



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
PHARSABAHAHAR BLOCK, JASHPUR DISTRICT,
CHHATTISGARH**

उत्तर मध्य छत्तीसगढ़ क्षेत्र, रायपुर
North Central Chhattisgarh Region, Raipur

2020

भारत सरकार

Government of India

जल शक्ति मंत्रालय, जल संसाधन, नदी विकास एवं गंगा संरक्षण विभाग

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Central Groundwater Board



फरसाबाहार बिकाशखंड, जशपुर जिला, छत्तीसगढ़ के जलभृत नक्शे एवं भूजल प्रबंधन योजना

Aquifer Maps and Ground Water Management Plan of Pharsabahar Block, Jashpur District, Chhattisgarh

केन्द्रीय भूमि जल बोर्ड

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

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AQUIFER MAPPING AND MANAGEMENT PLAN FOR PHARSABAHAHAR BLOCK (JASHPUR DISTRICT), CHHATTISGARH

CONTENTS

1. Salient Information:	1
1.1 About the area:	1
1.2 Population:.....	1
1.3 Growth rate:.....	1
1.4 Rainfall:	1
1.5 Agriculture and Irrigation.....	5
1.6 Groundwater Resource Availability and Extraction.....	6
1.7 Existing and Future Water Demand (2025):.....	7
1.8 Water Level Behavior:.....	7
2. Aquifer Disposition:	16
2.1 Number of Aquifers	16
2.2 Aquifer wise Characteristics:	16
3. Ground water Resource, extraction, contamination and other issues:	18
3.1 Aquifer wise resource availability and extraction:	18
3.2 Categorisation:	19
3.3 Chemical Quality of Ground water and Contamination:	19
4. Ground Water Resource enhancement:.....	19
4.1 Aquifer wise space available for recharge and proposed interventions:.....	19
5. Issues:	19
6. Management Plan:.....	19
7. Conclusion:.....	21

List of Tables

Table 1 Population Break Up	1
Table 2 Rainfall data in Pharsabahar block in mm	1
Table 3 Land use and Agricultural pattern (in ha).....	5
Table 4 Cropping pattern (in ha).....	5
Table 5 Area irrigated by various sources (in ha)	5
Table 6 Statistics showing Irrigation by Ground water	5
Table 7 Ground Water Budget of Pharsabahar block in Ham	6
Table 8 Ground Water Dynamic Resource (Unconfined Aquifer) of Pharsabahar block in Ham.....	6
Table 9 Ground Water Static Resource (Unconfined Aquifer) and Dynamic Resource (Confined Aquifer) of Pharsabahar block in Ham.....	6
Table 10 Total Resources in Pharsabahar Block (in MCM).....	7
Table 11 Phreatic aquifer Depth to Water Level in mbgl (Pre-monsoon).....	7
Table 12 Semiconfined Aquifer Depth to Water Level in mbgl (Pre-monsoon)	7
Table 13 Phreatic Aquifer Depth to Water Level in mbgl (Post-monsoon)	8
Table 14 Semiconfined Aquifer Depth to Water Level in mbgl (Post-monsoon).....	8
Table 15 Phreatic Aquifer Depth to Water Level Fluctuation in mbgl.....	8
Table 16 Semiconfined Aquifer Depth to Water Level Fluctuation in mbgl.....	8
Table 17 Aquifer Characteristics of Pharsabahar block	16
Table 18 Categorization of Assessment Unit.....	19
Table 19 Summarised detail of Volume of porous space available for recharge	19
Table 20 Types of Artificial Recharge structures feasible	20
Table 21 Potential of Additional GW abstraction structure creation	21
Table 22 Detail of groundwater saved through change in cropping pattern and other interventions.....	21

List of Figure

Figure 1 Administrative Map of the Block.....	2
Figure 2 Geomorphological Map of the Block.....	3
Figure 3 Drainage Map of the Block.....	4
Figure 4 Pre-monsoon depth to waterlevel of Phreatic Aquifer.....	9
Figure 5 Post-monsoon depth to waterlevel of Phreatic Aquifer	10
Figure 6 Seasonal waterlevel fluctuation of Phreatic Aquifer	11
Figure 7 Pre-monsoon depth to waterlevel of Confined/Semiconfined Aquifer.....	12
Figure 8 Post-monsoon depth to waterlevel of Confined/Semiconfined Aquifer	13
Figure 9 Seasonal waterlevel fluctuation of Confined/Semiconfined Aquifer	14
Figure 10 Hydrograph of Darima village, Pharsabahar block.....	15
Figure 11 Hydrograph of Pharsabahar town, Pharsabahar block	15
Figure 12 Aquifer map of Pharsabahar block	17
Figure 13 Fence diagram of Pharsabahar block.....	18
Figure 14 Location of proposed Artificial Recharge Structure.....	Error! Bookmark not defined.

PHARSABAHAR BLOCK

1. SALIENT INFORMATION:

1.1 About the area: Pharsabahar Block is situated in the southern part of Jashpur district of Chhattisgarh and is bounded on the north by Kansabel and Duldula Block, in the west by Pathalgaon block, in the south by Raigarh District and in the east by Odisha district. The block area lies between 22.286 and 22.627 N latitudes and 83.771 and 84.055 E longitudes. The geographical extension of the study area is 796.5 sq. km representing around 12 % of the district's geographical area. Administrative map of the block is shown in Figure 1. The major part of the block is comprises of pediment or pediplain on Chotanagpur granitic gneiss. Geomorphological map is shown in Figure 2. The major drainage of the block includes Ib river and Kokiya nala, which are parts of middle Mahanadi basin. Drainage map shown in Figure 3.

1.2 Population: The total population of Pharsabahar block as per 2011 Census is 108498 out of which rural population is 108498. 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
Pharsabahar	108498	53496	55002	108498	0

Source: CG Census, 2011

1.3 Growth rate: The decadal growth rate of the block is 10.32 as per 2011 census.

1.4 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) 1152.5 mm with 70 to 80 rainy days.

Table 2 Rainfall data in Pharsabahar block in mm

Year	2013	2014	2015	2016	2017
Annual rainfall	1186.2	1260.9	912.2	1480.2	923

Source: IMD

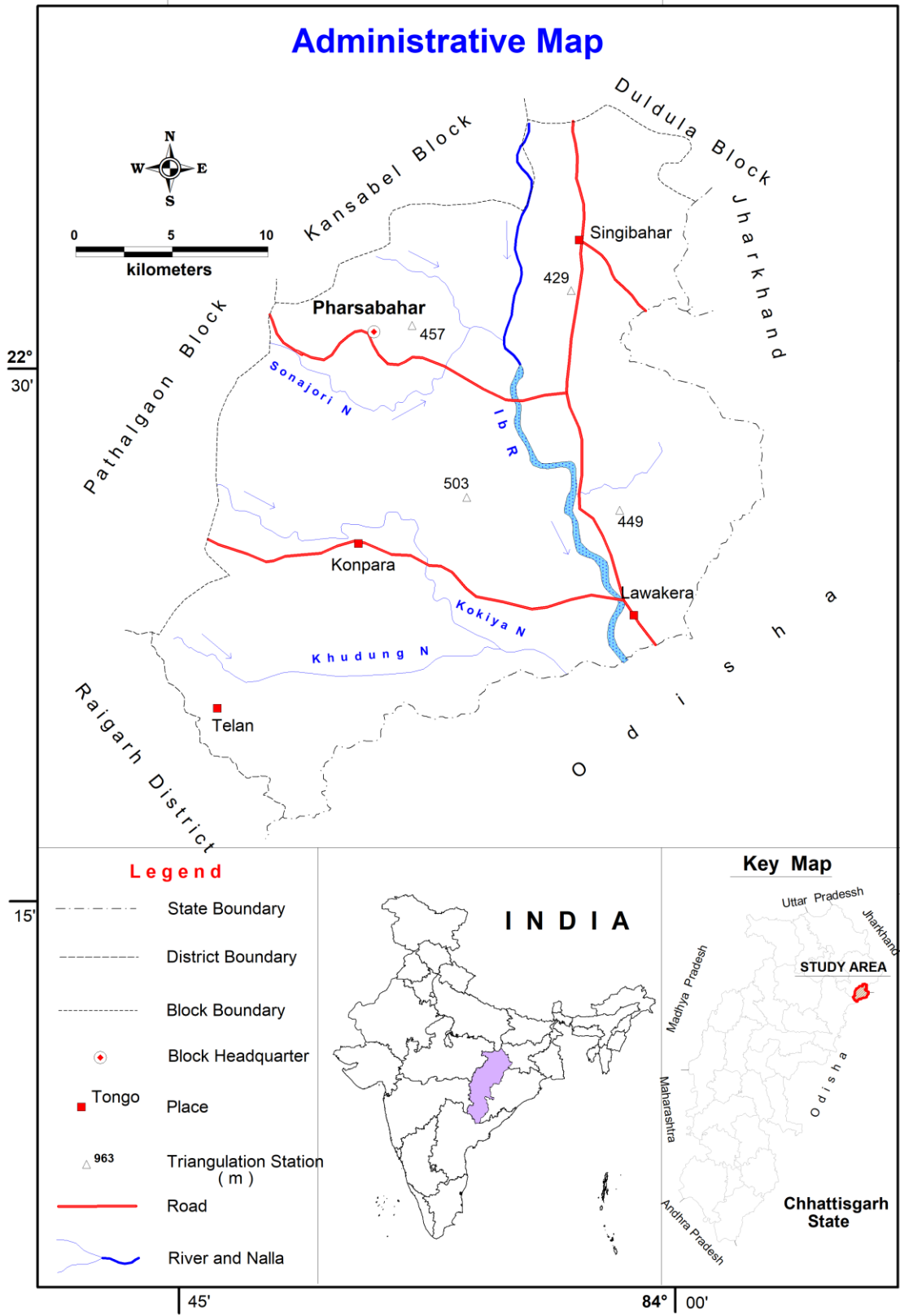


Figure 1 Administrative Map of the Block

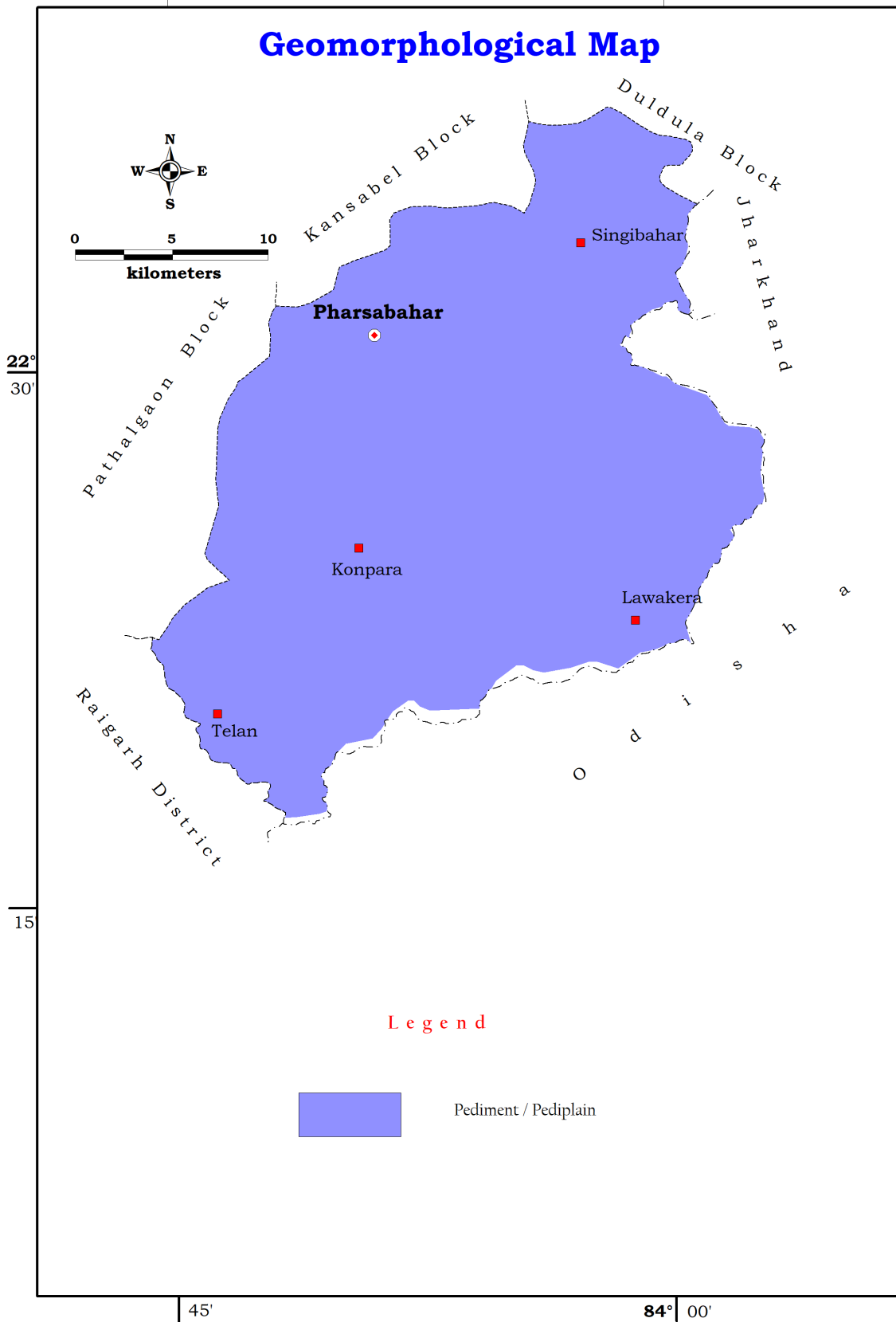


Figure 2 Geomorphological Map of the Block

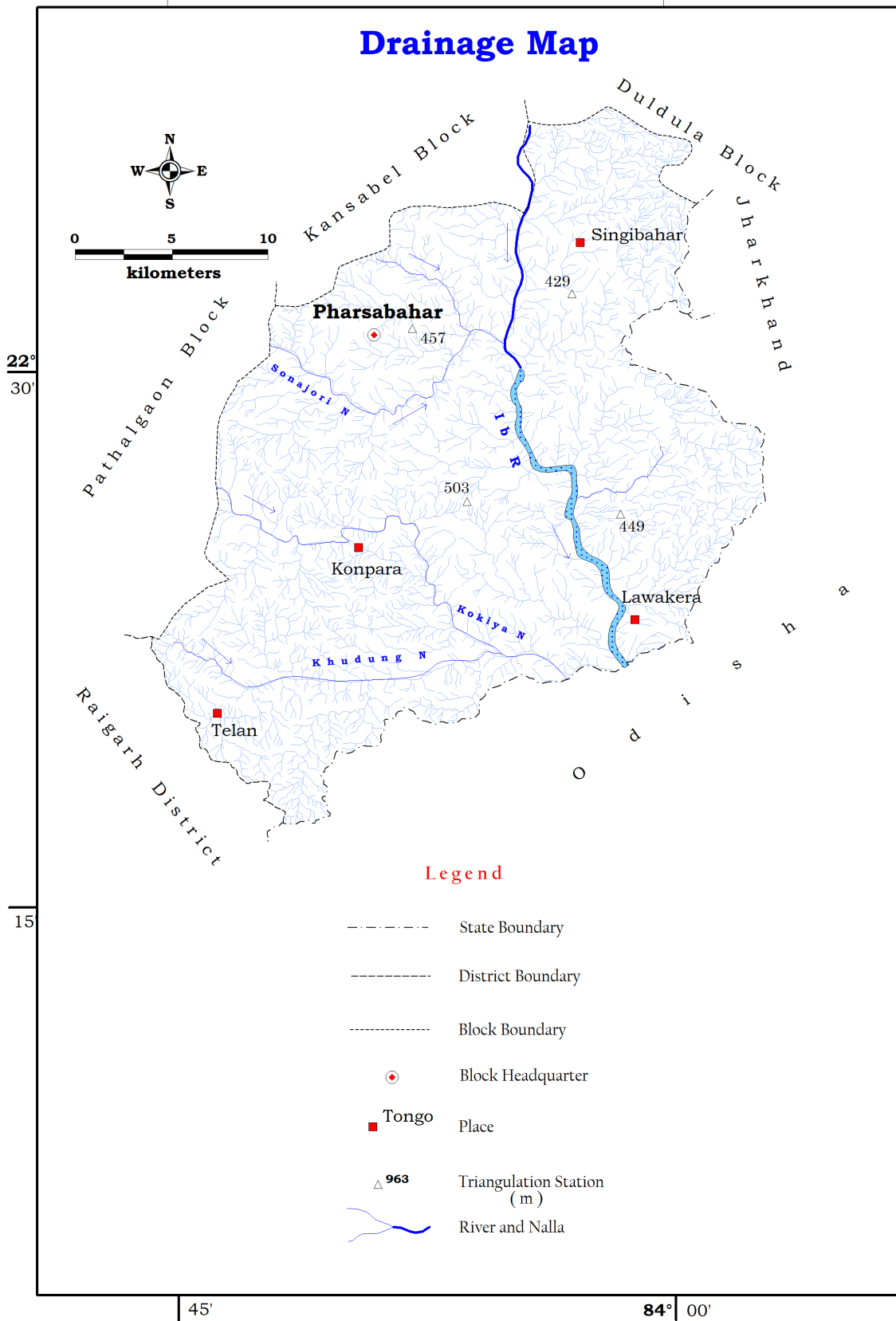


Figure 3 Drainage Map of the Block

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 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 Pharsabahar block is given in Table 3, 4, 5 & 6

Table 3 Land use and Agricultural pattern (in ha)

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
60862	11676	9012	4660	2338	29609	778	30387

Table 4 Cropping pattern (in ha)

Kharif	Rabi	Cereal				Pulses	Tilhan	Fruits and Vegetables	Mirch Masala	Sugarcane
		Paddy	Wheat	Jowar & Maize	Others					
29563	824	24287	37	141	0	3193	1609	1071	48	0

Table 5 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 Ponds	Irrigated area	Irrigated area by other sources	Net Irrigated area	Gross irrigated area	% of irrigated area wrt. Net sown area
6	386	27	26	1987	318	92	40	213	983	1010	3.41

Table 6 Statistics showing Irrigation by Ground water

Net Irrigated Area	Net Irrigated Area by ground water	Percentage of Area Irrigated by ground water
983	344	35

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

Table 7 Ground Water Budget of Pharsabahar block in Ham

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		
5623.96	241.23	684.18	570.11	7119.48	711.95

Table 8 Ground Water Dynamic Resource (Unconfined Aquifer) of Pharsabahar 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				
6407.53	1852.07	252.33	0.00	2104.40	271.95	4283.51	32.84	Safe

Table 9 Ground Water Static Resource (Unconfined Aquifer) and Dynamic Resource (Confined Aquifer) of Pharsabahar 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)
79650	6.17	0.00025	90.29	200.00	3672.72	3763.01

Table 10 Total Resources in Pharsabahar Block (in MCM)

Block	Dynamic Resources (MCM)		Insitu Resources (MCM)		Total Resources (MCM)
	Aquifer I	Aquifer II	Aquifer I	Aquifer II	
Pharsabahar	64.08	0.9	36.73	145.76	247.46

1.7 Existing and Future Water Demand (2025): The existing draft for irrigation in the area is 119.22 Ham while the total extraction for all uses is 1183.07 Ham. At present scenario to meet the future demand for water, a total quantity of 1465.52 ham of ground water is available for future use.

1.8 Water Level Behavior:

(i) Pre-monsoon water level: In the pre-monsoon period, it has been observed that in Pharsabahar block, water level in dugwells (phreatic aquifer) varies between 6.75 to 9.16 mbgl with average water level of 7.48 mbgl. Water level in semiconfined aquifer, varies between 6.51 to 21.1 mbgl with average water level is 13.09 mbgl.

Table 11 Phreatic aquifer Depth to Water Level in mbgl (Pre-monsoon)

Block Name	Phreatic Aquifer		
	Min	Max	Avg
Pharsabahar	6.75	9.16	7.48

Table 12 Semiconfined Aquifer Depth to Water Level in mbgl (Pre-monsoon)

Block Name	Semiconfined Aquifer		
	Min	Max	Avg
Pharsabahar	6.51	21.1	13.09

(ii) Post-monsoon water level: In the post-monsoon period, it has been observed that the water level varies from 2.92 to 7.32 mbgl with an average of 4.44 mbgl in phreatic aquifer. In semiconfined/fractured formation, the post monsoon water level variation range is 2.5 to 13.18 mbgl with average of 7.23 mbgl.

Table 13 Phreatic Aquifer Depth to Water Level in mbgl (Post-monsoon)

Block Name	Phreatic Aquifer		
	Min	Max	Avg
Pharsabahar	2.92	7.32	4.44

Table 14 Semiconfined Aquifer Depth to Water Level in mbgl (Post-monsoon)

Block Name	Semiconfined Aquifer		
	Min	Max	Avg
Pharsabahar	2.5	13.18	7.23

(iii) Seasonal water level fluctuation: The water level fluctuation data indicates that in Pharsabahar block, water level fluctuation in phreatic aquifer varies from 0.12 to 4.33 mbgl with an average fluctuation of 3.04 mbgl. Water level fluctuation in semiconfined Aquifer varies from 2.37 to 8.83 mbgl with an average fluctuation of 5.86 mbgl.

Table 15 Phreatic Aquifer Depth to Water Level Fluctuation in mbgl

Block Name	Semiconfined Aquifer		
	Min	Max	Avg
Pharsabahar	0.12	4.33	3.04

Table 16 Semiconfined Aquifer Depth to Water Level Fluctuation in mbgl

Block Name	Semiconfined Aquifer		
	Min	Max	Avg
Pharsabahar	2.37	8.83	5.86

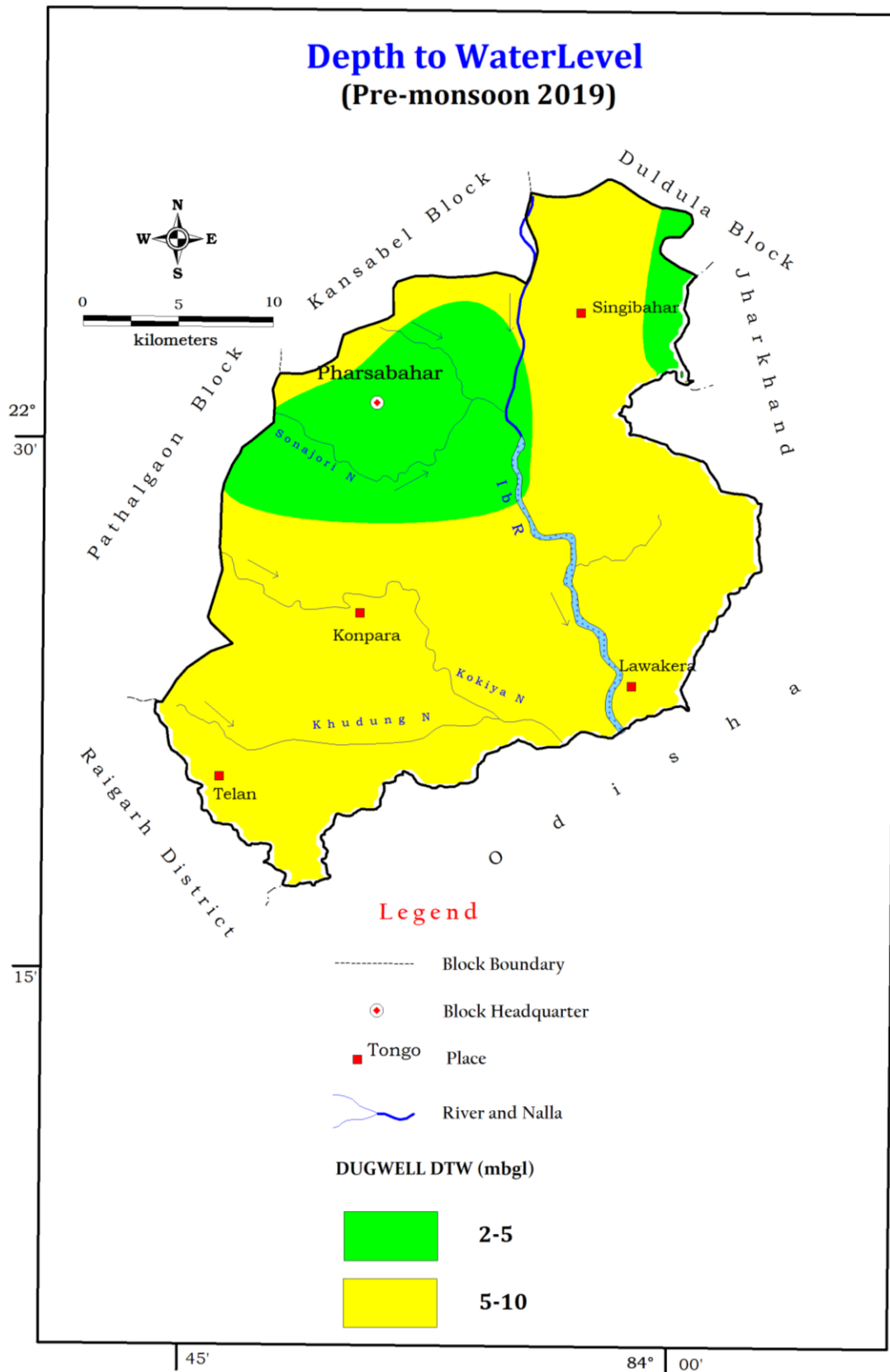


Figure 4 Pre-monsoon depth to waterlevel of Phreatic Aquifer

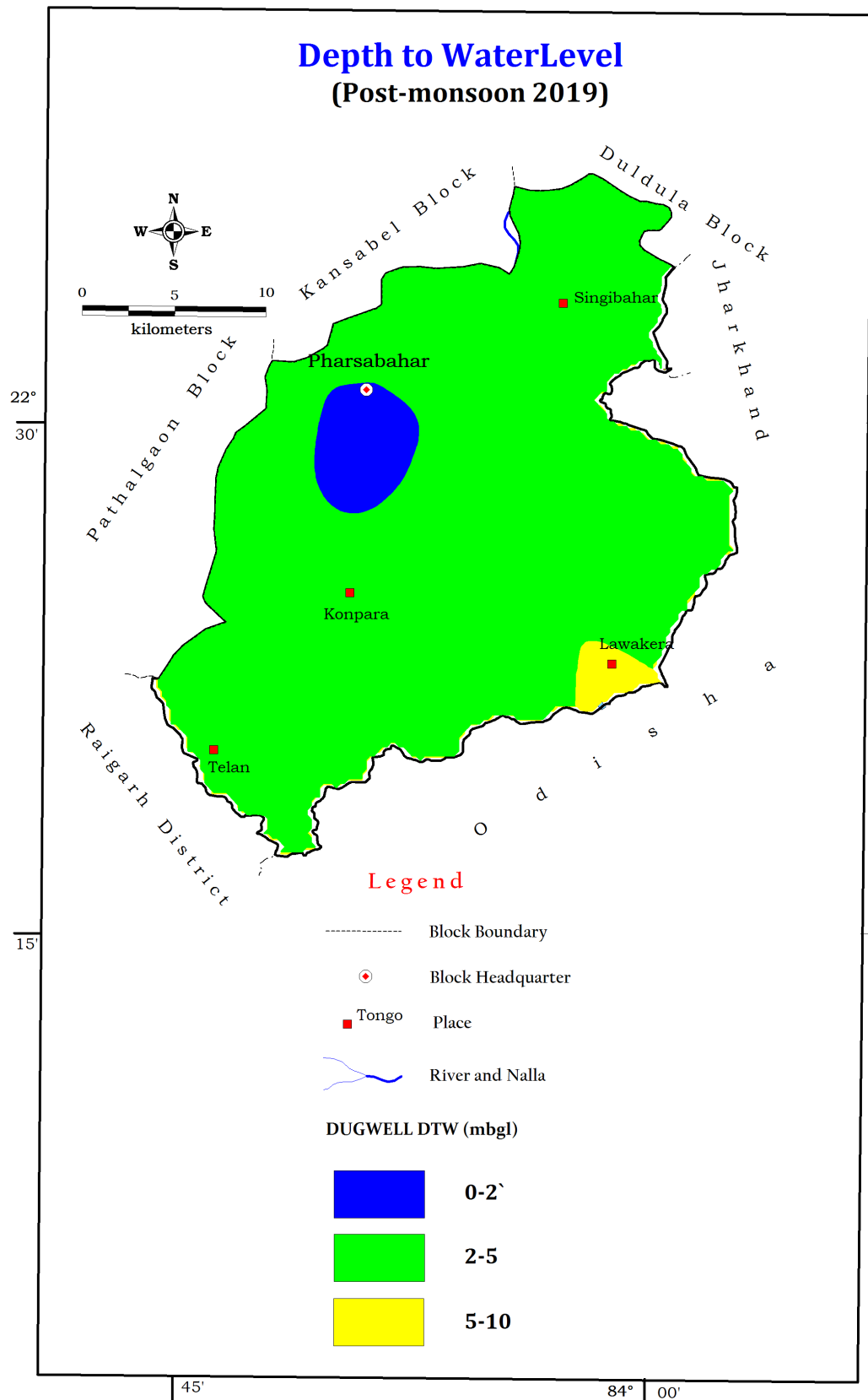


Figure 5 Post-monsoon depth to waterlevel of Phreatic Aquifer

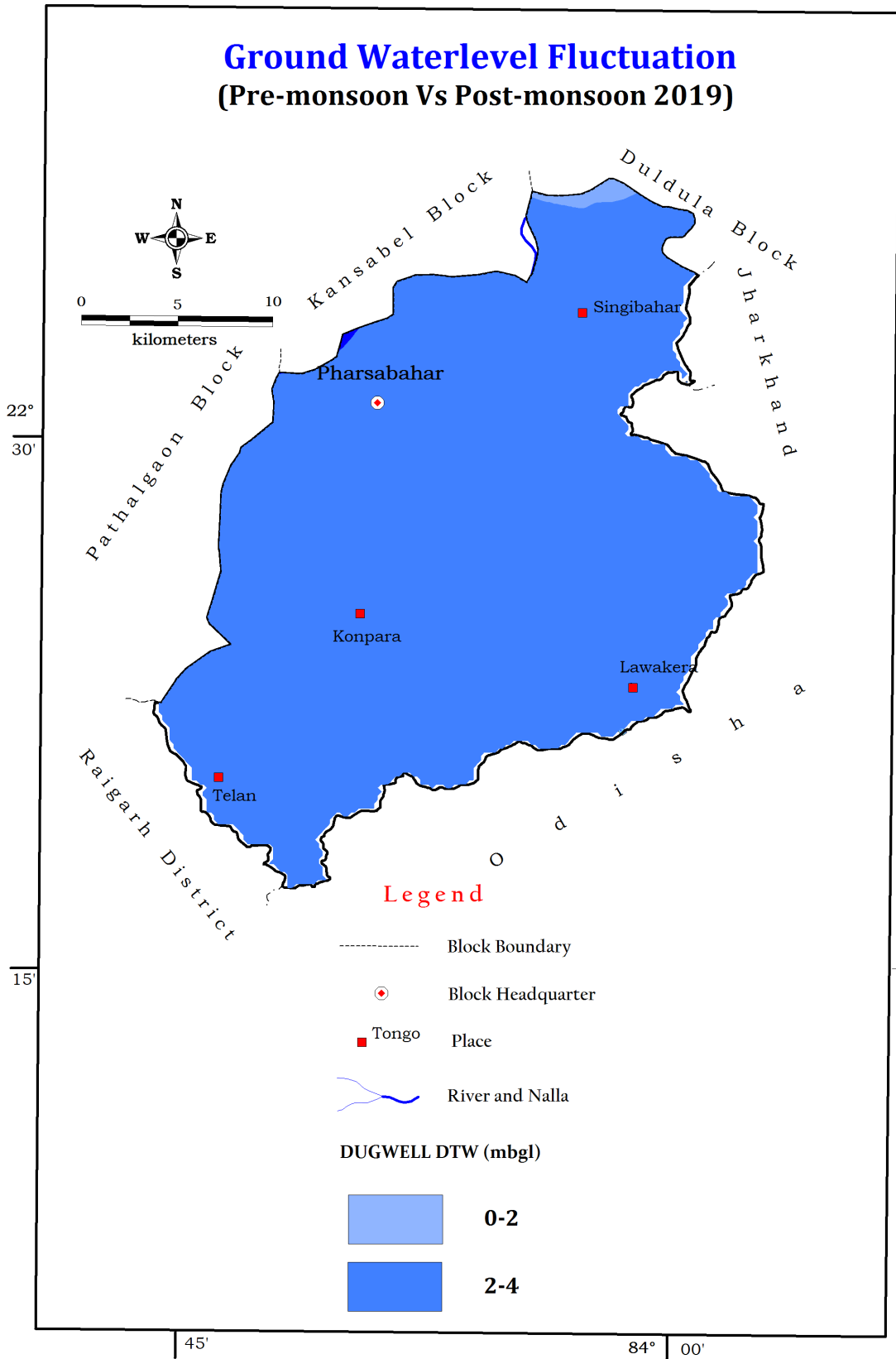


Figure 6 Seasonal waterlevel fluctuation of Phreatic Aquifer

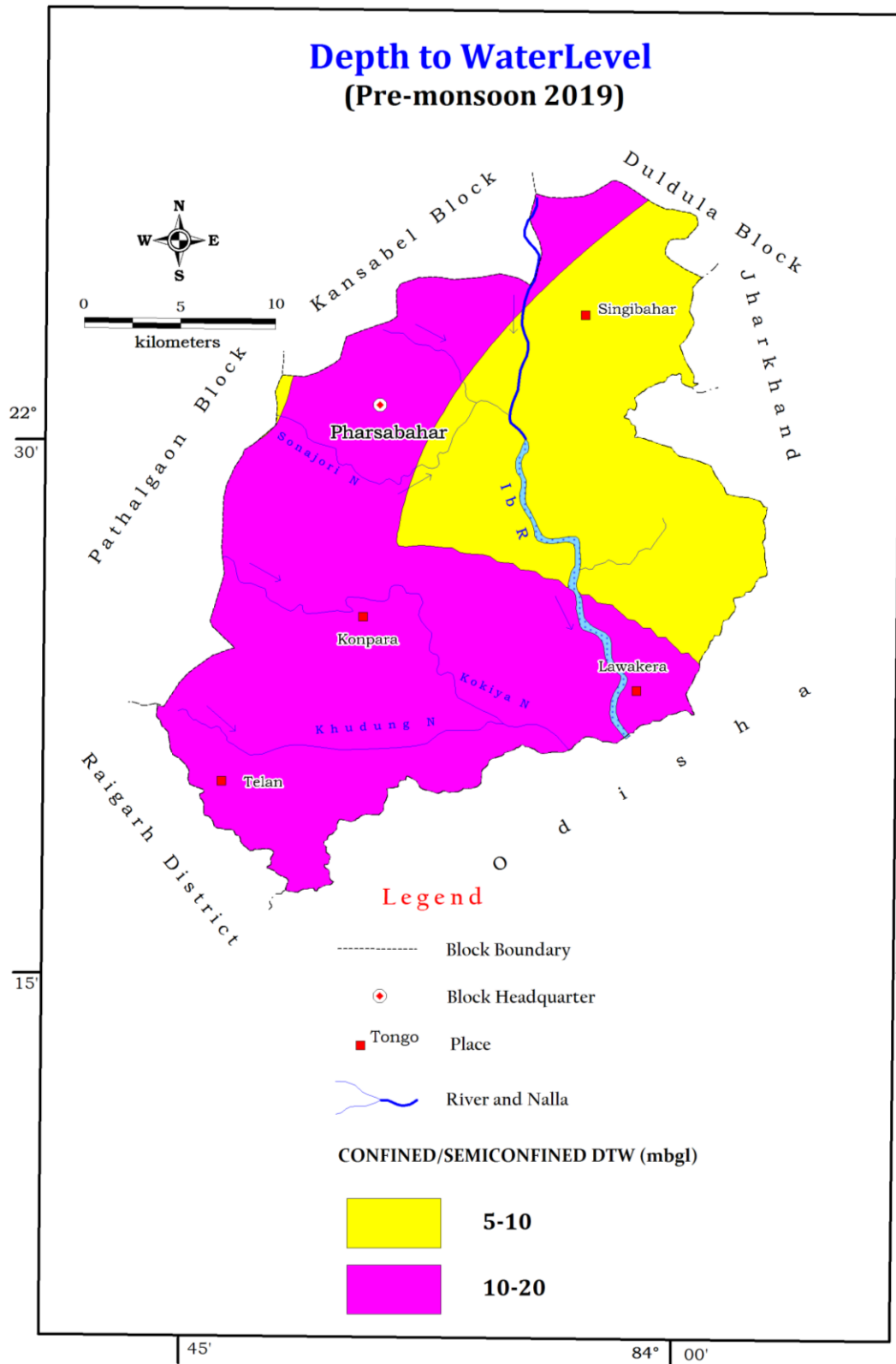


Figure 7 Pre-monsoon depth to waterlevel of Confined/Semiconfined Aquifer

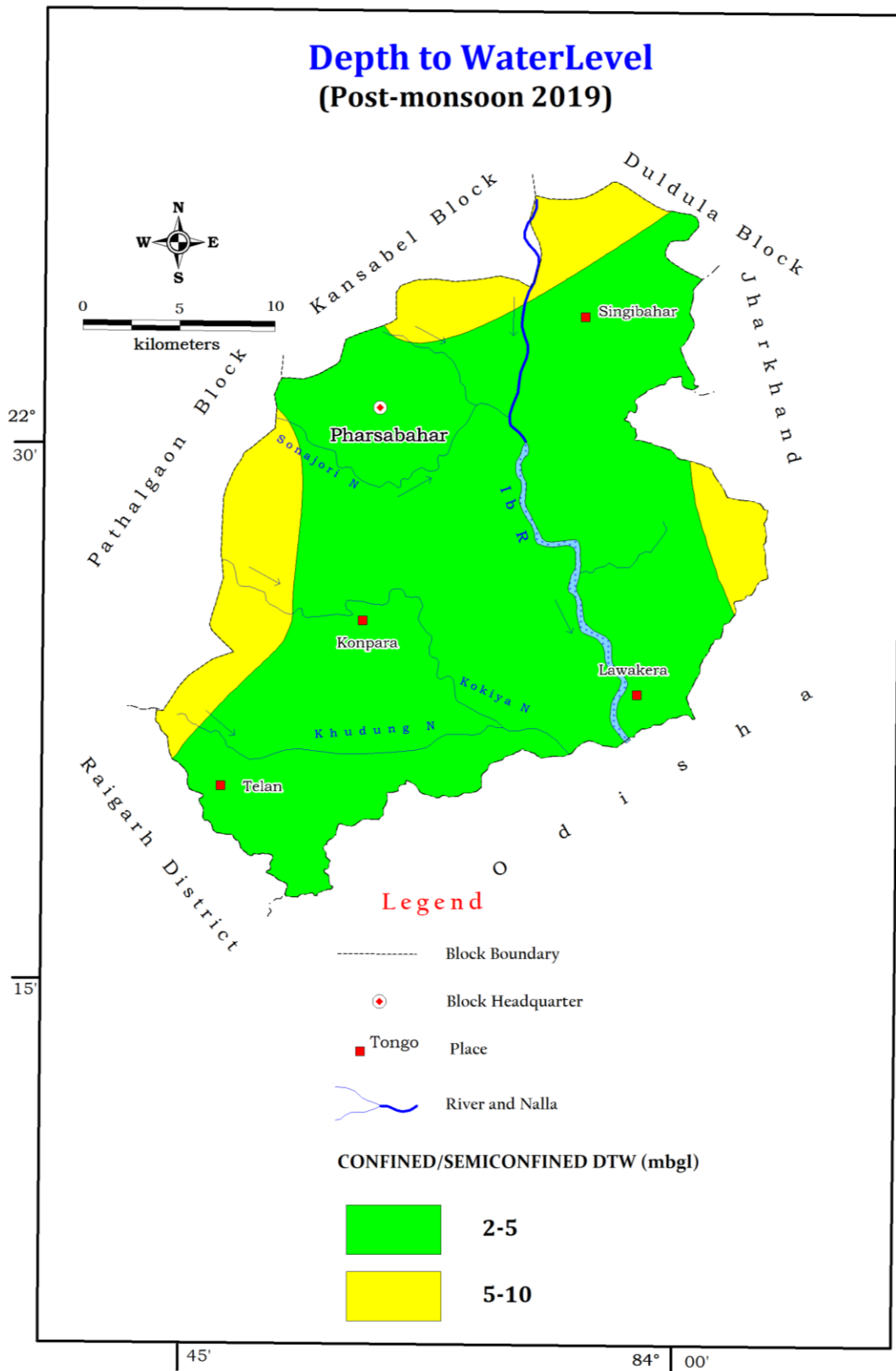


Figure 8 Post-monsoon depth to waterlevel of Confined/Semiconfined Aquifer

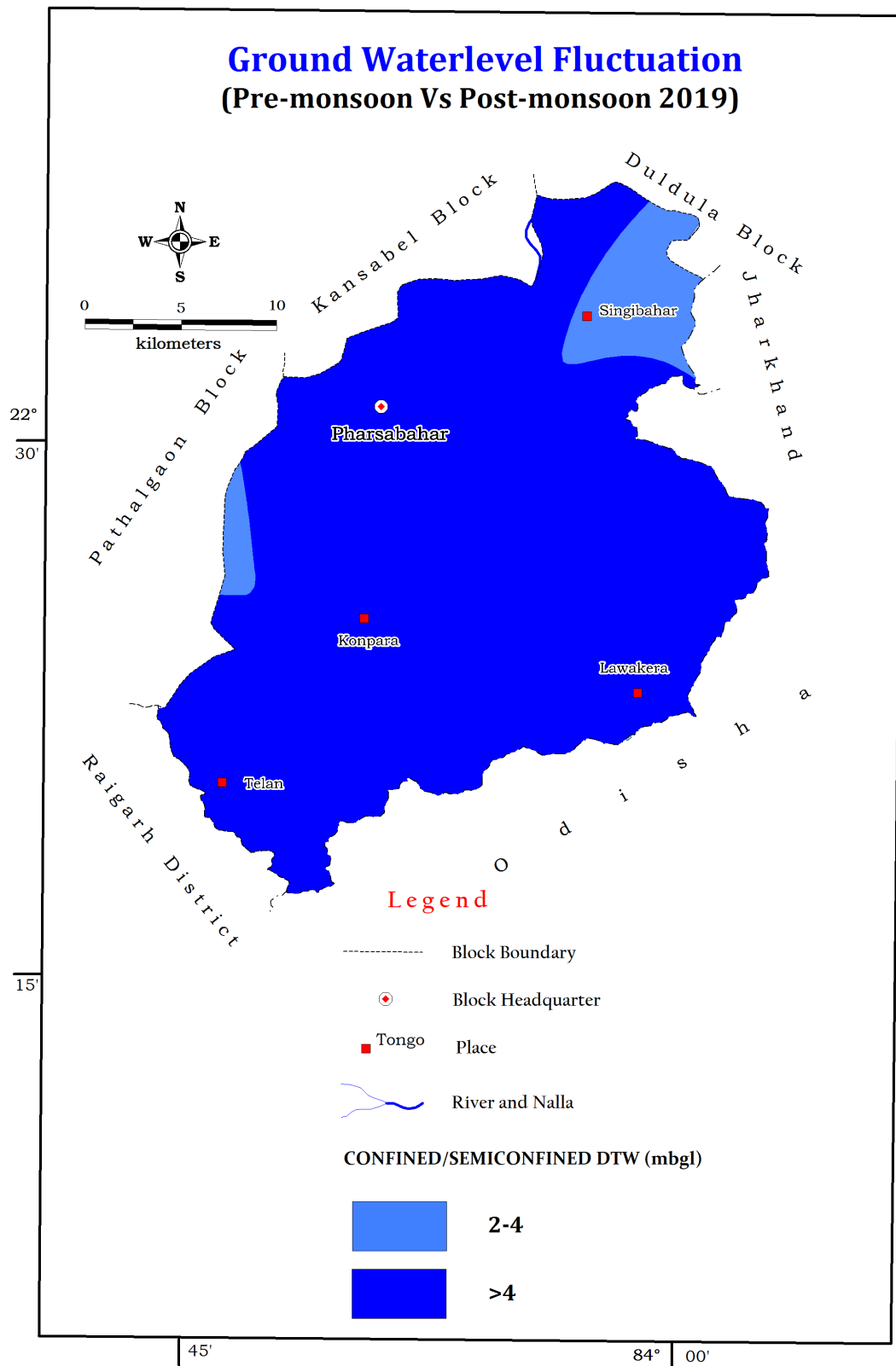


Figure 9 Seasonal waterlevel fluctuation of Confined/Semiconfined Aquifer

(iv) The long-term water level trend: There is no significant decline in water level in pre and post monsoon

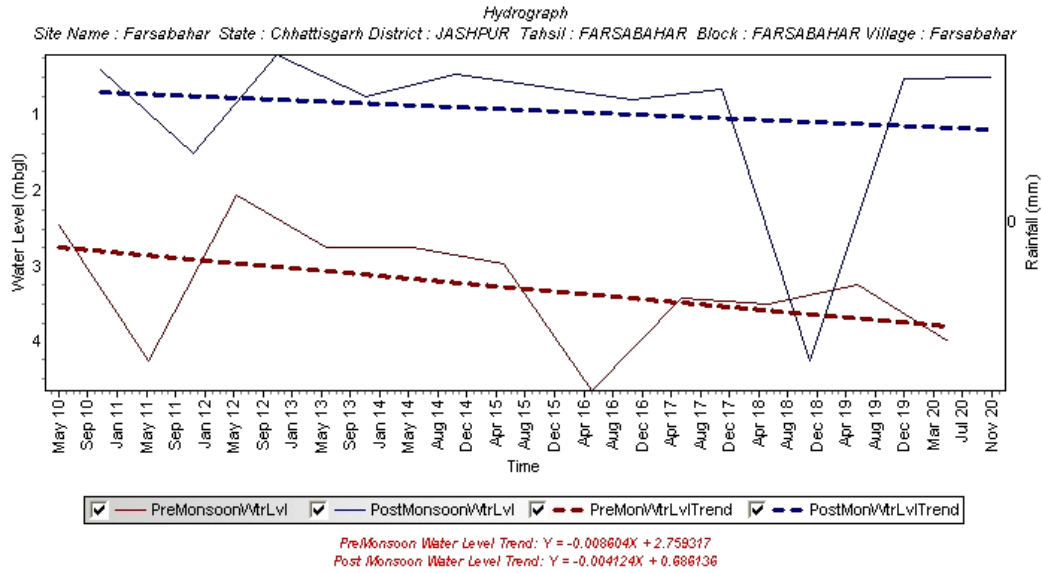


Figure 10 Hydrograph of Pharsabahar village, Pharsabahar block

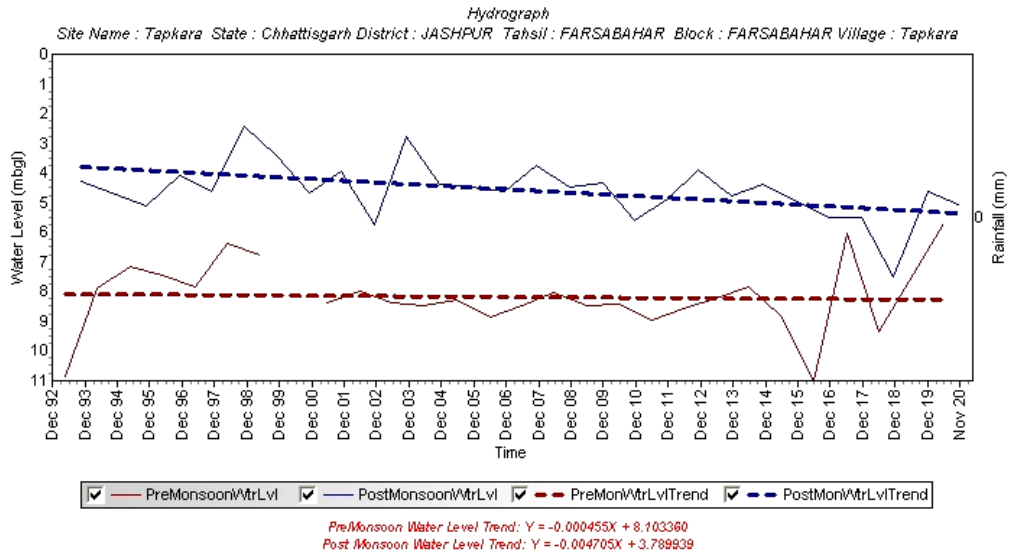


Figure 11 Hydrograph of Tapkara village, Pharsabahar block

2. AQUIFER DISPOSITION:

2.1 Number of Aquifers: There is only one major aquifer system viz. Granite Aquifer system. The aquifer system has the shallow aquifer and deeper aquifer which occurs in phreatic and semiconfined condition respectively.

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. DTH drilling technique is preferred in Granite aquifer where well construction is required depending upon the thickness of weathered zone.

2.2 Aquifer wise Characteristics:

Table 17 Aquifer Characteristics of Pharsabahar block

CHARACTERISTICS	AQUIFER SYSTEM	
	Fractured Granite	Weathered Granite
Major Geological Formation	Chotanagpur Granite Geneiss	Chotanagpur Granite Geneiss.
Major Rock type	Granite Geneiss	Granite Geneiss
Avg Weathered Thickness (m)	-	13.5
Transmissivity (m²/day)	1 to 34	-
Average Drawdown (m)	19	15
Discharge	Negligible to 7.8 lps	10 to 150 m ³ /day
No. of Potential Zone	1 to 2set < 50 m 1 to 2set: 50m to 100m 1 set: 100m to 200m (Most potential zone- 50 to 100m)	-

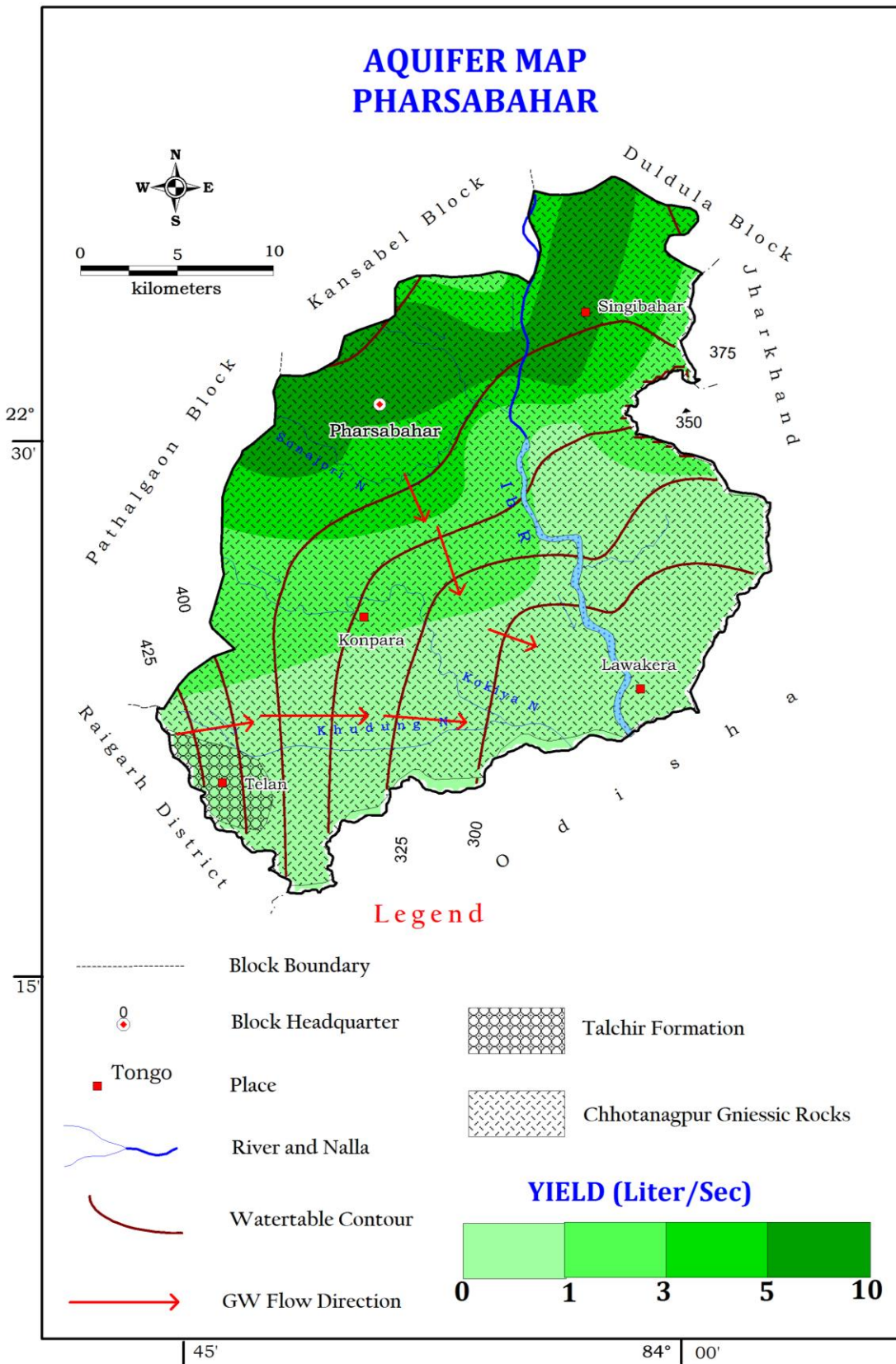


Figure 12 Aquifer map of Pharsabaha block

Disposition of Aquifer in Pharsabahar Block

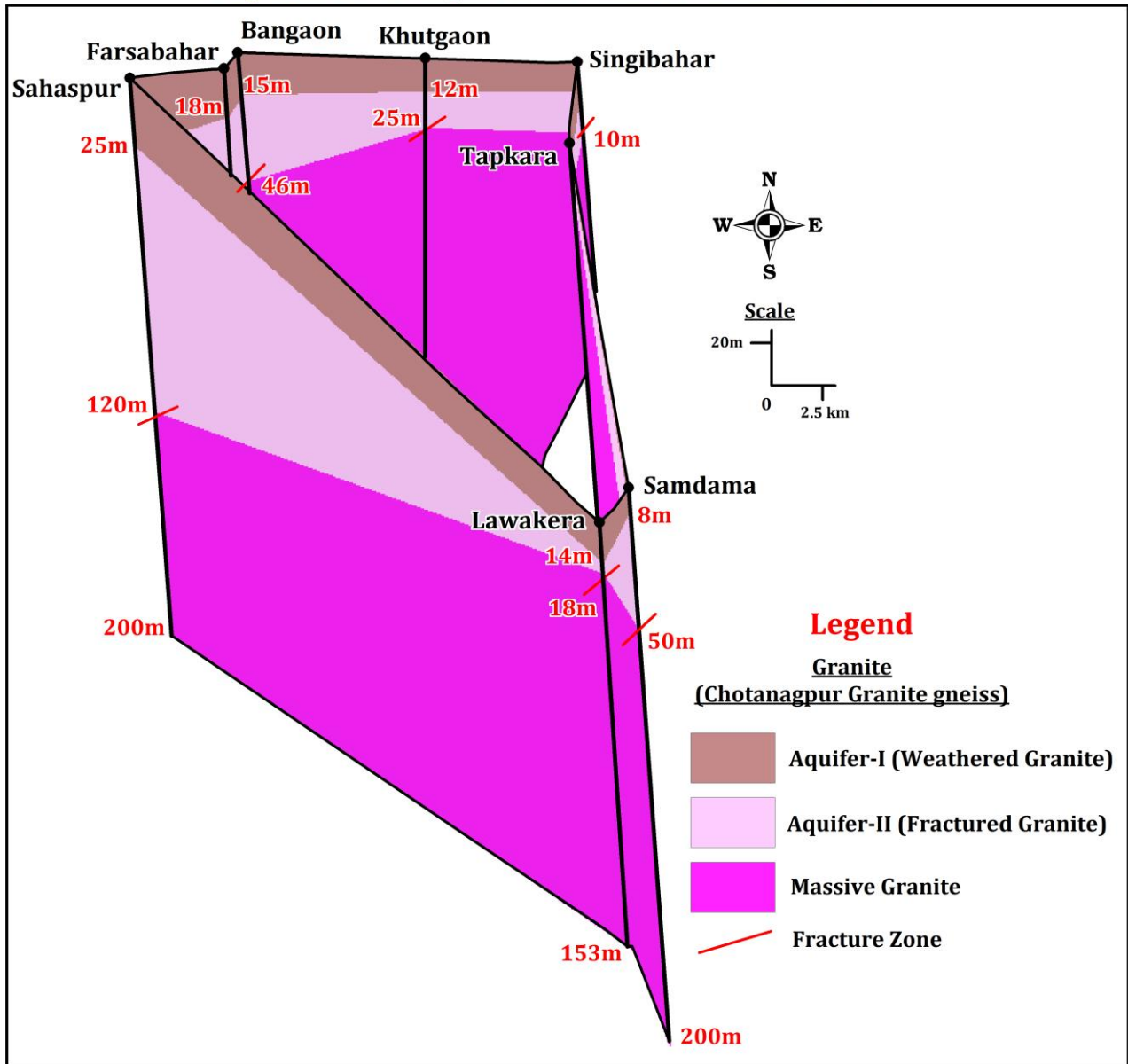


Figure 13 Fence diagram of Pharsabahar block

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

3.1 Aquifer wise resource availability and extraction: Resource availability of Pharsabahar block is given in the Table 8 where net ground water availability for future use is 193.63 ham. The extraction details and the future scenario (2025) along with the categorisation are also depicted in the Table 8.

Table 18 Categorization of Assessment Unit

District	Block	Stage of Ground water development (%)	Categorisation
Jashpur	Pharsabahar	32.84	Safe

3.2 Categorisation: Pharsabahar block falls in safe category. The stage of Ground water development is 32.84 %. Ground water extraction for irrigation is 1852.07 ham. The Ground water draft for all uses is 2104.40 Ham. The Ground water resource for future uses for Pharsabahar Block is 4283.51 Ham.

3.3 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. Villages like Tapkara have more Nitrate concentration. Overall ground water of the study area is suitable for the drinking, agriculture and industrial purpose.

4. GROUND WATER RESOURCE ENHANCEMENT:

4.1 Aquifer wise space available for recharge and proposed interventions:

Table 19 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)
Granite	152.41	0.008	229	2.543

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) 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 20

Table 20 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
Pharsabahar	152.41	2.543	6	19	45	33
	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 Sechewal 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 50.95 %. 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 (Figure 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 21 Potential of Additional GW abstraction structure creation

Net GW availability (ham)	Stage of GW Development (%)	Present GW draft (Ham)	GW draft at 70% stage of development (ham)	Surplus GW 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)
6407.53	32.84	2104.4	4485.27	2380.87	893	1323

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: 22).

Table 22 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
Pharsabahar	1852.07	555.62	0	2380.87	2936.49	5872.99	19.33%