availability is given in the following table where the total resource available in Rajnandgaon block is 1403.29 ham. The extraction details and the future scenario (2025) along with the categorization is depicted in the table

Table 8 Ground Water Resources of Rajnandgaon block in Ham

Name of Block	Annual Extractable Ground Water Recharge (Ham) (7=5-6)	Current Annual Ground Water Extraction (Ham)				Annual GW Allocation for Domestic Use as on 2025	Net Ground Water Availability for future use (13=7-8-9-12)
		Irrigation Use	Industrial Use	Domestic Use	Total Extraction (11=8+9+10)		
	7	8	9	10	11	12	13
Rajnandgaon	9618.96	6888.00	92.45	1265.51	8245.96	1235.22	1403.29

Net Annual Ground Water Availability (Ham)	23404.03
Existing Gross Ground Water Draft for All uses (Ham)	8245.96
Stage of Ground Water Development %	85.73
Category	Semi-Critical

4. GROUND WATER RESOURCE ENHANCEMENT:

4.1 Aquifer wise space available for recharge and proposed interventions:

Table 9 Aquifer wise space availability

Block	Area Identified for Artificial Recharge* Sq.Km	Average Depth to Post monsoon water level (mbgl)-3			Sy	Sub surface storage potential (mcm)	Surface Water Requirement (mcm)
		3 to 5	5 to 10	10 to 15			
Rajnandgaon	498.88	1	4.5		0.018	16	21.28

5. ISSUES:

- i. During summer, Dugwells in villages are dry except in few locations Several hand pumps also stop yielding water. Drying Dugwells and depletion of ground water level during premonsoon in Rajnandgaon blocks is due to excessive ground water withdrawal.
- ii. In Rajnandgaon block Ground Water Draft for Irrigation is 6888 ham which is 95% of Gross draft i.e. 4727.98
- iii. The aquifer itself is a low yielding one in Dongargaon block (i.e. Chandi formation)
- iv. It has been observed during fieldwork in pre-monsoon period, there is colossal wastage of groundwater through public water supply system.
- v. Poor stage of groundwater development.

6. MANAGEMENT PLAN:

6.1 Supply side interventions:

- i. 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 aware people about the importance 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.

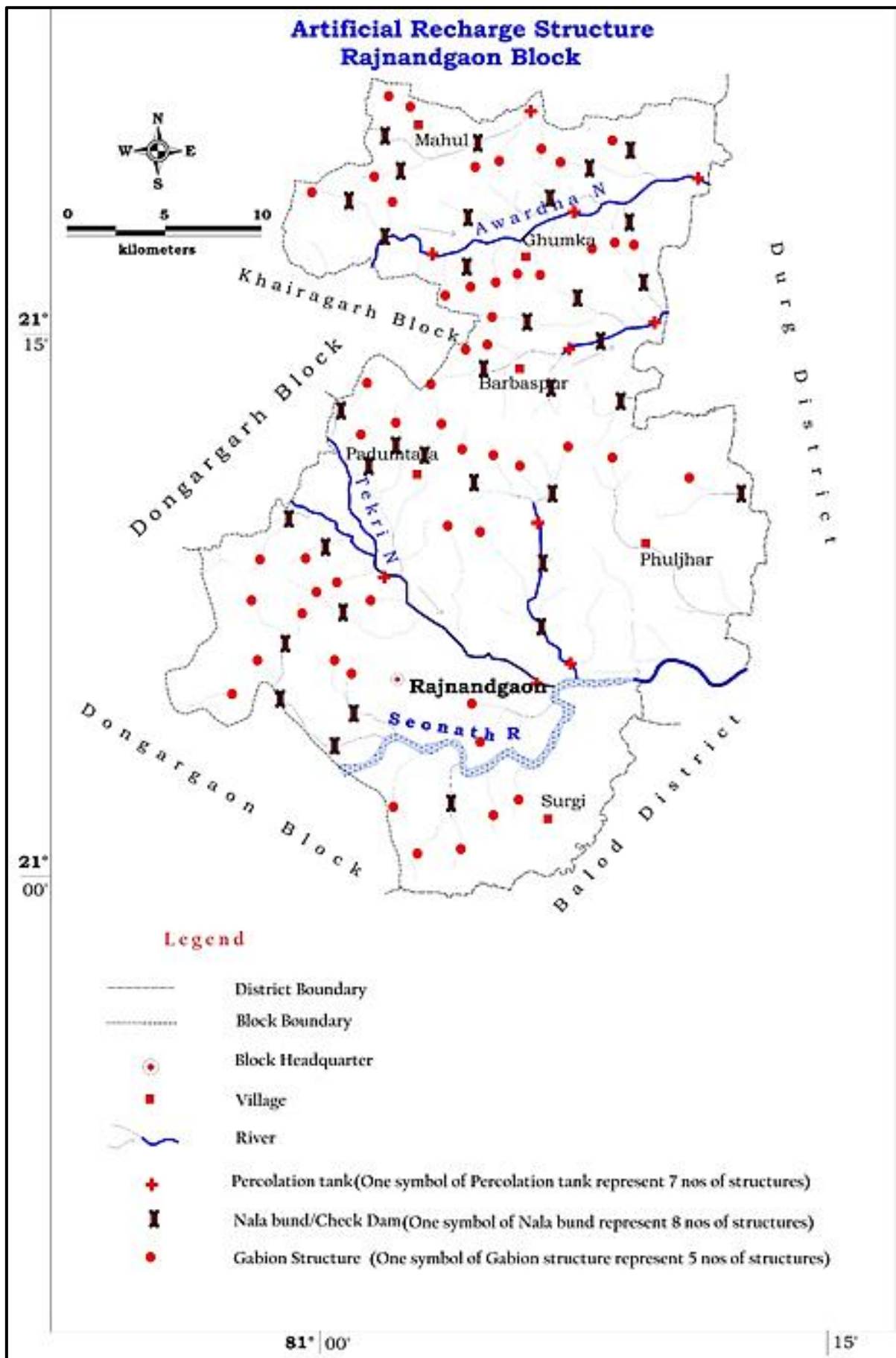


Figure 12 Management plan of Rajnandgaon Block

- iii. It has been observed that the demand of ground water is increasing for irrigation, industrial and domestic uses. At location near urban areas water level is declining, 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
- iv. Recharge should be practice in dried up bore well and Dug well.
- v. 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.

Table 10 Types of Artificial Recharge structures feasible

Name of Block	Area Feasible for recharge (sq.km)	Sub surface storage potential (mcm)	Types of Structures Feasible and their Numbers		
			P	NB & CD	G
Rajnandgaon	498.88	21.28	70	175	400
	Recharge Capacity		14	5.25	2
	Estimated cost (Appx. 161.5 million rupees)		140	17.5	4

6.2 Demand side interventions:

- i. Change in Irrigation practices- Water can be Saved using micro irrigation methods such as sprinklers, drip irrigation etc.
- ii. Change in cropping pattern- Water can be Saved by change crops from paddy to Maize.
- iii. Control on wasting water through Public water Supply- 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.
- iv. Sapling should be planted in Barren land

7. CONCLUSION:

An area of 743 sq.km of Rajnandgaon block of Rajnandgaon district has been considered for Aquifer Mapping and Management Plans. The total g.w resource is 23404.03 Ham with stage of g.w development 85.73 % and categorized as "Semi Critical". 70.51 % of the irrigated area is uses groundwater for irrigation. The major aquifer groups are Gunderdehi Shale, Chandi

Limestone and Chandi Sandstone. In terms of Demand side management, by change in cropping and irrigation pattern (micro irrigation methods) water can be saved respectively. In terms of Supply side management, by constructing artificial recharge structure 21.28 MCM water can be recharged and constructing of tubewell at suitable locations, drinking water needs may be fulfilled.