Draft Report

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

Dhamdha Block, Durg District, Chhattisgarh

उत्तर मध्य छत्तीसगढ़ क्षेत्र, रायपुर

North Central Chhattisgarh Region, Raipur

REPORT ON
AQUIFER MAPPING AND MANAGEMENT PLAN
OF DHAMDHA BLOCK , DURG DISTRICT, CHHATTISGARH

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AQUIFER MAPPING AND MANAGEMENT PLAN FOR DHAMDHA BLOCK (DURG DISTRICT), CHHATTISGARH

CONTENTS

BLOCK-WISE AQUIFER MAPS AND MANAGEMENT PLANS

1. Salient Information:

About the area**:** Dhamdha Block is situated in the northern part of Durg district of Chhattisgarh and is bounded on the north and east by Bemetara district, in the west by Rajnandgaon district of Chhattisgarh, in the south and south-east by Raipur and Dhamtari district. The area lies between 21.33 and 21.50 N latitudes and 81.16 and 81.56 E longitudes. The geographical extension of the study area is 1021 sq.km representing around 41 % of the district's geographical area. Administrative map of the block is shown in Fig. 1. River Shivnath, flowing northwards cuts through the middle of block. Kharun river lies south-east of the block. Drainage map shown in Fig.2. Geomorphology is mainly represented by structural plains.

Population: The total population of Dhamdha block as per 2011 Census is 269990 out of which rural population is 204260 while the urban population is 65499.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
Dhamdha	269990	135480	134510	204260	65499

Source: CG Census, 2011

Growth rate: The decadal growth rate of the block is 21.02 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. 2010 to 2015)1134.18 mm with 50 to 60 rainy days where as normal rainfall as per IMD is 1392 mm.

Table-2: Rainfall data in Dhamdha block in mm

Year	2010-11	2011-12	2012-13	2013-14	2014-15
Annual rainfall	1156.8	1191.0	1152.9	1107.3	1062.9

Source: IMD

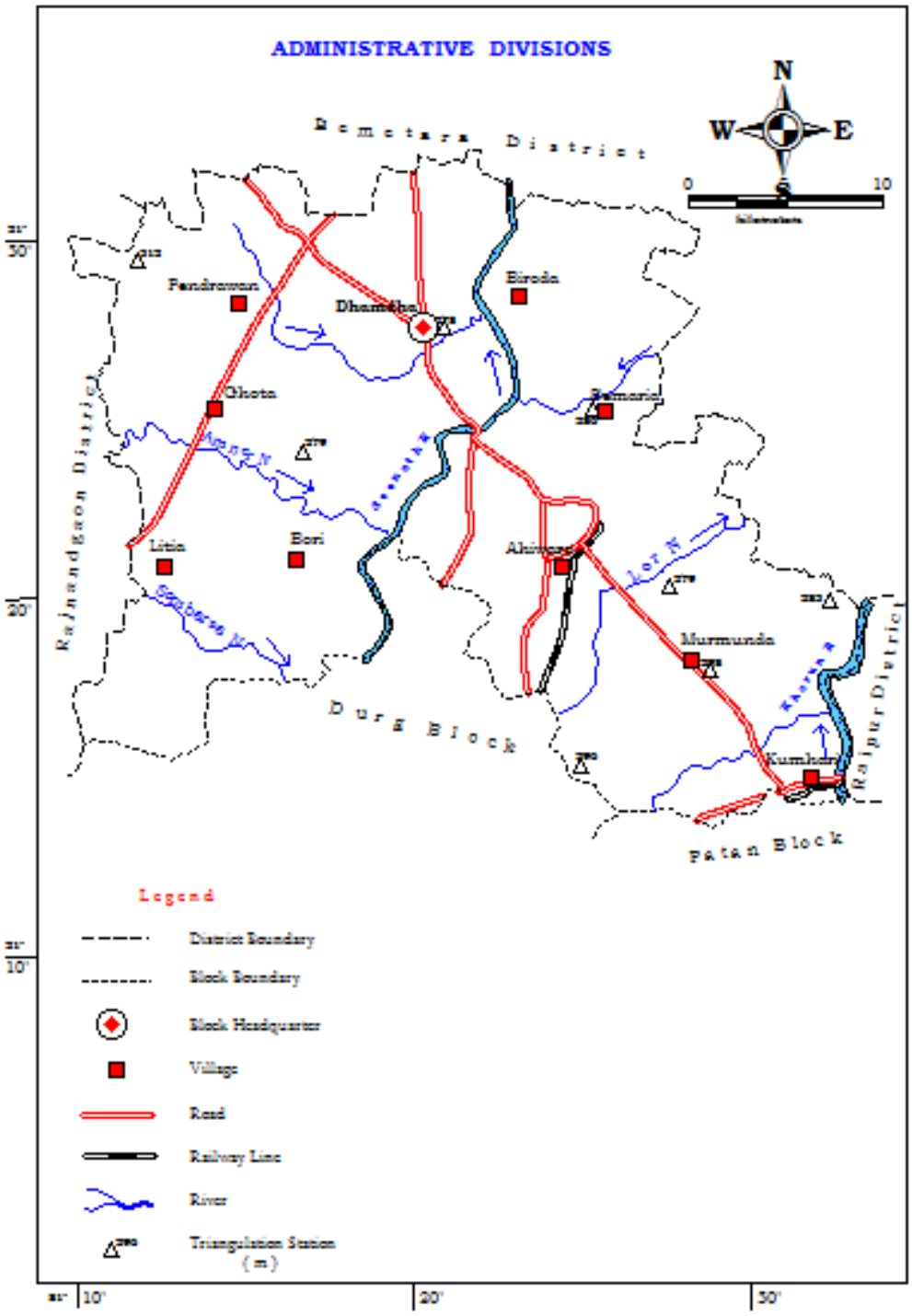


Figure: 1 Administrative Map of Dhamdha Block

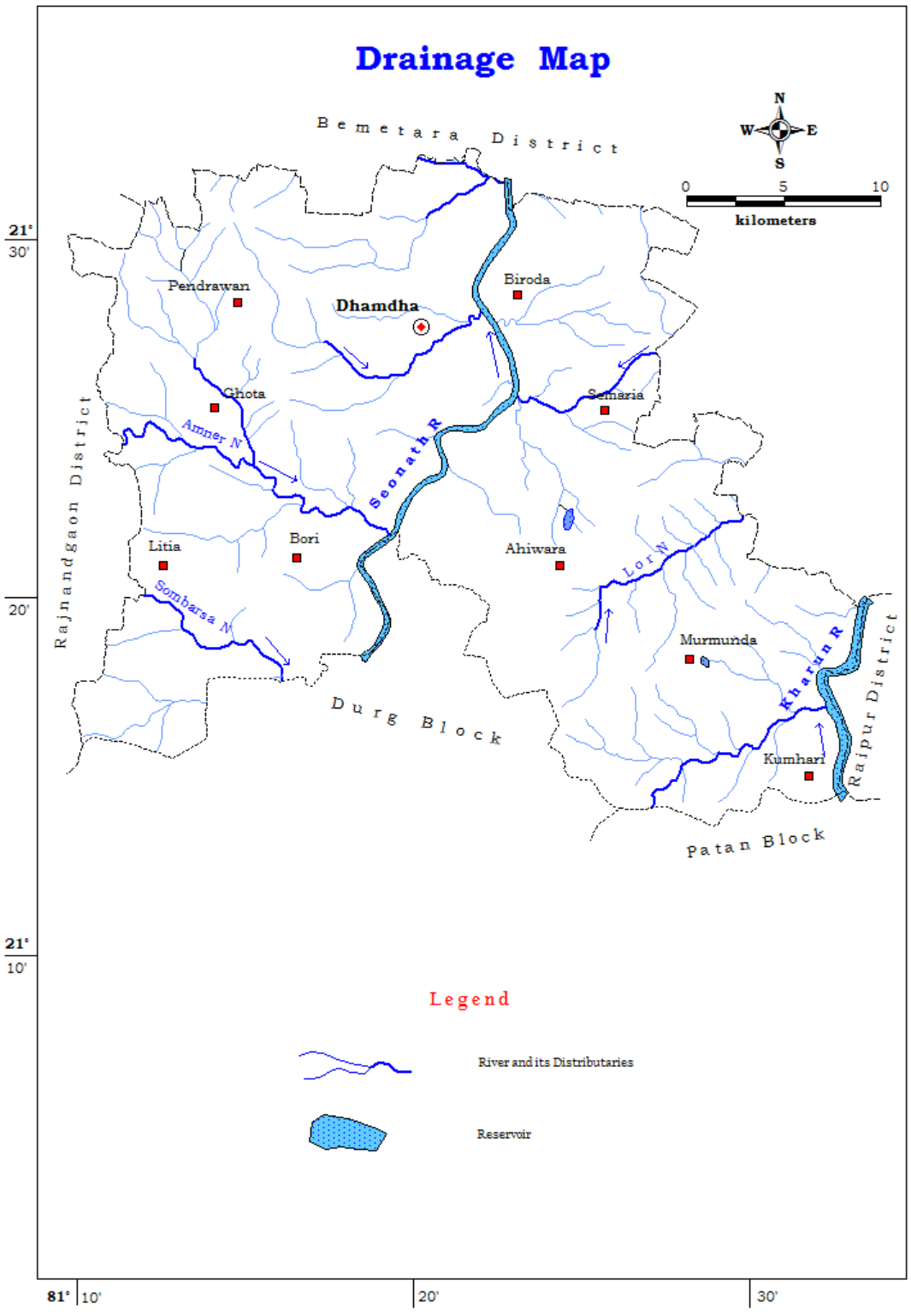


Figure 2: Drainage Map of Dhamdha Block

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 and Gram.

In some areas, double cropping is also practiced. The agricultural pattern, cropping pattern and area irrigated data of Dhamdha 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
Dhamdha	102100	nil	9974	59649	16889	76538

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
Dhamdha	102100	nil	9974	9320	5326	59649	16889	76538

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

Block	Kharif	Rabi	Cereal				Pulses	Tilhan	Fruits Vegetables	Reshe	Mirch Masala	Sugar-cane
			Wheat	Rice	Jowar & Maize	Others						
Dhamdha	55342	21173	3385	42901	77	30	14656	7568	7391	30	22	379

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 irrigat ed area	% of irrigated area wrt. Net sown area
10075	10078	26978	16083	112	96	206	nil	799	27917	28087	50 %

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
Dhamdha	27917	16179	57.95

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

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

Block	**Shale (Tarenga)**				**Stromatolitic limestone (Chandi)**			
	Phreatic		Fractured	Total resource	Phreatic		Fractured	Total resource
	Dynamic	Static	In-storage		Dynamic	Static	In-storage	
Dhamdha	3131.37	863.72	60.55	**4055.64**	8052.08	11333.7	155.69	**19,541.47**

Existing and Future Water Demand (2025)*:* The existing demand for irrigation in the area is 8041.63 Ham while the same for domestic and industrial field is 660.24 Ham. To meet the future demand for ground water, a total quantity of 3141.82 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 in Dhamdha block, in phreatic shale, the maximum water level is 10.8 m, the average water level is 7.35mbgl and in fractured shale, the maximum water level is 30.88m bgl. In phreatic limestone, the maximum water level is 12.33mbgl, the average water level is 7.80mbgl and in fractured limestone, the maximum water level is 21.17mbgl, the average water level is 16.15mbgl.

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

Block Name	Phreatic Shale			Phreatic limestone		
	Min	Max	Avg	Min	Max	Avg
Dhamdha	3.9	10.8	7.35	2.47	12.33	7.80

Water Level (in mbgl)

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

Block Name	Fractured Shale			Fractured limestone		
	Min	Max	Avg	Min	Max	Avg
Dhamdha	27.54	30.88	29.21	11.13	21.17	16.15

(ii) Post- monsoon water level**:** In the post-monsoon period, it has been observed that the water level varies from 2.38 - 7.26mbgl with an average of 4.82mbgl in phreatic shale area. In phreatic limestone terrain, the post monsoon water level variation range is 1.71 to 3.63mbgl. In fractured limestone terrain, the post monsoon water level variation range is 6.38 to 9.28mbgl. In fractured shale terrain, the post monsoon water level variation range is 7.86 to 8.24mbgl.

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

Block Name	Phreatic Shale			Phreatic limestone		
	Min	Max	Avg	Min	Max	Avg
Dhamdha	2.38	7.26	4.82	1.71	3.63	2.46

Water Level (in mbgl)

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

Block Name	Fractured Shale			Fractured limestone		
	Min	Max	Avg	Min	Max	Avg
Dhamdha	7.86	8.24	8.05	6.38	9.28	8.30

(iii) Seasonal water level fluctuation: The water level fluctuation data indicates that in Dhamdha block, water level fluctuation in phreatic shale varies from 0.3 to 4.43 m with an average fluctuation of 2.33 m. Water level fluctuation in fractured shale is 23.02 m. In phreatic limestone, average fluctuation is 3.03 m. Water level fluctuation in fractured limestone varies from 4.75 to 11.89 m with an average fluctuation of 8.32 m

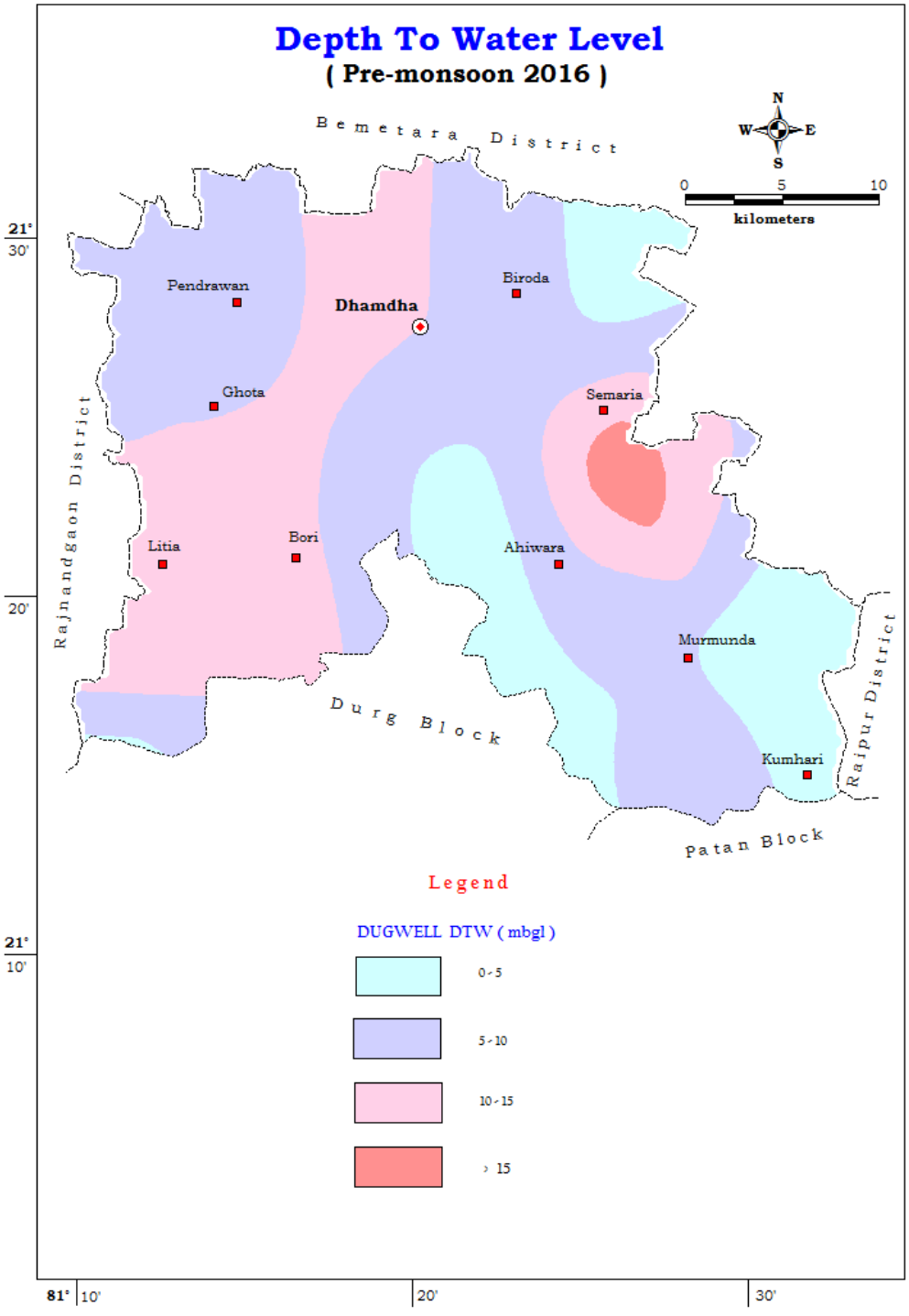


Figure-3: Depth to water level map Phreatic Aquifer (Pre-monsoon)

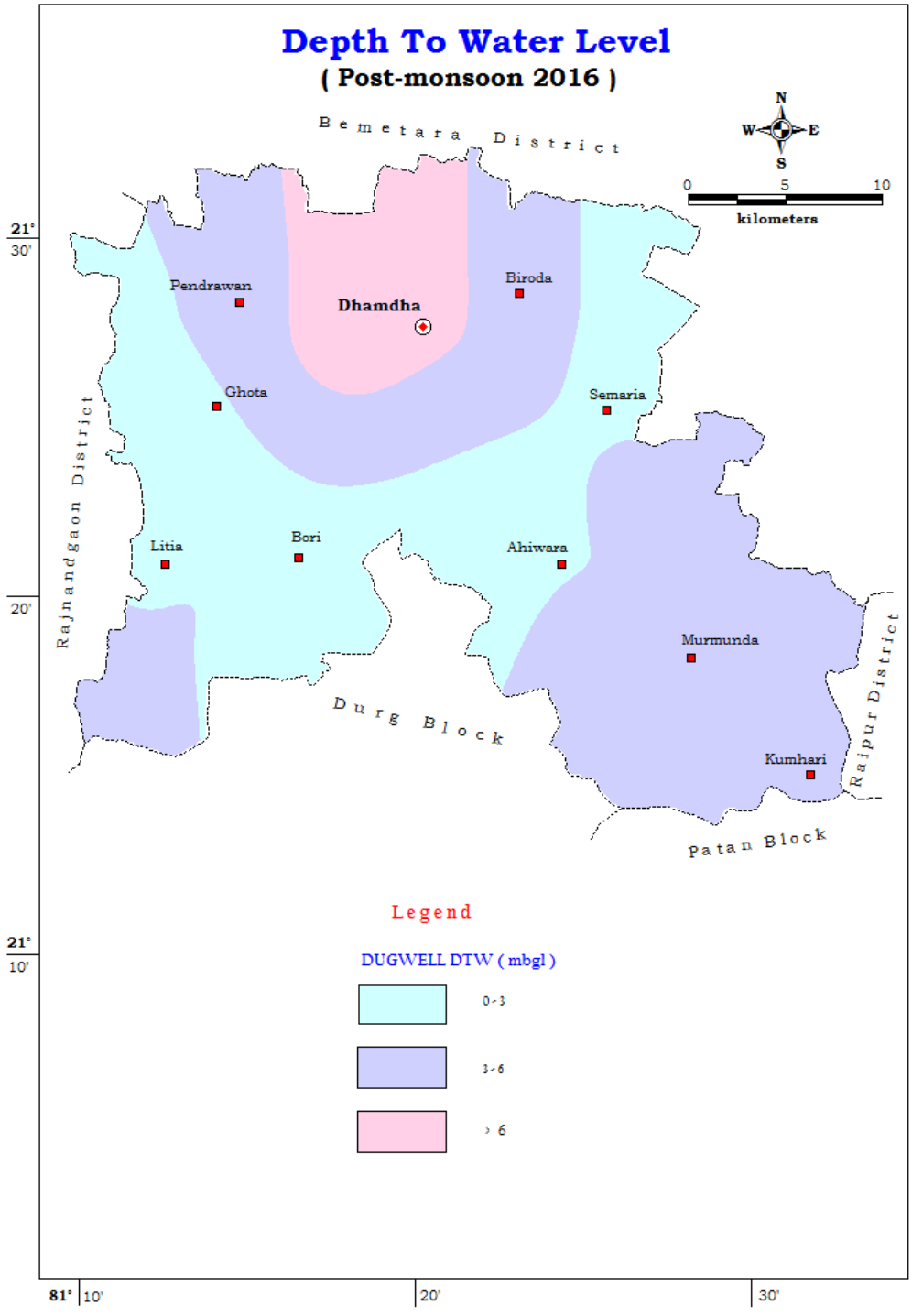


Figure 4: Depth to water level map Phreatic Aquifer (Post-monsoon)

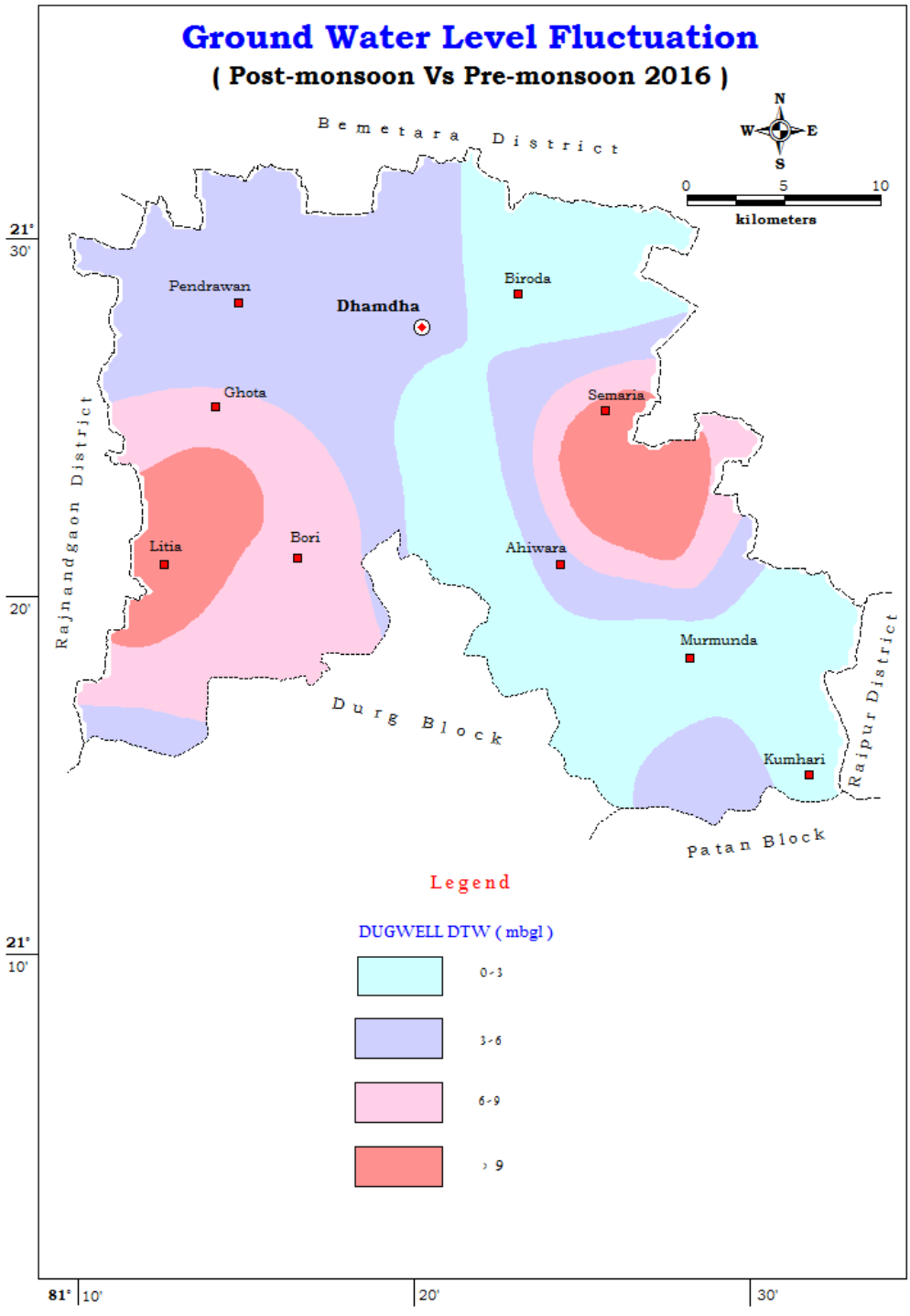


Figure 5: Depth to water level fluctuation map of Phreatic Aquifer

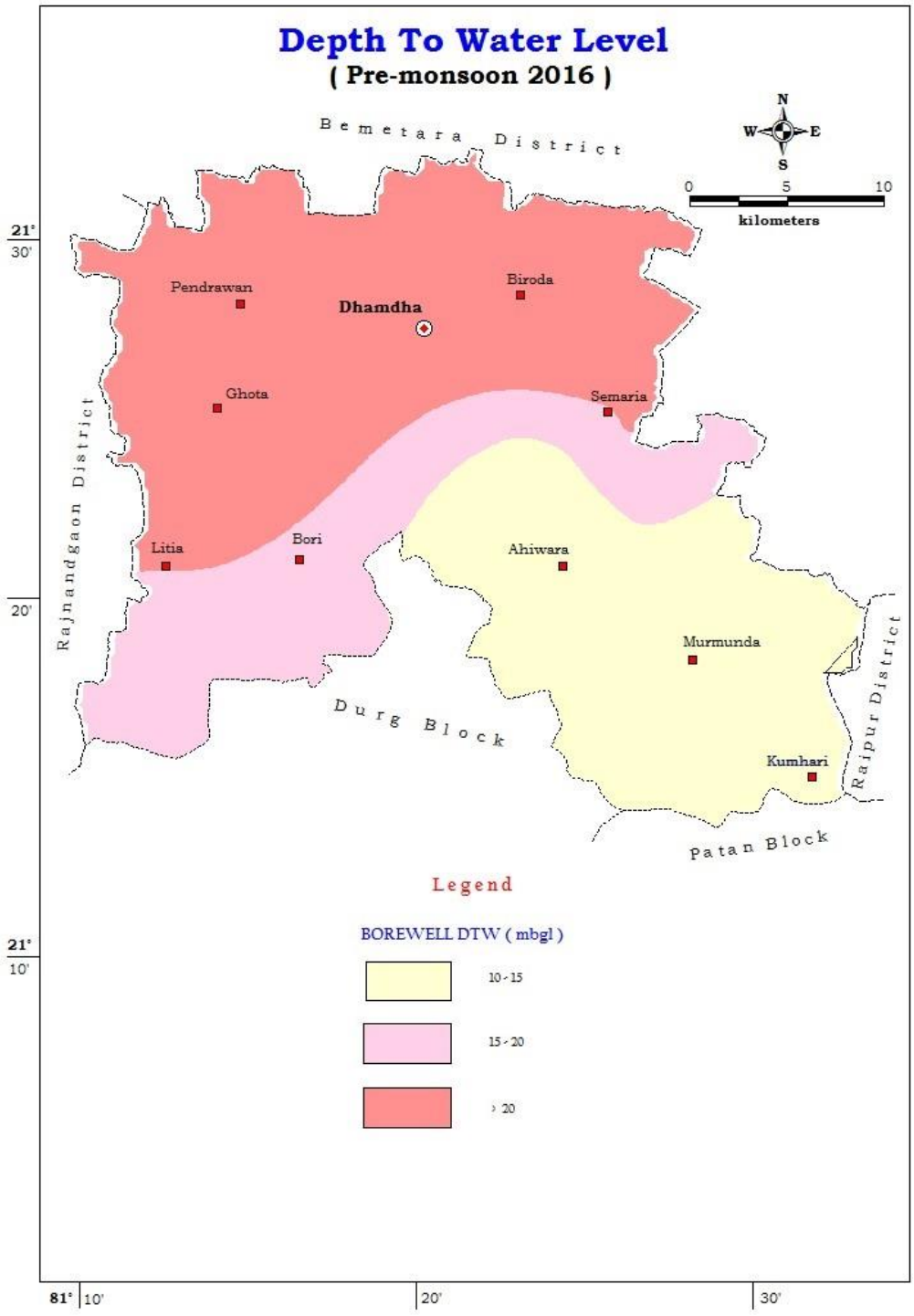


Figure-6: Depth to water level map Fractured Aquifer (Pre-monsoon)

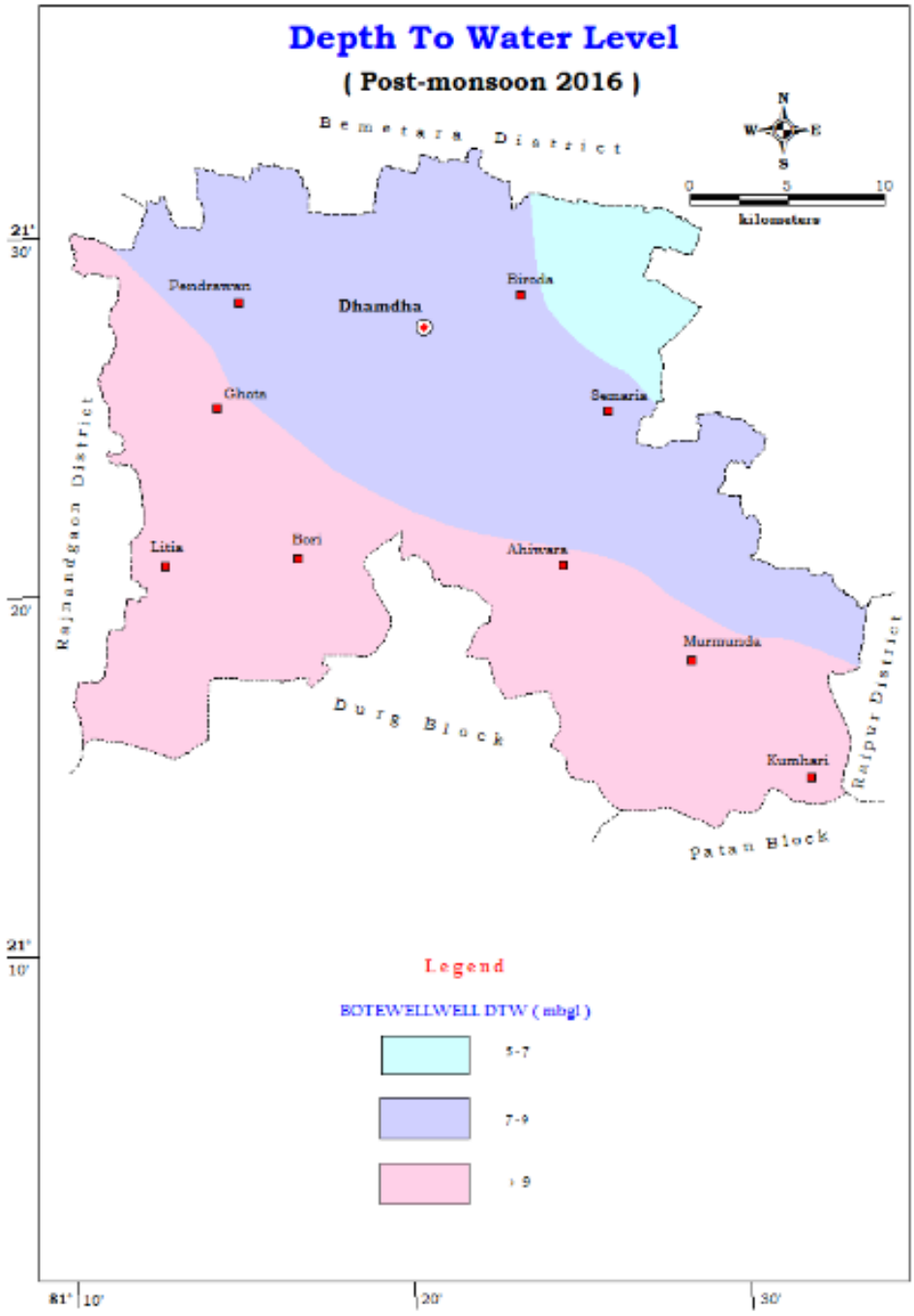


Figure-7: Depth to water level map Fractured Aquifer (Post-monsoon)

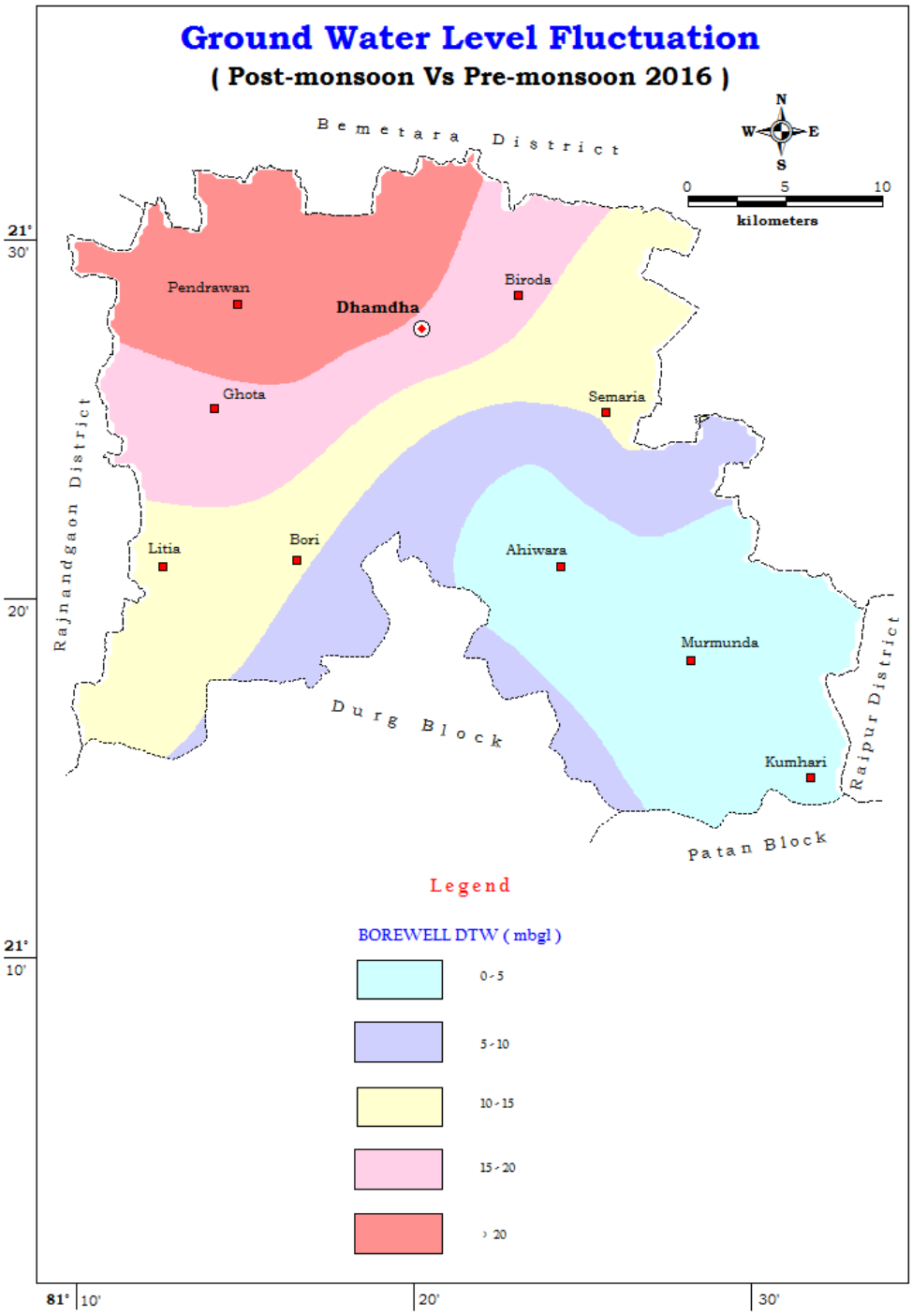


Figure 8: water level fluctuation map of Fractured Aquifer

Table 5E: Aquifer wise Water Level Fluctuation (m)

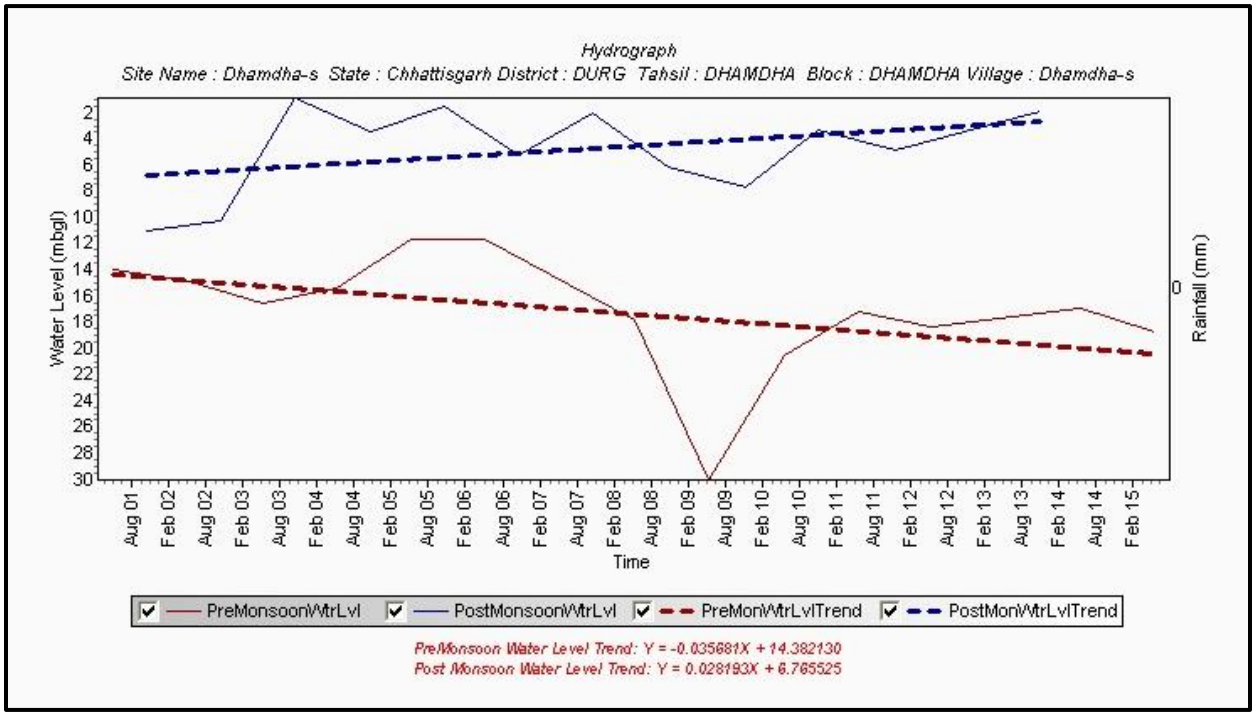
Block Name	Phreatic Shale			Phreatic limestone		
	Min	Max	Avg	Min	Max	Avg
Dhamdha	0.3	4.43	2.33	2.63	3.43	3.03

Table 5F: Aquifer wise Water Level Fluctuation (m)

Block Name	Fractured Shale			Fractured limestone		
	Min	Max	Avg	Min	Max	Avg
Dhamdha	19.68	22.64	21.16	4.75	11.89	8.32

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

Figure 9: Hydrograph of Dhamdha village, Dhamdha block



2. Aquifer Disposition:

Number of Aquifers: There are two major aquifers viz. (i) Shale (Tarenga formation) & (ii) Stromatolitic limestone (Chandi formation) both in phreatic and fractured condition serves as major aquifer system in the block of Dhamdha.

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

(A) Geology: Geologically the block exhibits lithology of Meso to Neo Proterozoic age occupied by calcareous shale (Tarenga formation) and Stromatolitic limestone (Chandi formation).

a. Tarenga Formation: This formation comprises predominantly of argillite-dolomite sequence. The shales are cherty and calcareous. Shale is green, grey and purple in colour and compact. This formation has good ground water potential at places.

b. Chandi Formation: This Formation comprises a dominant stromatolitic limestone sequence. The bottom most (Newari member) comprises of stromatolitic limestone and dolomite which is pink to light grey in colour and thickly bedded followed by dark grey flaggy limestone (Pendri member) with intercalations of calcareous shale and Deodongar sandstone of lensoid shape. The topmost unit (Nipania member) comprises of pink to purple dolomitic limestone. Towards upper part it changes into bedded limestone and purple shale and is devoid of stromatolitic structure. This formation has very good ground water potential due to development of caverns at places.

Aquifer wise characteristics:

(i) The ground water in Tarenga shale occurs under phreatic/water table conditions in the weathered portion while semi-confined to confined conditions in deeper part consisting of fractures. The average thickness of the weathered portion in the area is around 10.36 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 50 m depth and 1to 2 sets of fractures are encountered within 50 to 200 m depth. The potential zones are present within 50 m depth below ground level. In general, the discharge varies from negligible to 2 lps with an average yield of 1.5 lps. The development in these formations is mostly by way of bore wells. The average drawdown is 35.2 m. The thickness of fractured aquifer is around 0.33 m.

(ii) The ground water movement in Chandi limestone is controlled by the solution cavities, joints and fractures. The average thickness of the weathered portion in the area is around 24 m Generally 1 to 2 sets of fractures are encountered within 50 m depth, 1 to 3 sets of fractures within 50 to 200 m depth. The average discharge of 3.0 lps. The average drawdown is 19.6 m. the thickness of fracture is around 0.46 m. These formations are mostly developed by the way of dug wells, bore wells and tube wells.

Table 6: Distribution of Principal Aquifer Systems in Dhamdha

Block	Phreatic and fractured shale	%	Phreatic and fractured limestone	%	Total Area (sq.km)
Dhamdha	286	28.01	735	71.99	1021

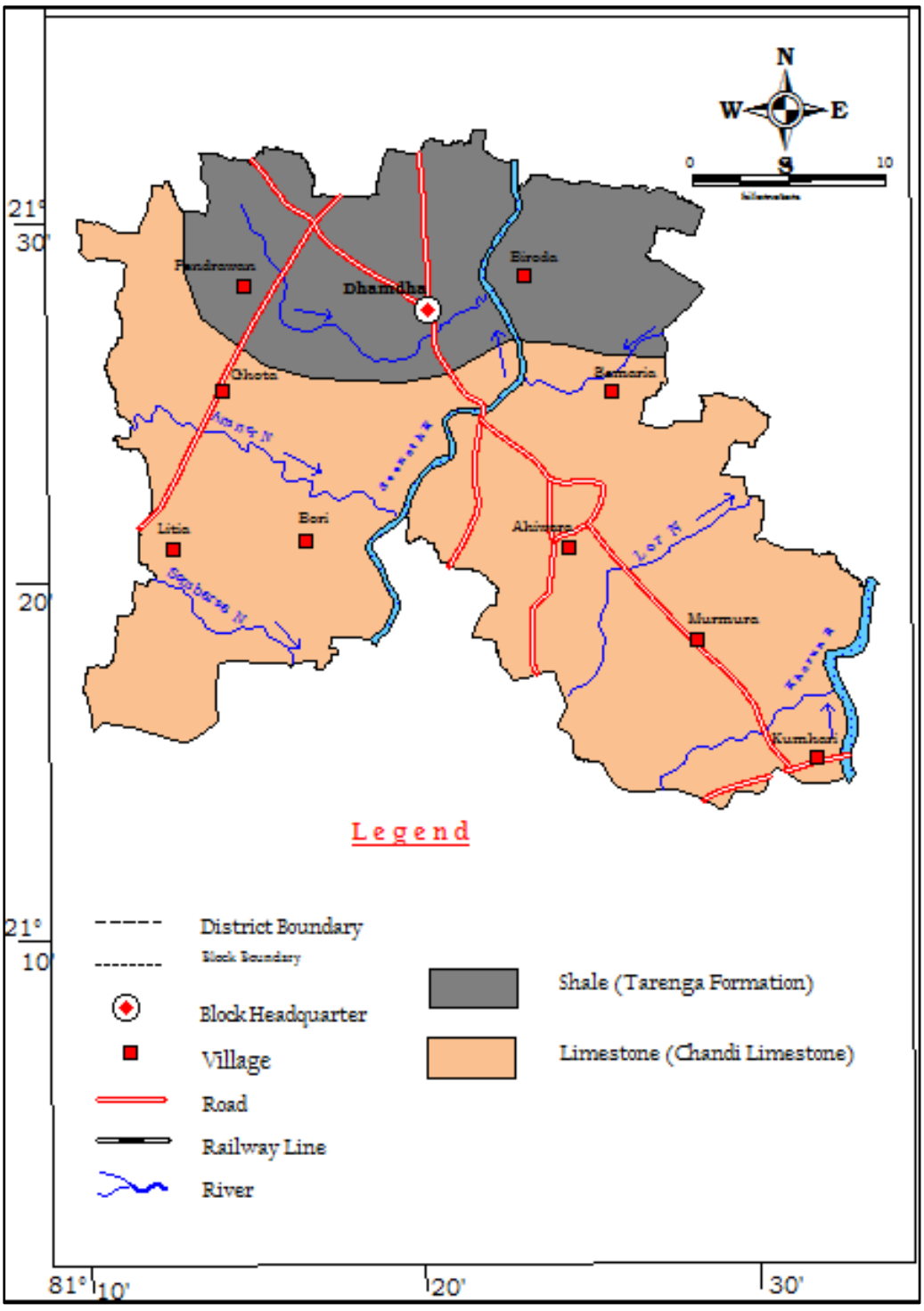


Figure 10: Aquifer map of Dhamdha block

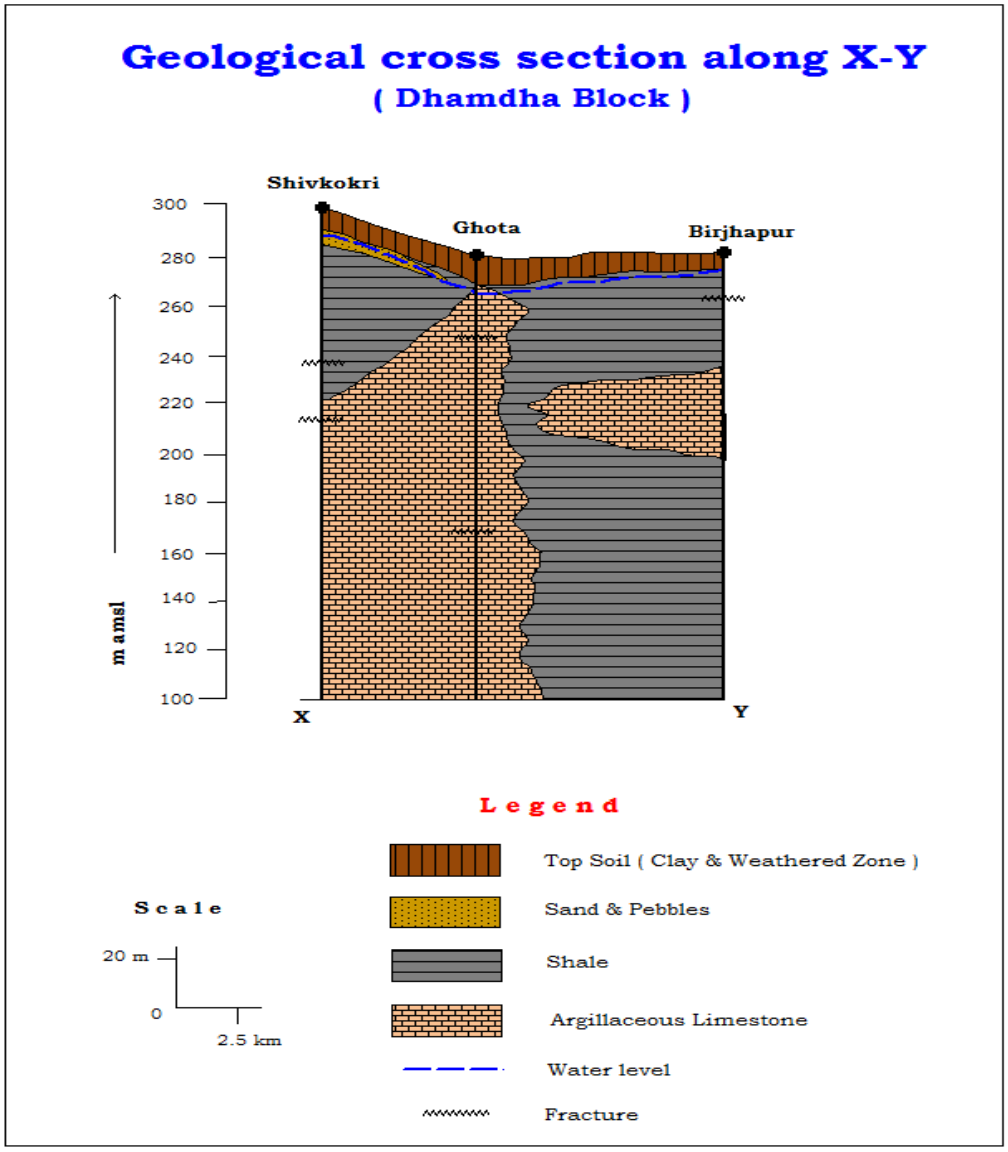
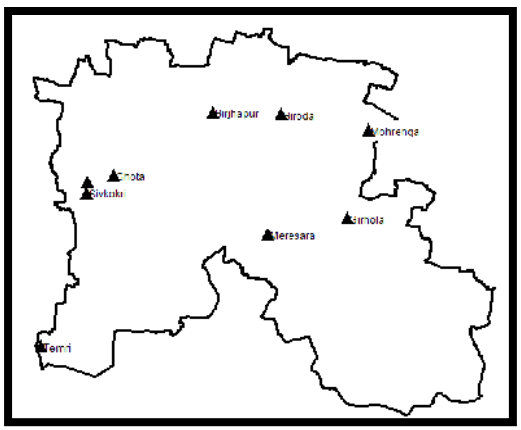


Figure-11: Hydrogeological Cross Section, Dhamdha Block



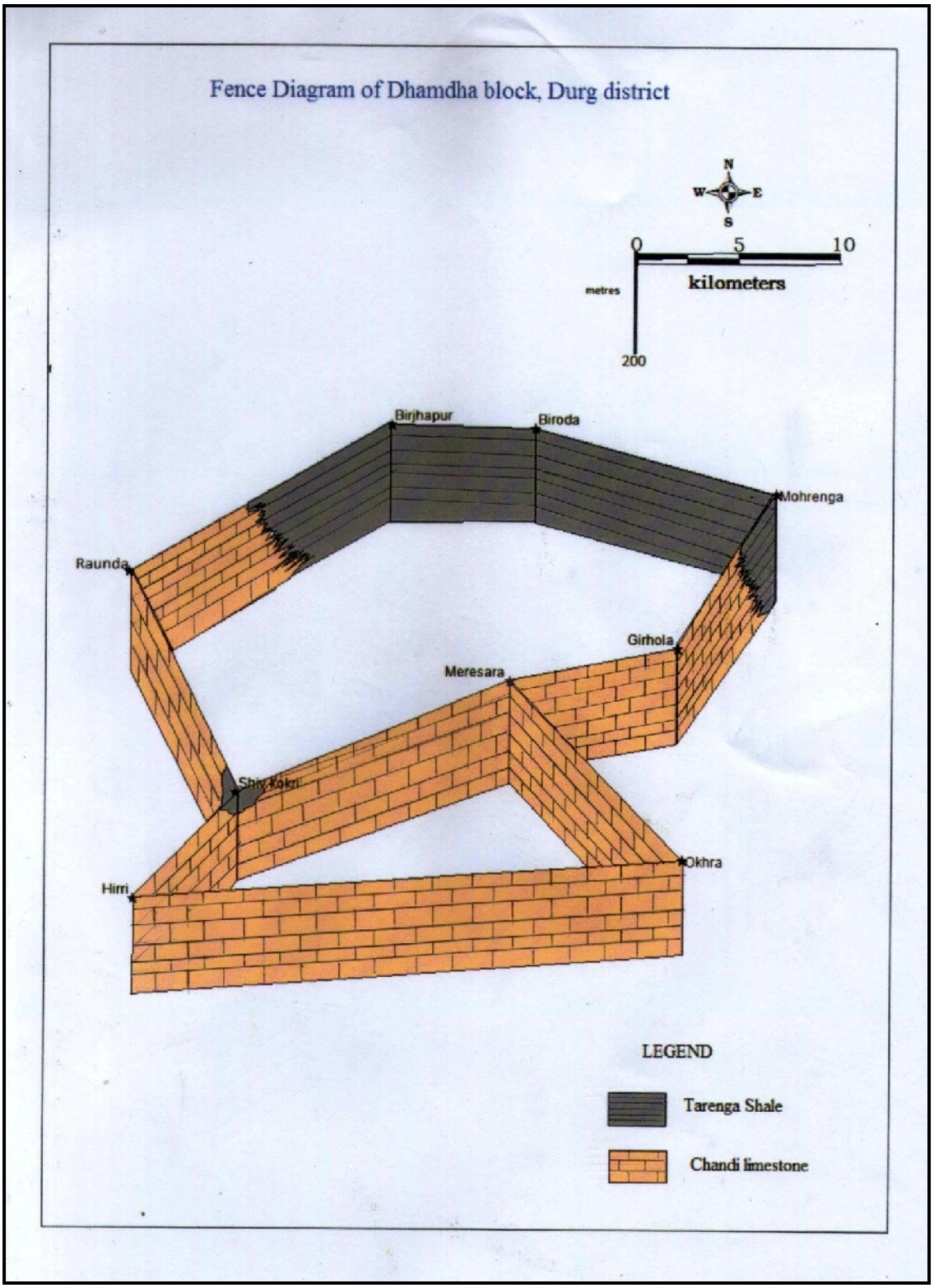


Figure 12: Fence diagram of Dhamdha block

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 Dhamdha block is 11399.69 ham out of which the resource available with shale (Tarenga) area is 3191.91 and with limestone 8207.78 ham. The dynamic resource of the block is 11183.45 ham out of which the shale area contributes 3131.37ham and the limestone terrain contributes 8052.08 ham. 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 Dhamdha

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)
Durg	Dhamdha	11183.45	8041.63	660.24	8701.87	761.02	2380.80

Table 8 Categorization of Assessment Unit

District	Block	Stage of Ground water development (%)	Categorization
Durg	Dhamdha	77.81	Semi-critical

Categorization: The Dhamdha block falls in semi-critical category. The stage of Ground water development is 77.81%. The Net Ground water availability is 11183.45Ham. The Ground water draft for all uses is 8701.87 Ham. The Ground water resources for future uses for Dhamdha Block is 3141.82Ham.

Chemical Quality of Ground water and Contamination**:** Throughout the study area, the water quality (phreatic 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. Issues and Management plan:

Aquifer wise space available for recharge and proposed interventions:

The Volume of porous space available for recharge (m^3) is in limestone area is nil. Similarly, the Volume of porous space available for recharge (m^3) in the unsaturated zone of shale is 7.81x 10^6 m^3 assuming the specific yield of shale as 0.015, considering the void space depth i.e. the desirable thickness of unsaturated zone as 1.82 m (not considering the top 3m of the average post-monsoon water level) and the area is 286 sq. km. This is summarized in Table 9.

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)
Shale	286x 10^6	1.82	0.015	7.81 x 10^6
Limestone	735x 10^6	0	0.015	nil

Issues:

Stage of ground water development in Dhamdha block is relatively high (78%). Region underlain by Tarenga shale faces drying up of dug wells and non-functioning of hand pumps during summer.

Management plan**:**

1. Field to field irrigation (flooding method) should be replaced with channel irrigation in command area as there is about 30-40% conveyance loss in field irrigation. Same amount of water can be saved through channel irrigation.

2. Double cropping of paddy using groundwater is to be discouraged. More water efficient crops like, Maize and Millet to be substituted for paddy during second cropping.

Table-10: Detail of groundwater saved through change in cropping pattern

Detail of groundwater saved through change in cropping pattern								
Block	Paddy cultivation area in Rabi season (ha)	Water required (m) per ha (m)		Difference (m per ha)	Total saving of water (ham)	GW saving in command area (ham)	Available Resource (ham)	Improved Status of groundwater Development
		Paddy	Maize					
Dhamdha	3025	1.5	0.5	1.0	3025	1351.49	11183.4	46

3. Government should provide attractive incentives and subsidies to encourage farmers to take up alternative crops to paddy, which are equally profitable and adopt micro-irrigation practices such as drip and sprinkler irrigation.

4. Information, education and Communication (IEC) activities to be organized to sensitize people on the issues of depleting groundwater resource. Need for massive mass awareness among the farmers to shift from summer rice to Maize/Ragi, advantages of taking such crops, crop methodology and its related aspects.

5. The practice of providing free electricity to operate irrigation bore wells 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.

6. 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.

7. It has been observed from the long term trend lines that there is a declining tendency during pre-monsoon; we should go for artificial recharge on a long term basis. Hence 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 non-committed run-off to augment the ground water storage in the area. The different types of artificial recharge structures feasible in the block are described in table-11.

Table-11: Types of artificial 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
Dhamdha	148	7.81	15	200	100	200
	Recharge Capacity		**3.81**	**2**	**1**	**1**
	Estimated cost (Appx.)		**Rs. 11.55 crore**			
	Stage of Development to be lowered		**15**			

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

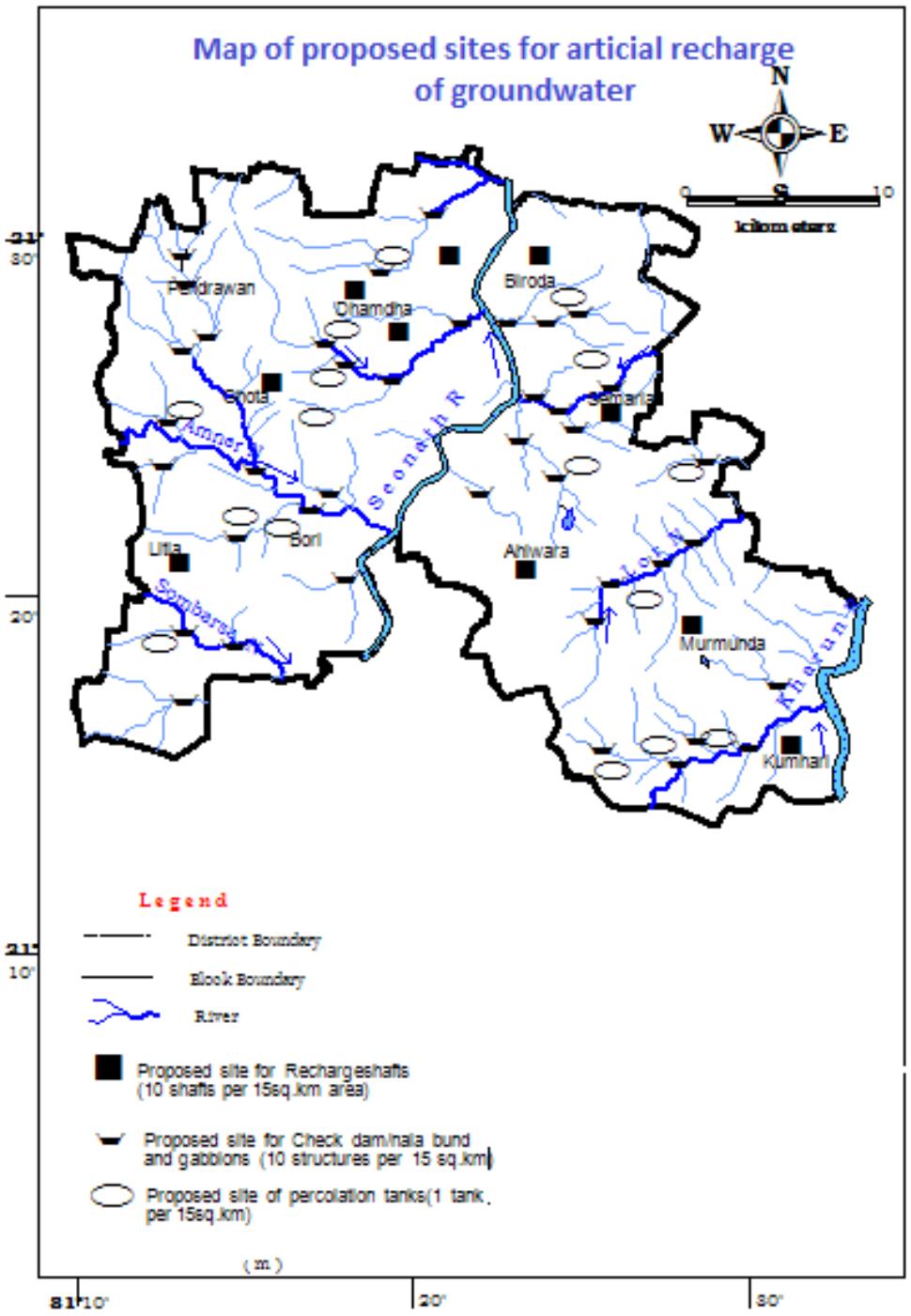


Figure 13: Map of proposed sites for artificial recharge of groundwater in Dhamdha block