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

Kurud Block, Dhamtari District, Chhattisgarh

उत्तर मध्य छत्तीसगढ़ क्षेत्र, रायपुर

North Central Chhattisgarh Region, Raipur

REPORT ON
AQUIFER MAPPING AND MANAGEMENT PLAN
OF KURUD BLOCK, DHAMTARI DISTRICT, CHHATTISGARH

Prepared By

Uddeshya Kumar

Scientist-B

Under Guidance of

Shri A. K.Biswal

Scientist-D

Central Ground Water Board
North Central Chhattisgarh Region, Raipur
Ministry of Water Resources,
Ganga Rejuvenation & River Development
Government of India

RAIPUR
2016-17

Acknowledgement

I wish to express my sincere gratitude and indebtedness to Shri D. Saha, Member (SAM), CGWB, for giving the opportunity to prepare and write this block report.

I wish to express my sincere gratitude and indebtedness to Shri C. Paul Prabhakar, Regional Director, CGWB, NCCR, Raipur for his useful suggestions and technical guidance from time to time. to prepare and write this report.

I am extremely grateful to Sh. A.K. Biswal, Scientist-D, for his continuous guidance and technical support during preparation of this report.

I would like to acknowledge the help rendered by Shri A.K. Patre, Scientist-D, for their constant support and improvement during compilation of the report.

The efforts made by Sh. T.S. Chouhan, Draftsman, for digitization of maps are thankfully acknowledged.

The author is thankful to Technical Section, Data Centre, Chemical Section, Report Processing Section and Library of CGWB, NCCR, Raipur for providing the various needful data without which the report could not have been completed.

The author is also thankful to the state agencies for providing the various needful data without which the report could not have been completed.

Lastly I offer my thanks to all the individuals who helped at various stages in this endeavour.

Uddeshya Kumar
Scientist-'B'

AQUIFER MAPPING AND MANAGEMENT PLAN FOR KURUD BLOCK (DHAMTARI DISTRICT), CHHATTISGARH

CONTENTS

BLOCK-WISE AQUIFER MAPS AND MANAGEMENT PLANS

1. Salient Information:

About the area: The Kurud Block is situated in the northern part of Dhamtari district of Chhattisgarh and is bounded on the north by Raipur district, in the west by Durg and Balod districts of Chhattisgarh, in the south by Dhamtari block and in the east by Magarlod block. The area lies between 20.7404 and 21.0829 N latitudes and 81.4750 and 81.8530 E longitudes. The geographical extension of the study area is 975 sq.km representing around 29 % of the district's geographical area. Major rivers are Mahanadi and Kharun on eastern and western boundary of block respectively. The area is served by a good road network from the capital city Raipur. The administrative map of Kurud block is shown in Fig. 1.

Population: The total population of Kurud block as per 2011 Census is 219013 out of which rural population is 197683 & the urban population is only 21330. 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
Kurud	219013	109458	109555	197683	21330

Source: CG Census, 2011

Growth rate: The ten-year population growth rate of the block is 14.96* as per 2011 census. *Growth rate has been determined based on the total population of Kurud and Magarlod Block, as no separate data is available for Magarlod Block in 2011.

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 80% 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. 2010-11 to 2014-15) 1207.48 mm with 50 to 60 rainy days whereas the normal rainfall as per IMD is 1,008.80 mm.

Table-2: Rainfall data in Kurud block in mm

Year	2010-11	2011-12	2012-13	2013- 14	2014- 15
Average rainfall	1070.20	1226.20	1125.60	1398.20	1217.2

Source: District Statistical Handbook 2014, Dhamtari

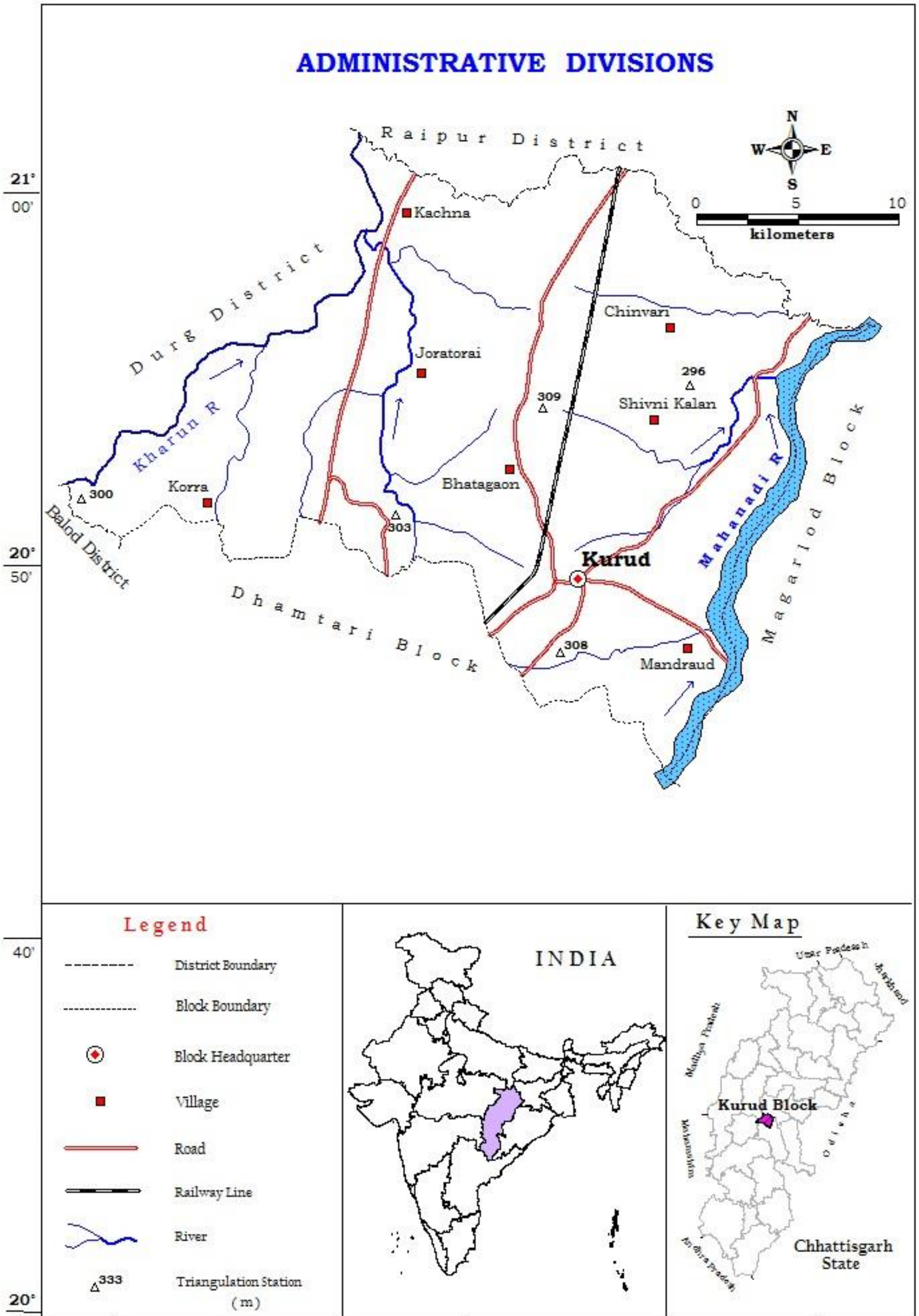

Fig: 1 Administrative Map of Kurud Block

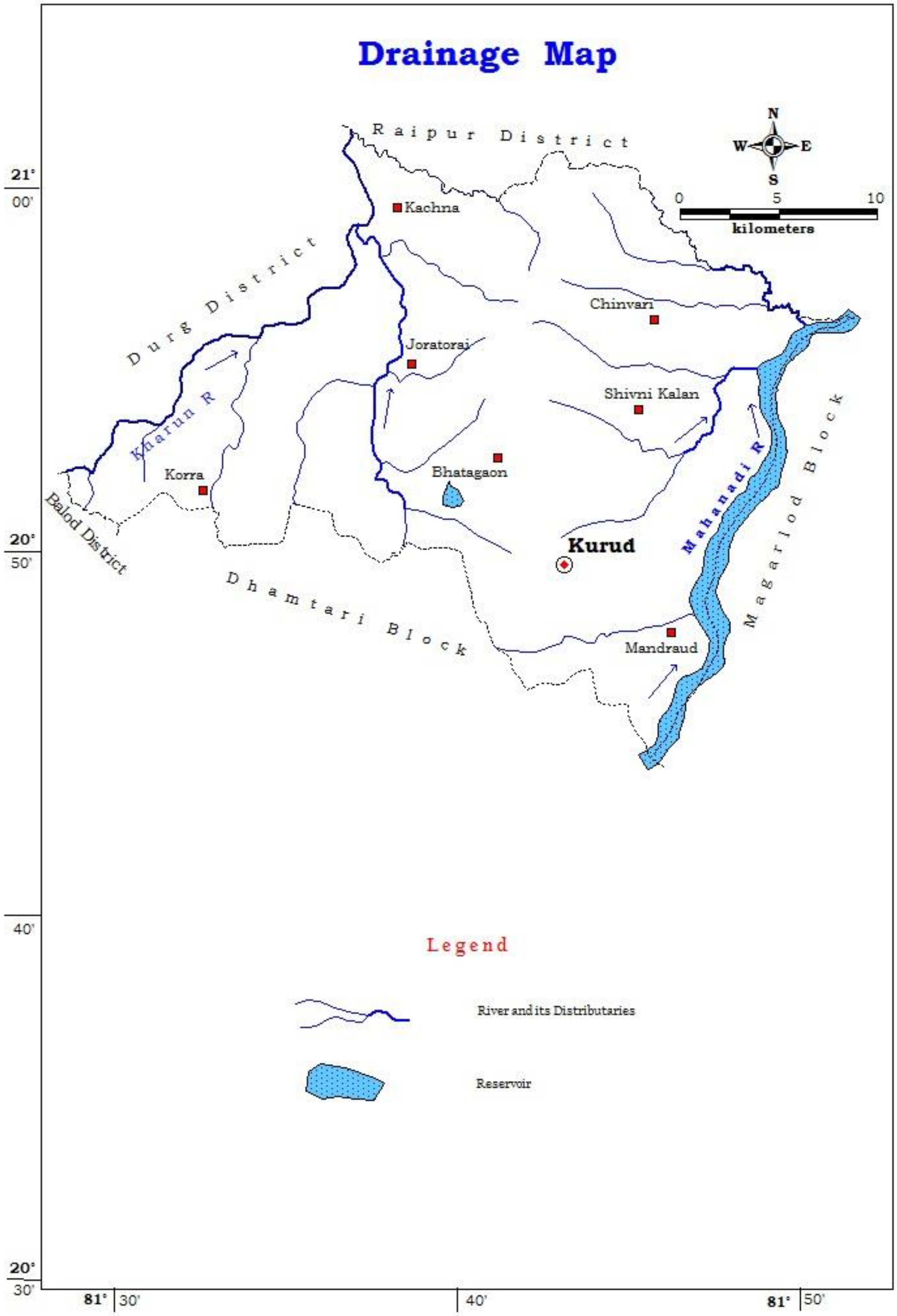

Fig: 2 Drainage Map of Kurud Block

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 canal water and ground water as well as partly through ponds and other sources. The groundwater abstraction structures are generally Dugwells, Borewells /tubewells. The principal crops in the block are paddy, pulses and oil seeds.

. In some areas, double cropping is also practiced. The agricultural pattern, cropping pattern and area irrigated data of Kurud block is given in Table3 (A, B, C, 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
Kurud	59242	0	5505	6255	214	47268	33910	81178

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

Block	Kharif	Rabi	Cereal			Pulses	Oil Seeds	Fruits/	Others (Fibre)
			Rice	Wheat	Others			Vegetables	
Kurud	47254	33924	66626	160	11	13354	280	734	12

Table 3 (C): 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 Irrigated area	Gross irrigated area	% of irrigated area wrt. Net sown area
1	47198	5255	14847	70	175	0	0	7	44591	62227	94.33

Table 3 (D): Contribution of Groundwater in Irrigation Pattern (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 (%)
Kurud	14847	175	15022	44591	33.69

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

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

Formation	Phreatic		Fractured	Total resource
	Dynamic	Static	In-storage	
Shale	11900.5908	2628.8	110.24	14639.6308
Limestone	1778.2492	393.7	26.035	2197.9842

Existing and Future Water Demand: The existing demand for irrigation in the area is 10206.90 Ham while the same for domestic and industrial field is 509.01 Ham. To meet the future demand for ground water, a total quantity of 2962.93 ham of ground water is available for future use.

Water Level Behavior (Phreatic Aquifer): (i) Pre- monsoon water level: In Gunderdehi Formation, it has been observed water level varies from 1.88 mbgl to 11.82 mbgl, though the maximum water level is 11.82 m at Mourikalan and the average water level is 5.16 mbgl. In Charmuria Formation the water level varies from 1.94 mbgl to 2.7 mbgl.

(ii) Post- monsoon water level: In Gunderdehi Formation, it has been observed that water level varies from 1.15 mbgl to 3.55 mbgl though the maximum water level is 3.55 mbgl at Mourikalan and the average water level is 1.99 mbgl. In Charmuria Formation the water level varies from 1.55 mbgl to 2.3 mbgl.

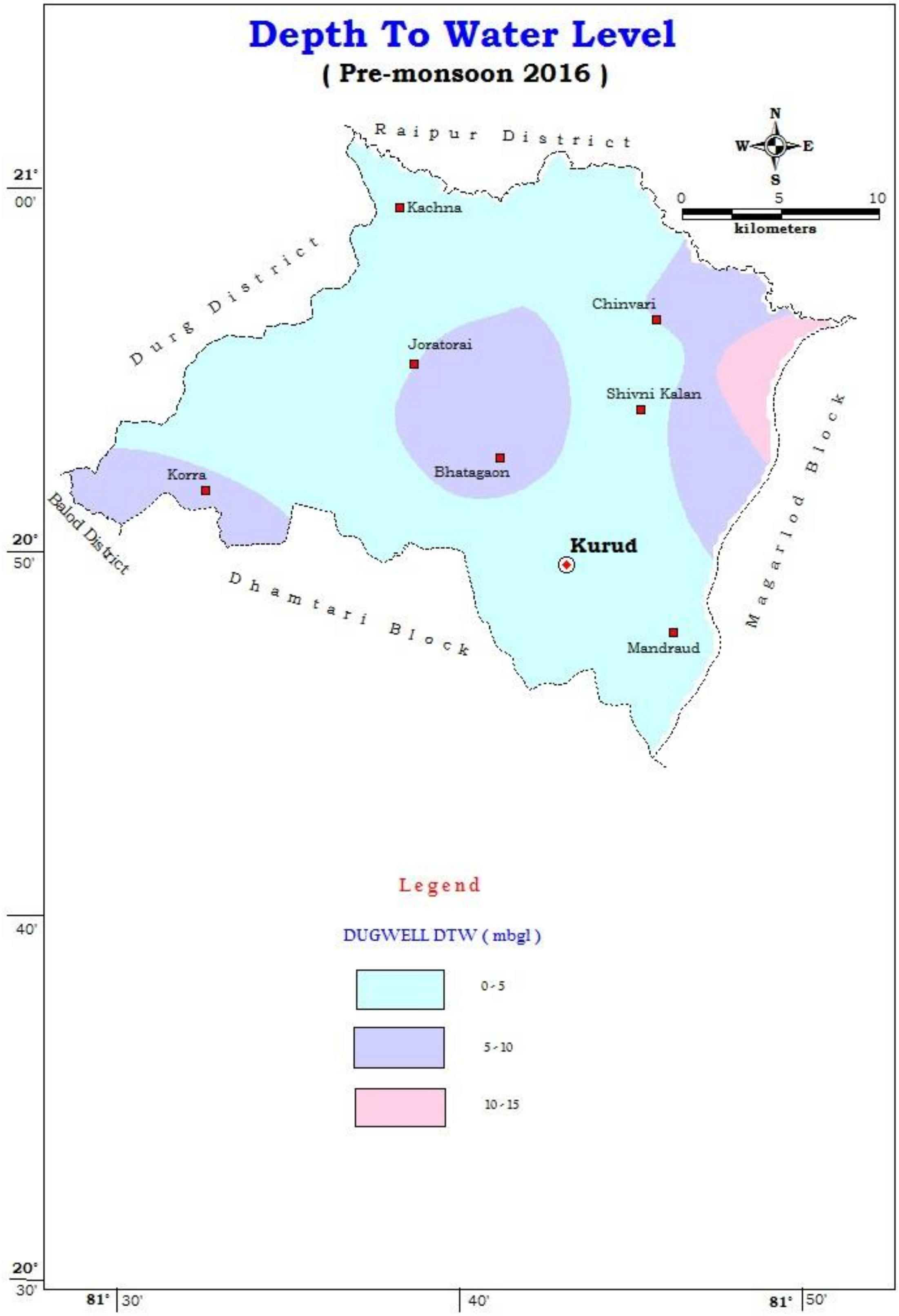

Fig -3: Depth to water level map Phreatic Aquifer (Pre-monsoon)

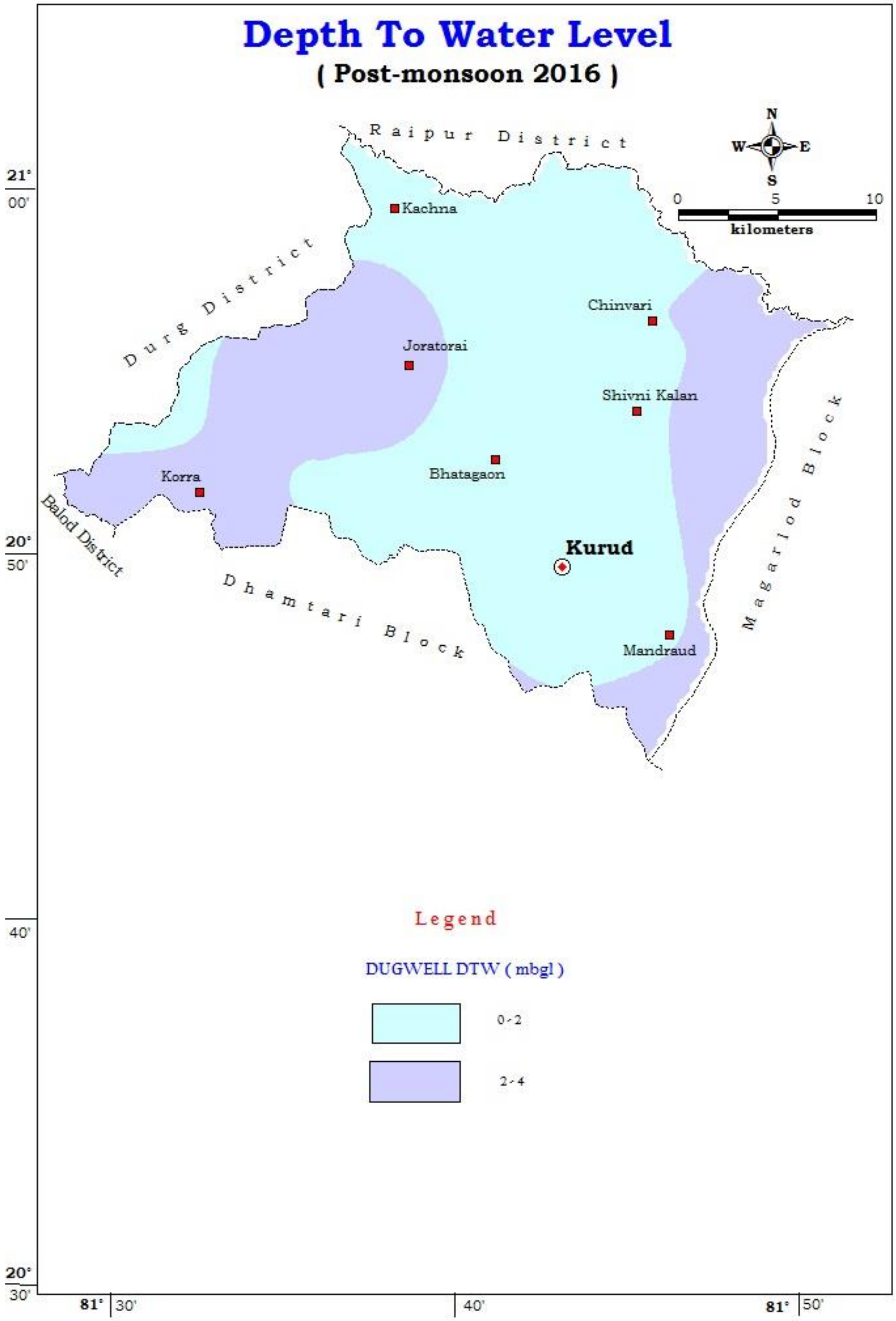

Fig -4: Depth to water level map Phreatic Aquifer (Post-monsoon)

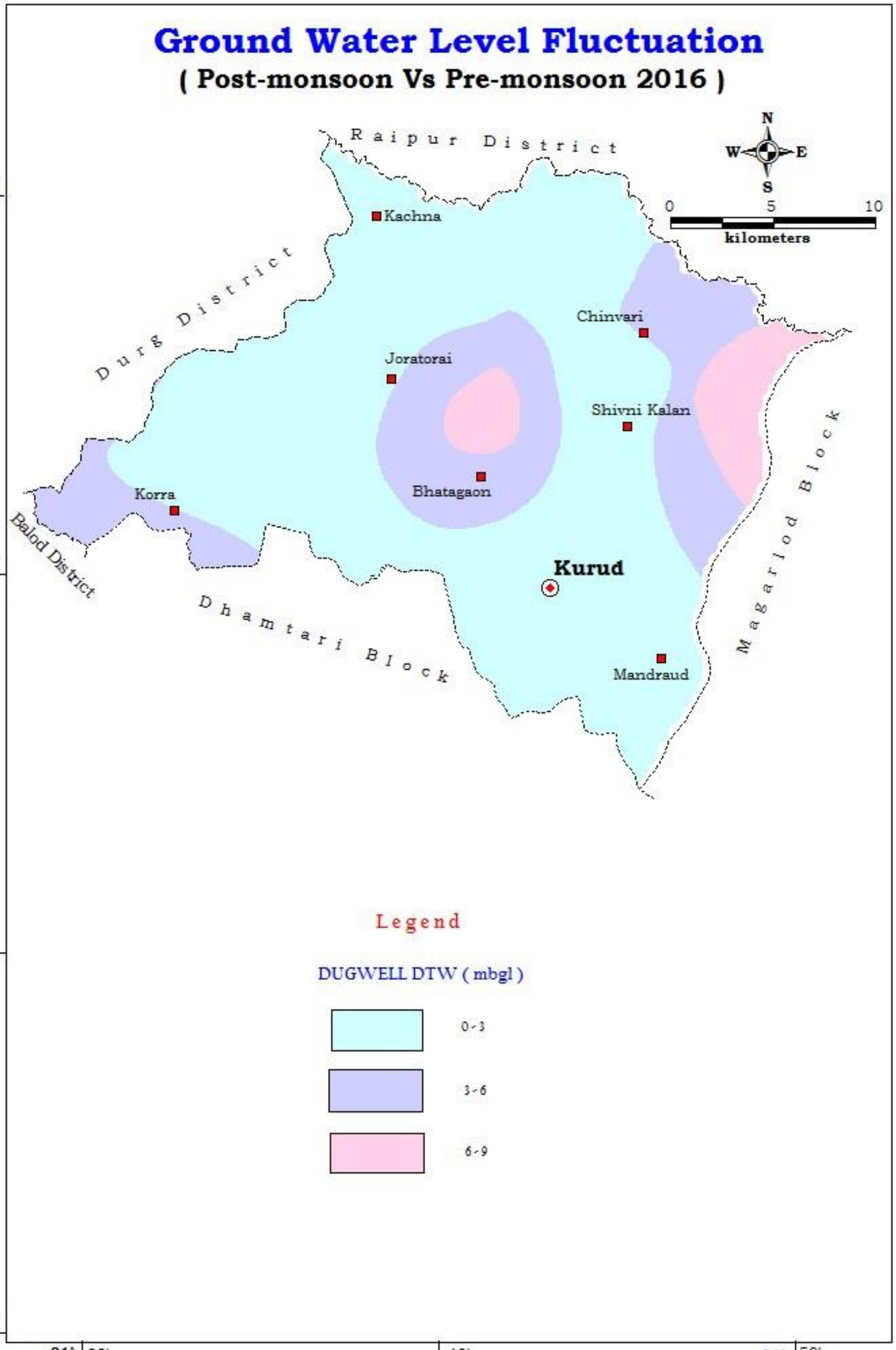

Fig -5: Water Level Fluctuation Map, Phreatic Aquifer

(iii) Seasonal water level fluctuation: The water level fluctuation data indicates that in Gunderdehi Formation, water level fluctuation varies from 0.72 to 8.27 m with an average fluctuation of 2.79 m as the highest fluctuation in the order of more than 8.27 m is only observed at Maurikala. In Charmuria Formation in Kurud block there is no significant fluctuation i.e. 0.40 m.

Table 5: Aquifer wise Depth to Water Level Characteristics

Formation	Premonsoon			Postmonsoon			Fluctuation (m)
	Min	Max	Avg	Min	Max	Avg	
Gunderdehi Shales	1.88	11.82	5.16	1.15	3.55	1.99	2.79
Charmuria Limestone	1.94	2.70	2.32	1.55	2.30	1.93	0.40

Water Level (in mbgl)

(iv) The long term water level trend: It indicates that there is no appreciable change in water level both in pre-monsoon and post-monsoon period.

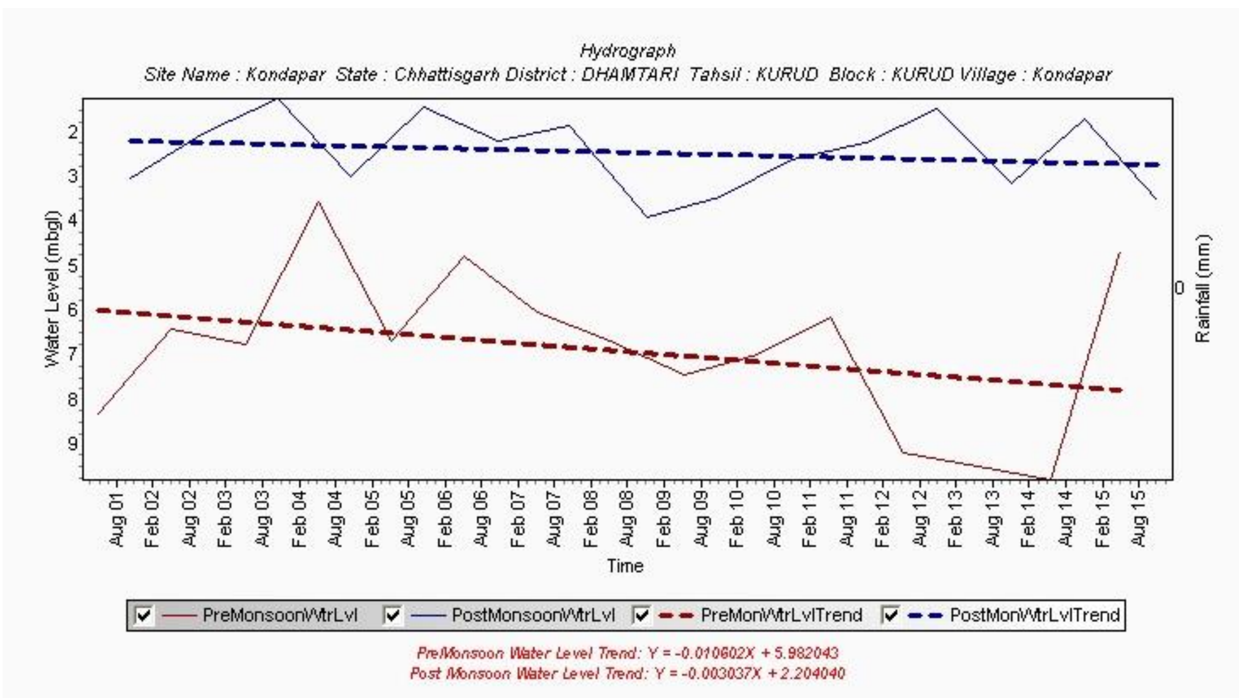

Fig-6: Hydrograph of Kondapar, Kurud

Water Level Behavior (Fractured Aquifer):

(i) Pre- monsoon water level: In the pre-monsoon period, it has been observed that in fractured aquifer, the maximum water level is 12.30 mbgl at Megha, the average water level in the block is 10.77 mbgl.

(ii) Post- monsoon water level: In the post-monsoon period, it has been observed that the water level varies from 2.85 to 7.46 mbgl with an average of 5.15 mbgl in Kurud block.

(iii) Seasonal water level fluctuation: The water level fluctuation data indicates that in Kurud block, water level fluctuation varies from 0.55 to 12.00 m with an average fluctuation of 5.62 m as the highest fluctuation in the order of more than 12.00 m is observed at Birejhar village.

Table 5: Aquifer wise Depth Water Level Characteristics

Formation	Premonsoon			Postmonsoon			Fluctuation(m)
	Min	Max	Avg	Min	Max	Avg	
Gunderdehi Shale	3.4	13.22	11.46	2.85	7.46	5.13	6.33
Charmuria Limestone	5.80	12.30	9.05	3.90	6.50	5.20	3.85

Water Level (in mbgl)

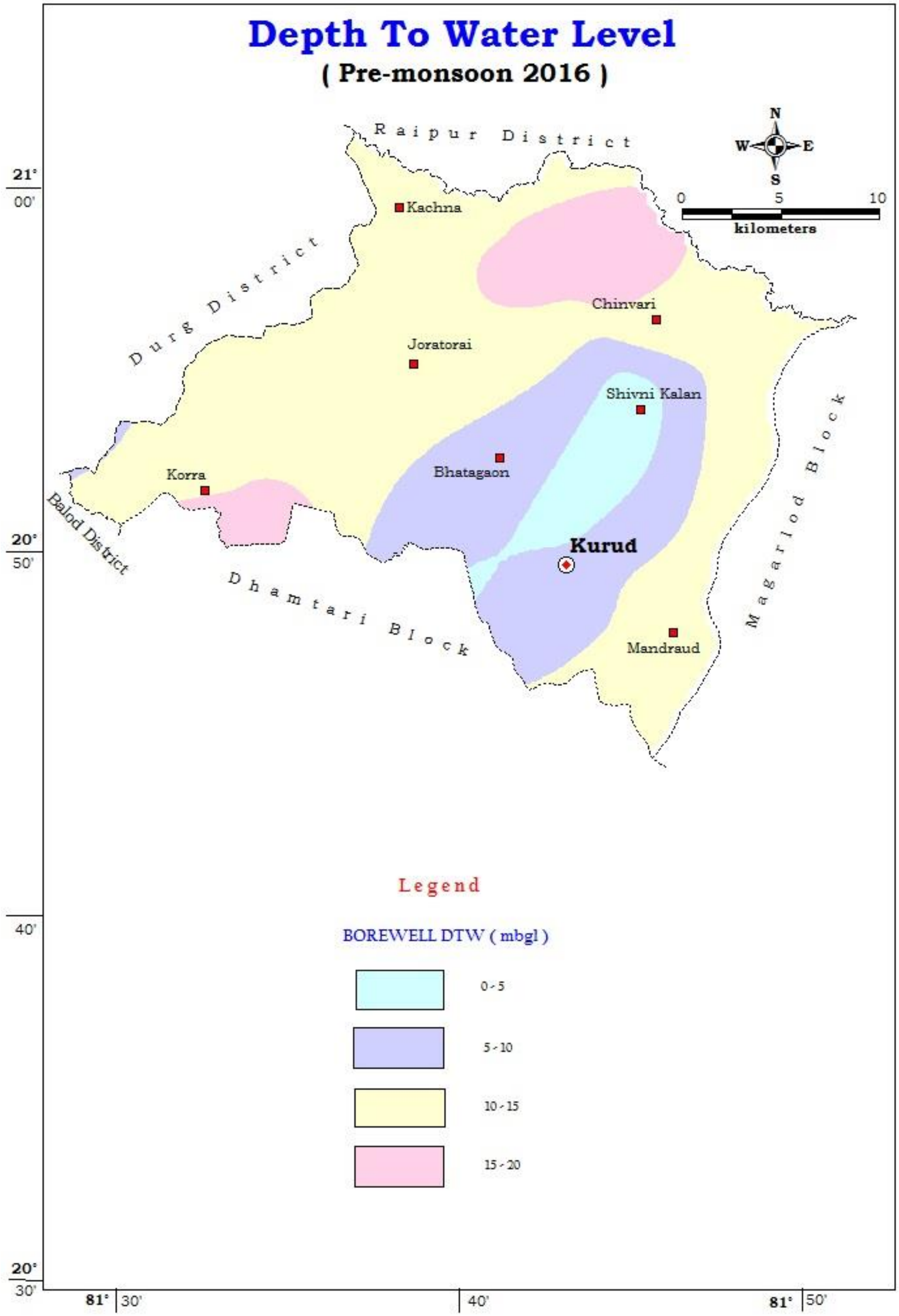

Fig -7: Depth to water level map Fractured Aquifer (Pre-monsoon)

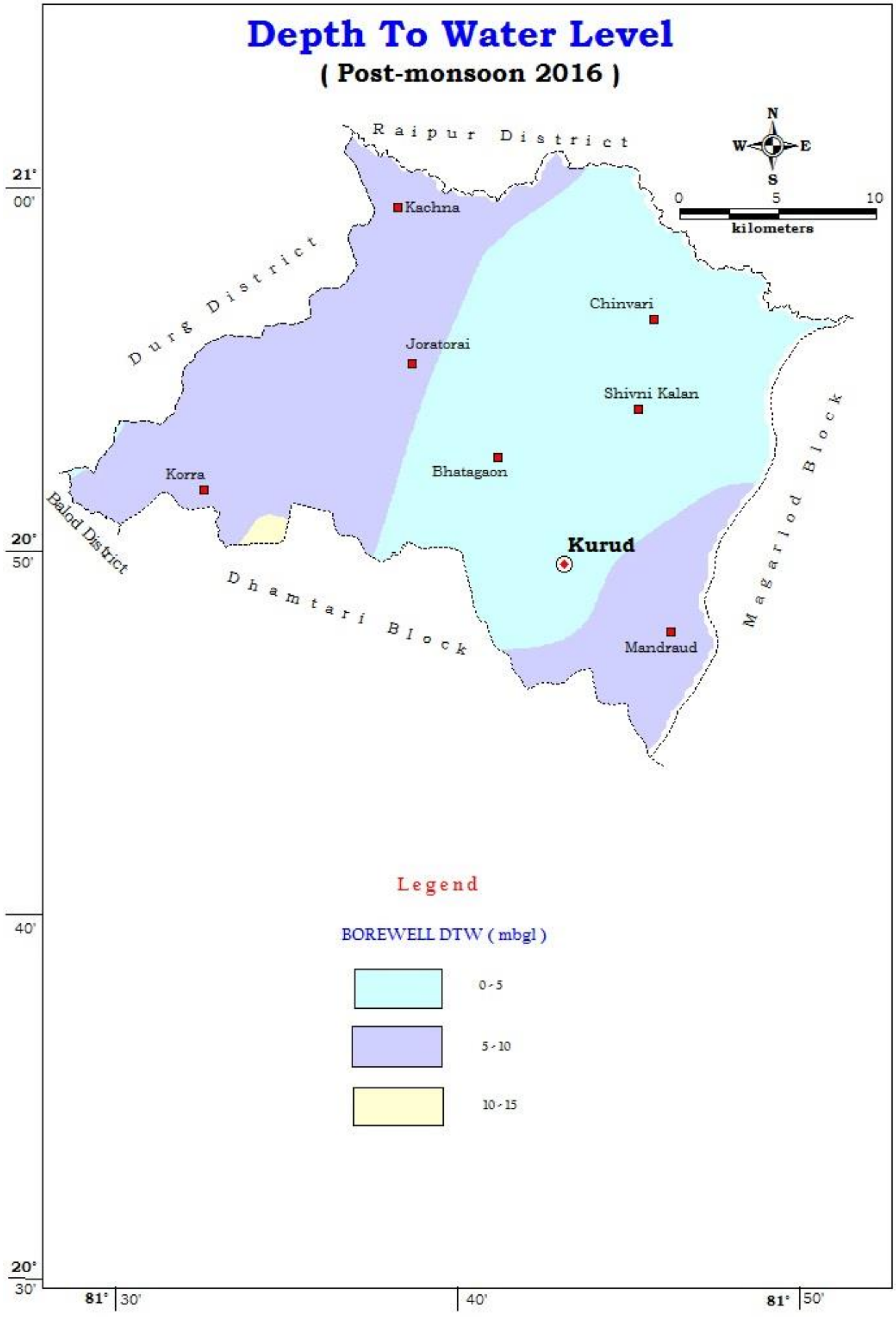

Fig -8: Depth to water level map Fractured Aquifer (Post-monsoon)

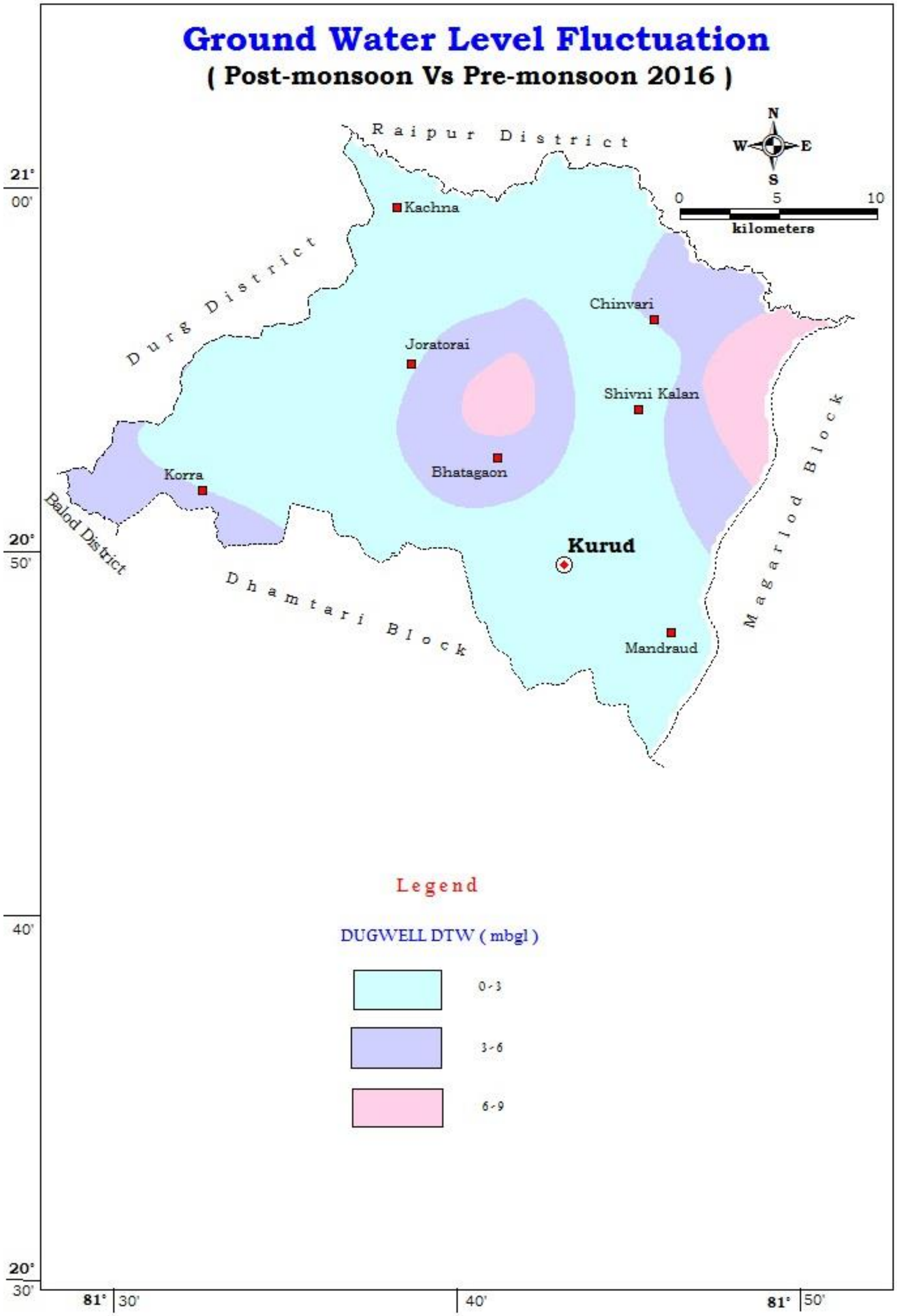

Fig -9: Water Level Fluctuation Map, Fractured Aquifer

2. Aquifer Disposition:

Number of Aquifers: There are two major aquifers viz. (i) Limestone (Charmuria Formation) & (ii) Shale (Gunderdehi Formation) both in phreatic and fractured condition serves as major aquifer system in Kurud block.

3-D aquifer disposition and basic characteristics of each aquifer: Geologically the district exhibits lithology of Proterozoic age having Charmuria limestone and Gunderdehi Shales.

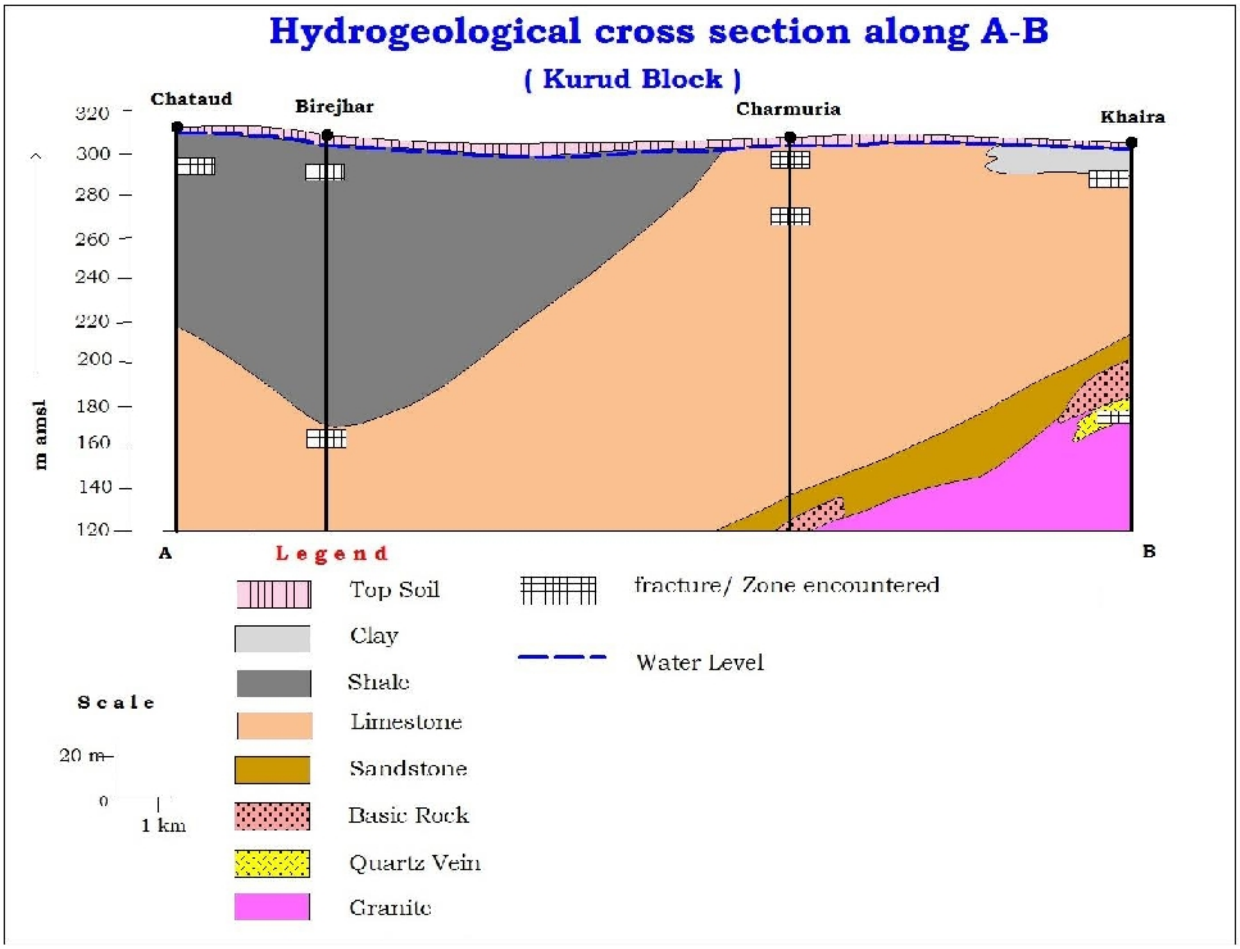

Fig-10: Hydrogeological Cross Section, Kurud Block

a. Charmuriya Formation: mainly comprises grey bedded limestone with minor phosphatic clay bands. The Charmuriya limestones with intercalated shales are good aquifers.
b. Gunderdehi Shales: Gunderdehi formation is primarily an argillaceous sequence consisting of a very thick succession of purple shales attaining the maximum thickness of about 250 m. They trend in E-W to NW – SE direction and with an almost horizontal disposition, but do show local dips towards North and NE with

very low angles. Association of thin band of siltstone of greenish and pale grayish colour are seen in the upper portion.

Aquifer wise characteristics:

(i). Charmuriya Formation mainly comprises grey bedded limestone with minor phosphatic clay bands. The Charmuriya limestones with intercalated shales are good aquifers. The average weathered thickness of Charmuriya formation is 19 m. Most of the potential aquifer are below 50m where an average of 02 sets of fracture may encounter. Although 01 set of fracture may encounter between 50 to 100m. Average transmissivity is 101 m^2per day with an average drawdown of 13.84m. The discharge in this formation ranges from negligible to 14 lps having an average discharge of 1.79 lps. Cumulative thickness of fracture in this formation is up to 0.41m. The development in these formation is by the way of tubewells and borewells.

(ii). Gunderdehi Formation is primarily an argillaceous sequence consisting of a very thick succession of purple shales attaining the maximum thickness of about 250 m. The average weathered thickness of Gunderdehi Formation is 12.32 m. Most of the potential aquifer are below 50m where an average of 02 sets of fracture may encounter. Although 01 set of fracture may encounter between 50 to 100m. Transmissivity ranges from 5.2 to 50.5 m^2per day with drawdown range of 20.74 to 42.51m. The discharge in this formation ranges from dry to 6 lps having an average discharge of 2.6 lps. Cumulative thickness of fracture in this formation is up to 0.26 m. The development in these formation is by the way of tubewells and borewells.

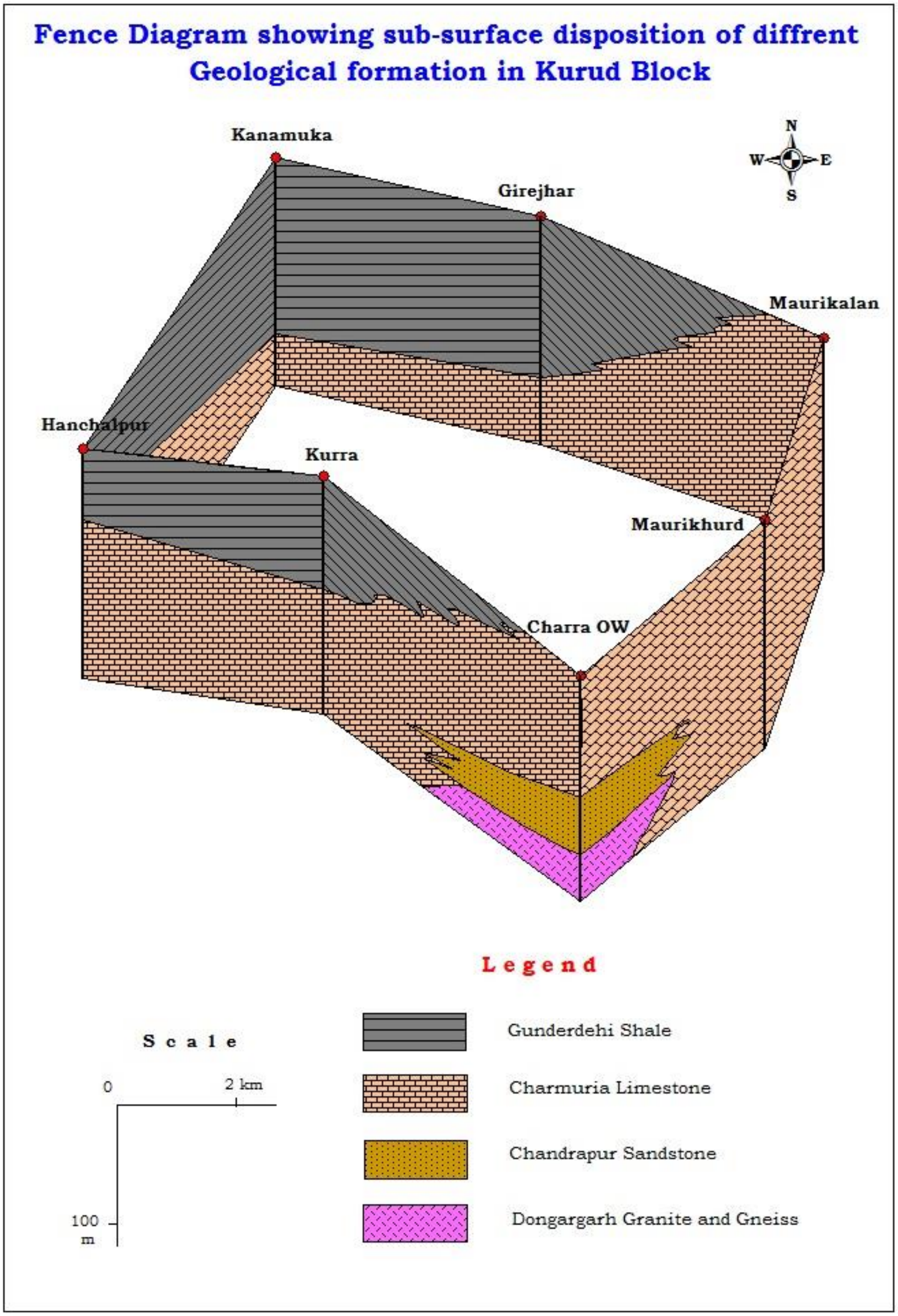

Fig-11: Fence diagram showing sub surface disposition, Kurud block

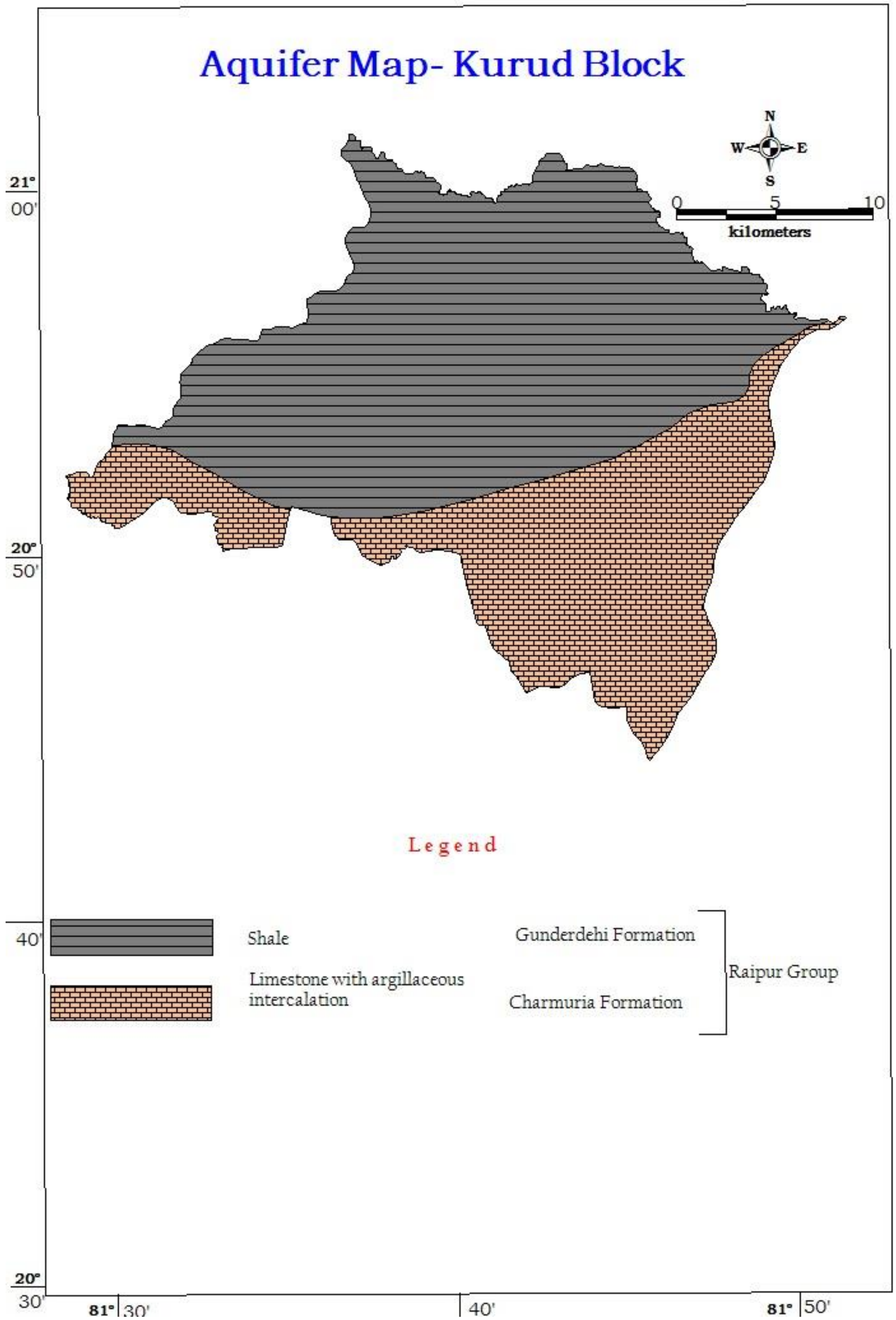

Fig-12: Aquifer Map of Kurud Block

Table 6: Distribution of Principal Aquifer Systems in Kurud Block

Block	Phreatic and fractured Charmuria Limestone	%	Phreatic and fractured Gunderdehi Shales	%	Total Area (sq.km)
Kurud	127	13	848	87	975

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 Kurud block is 16837.61 ham out of which the resource available with shale (Gunderdehi Formation) is 14639.63ham and with limestone (Charmuria Formation) area is 2197.98 ham. The dynamic resource of the block is 13678.84 ham out of which (Gunderdehi Formation) shale is 11900.59 ham and limestone (Charmuria Formation) area is 1778.25 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 Kurud 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)
Dhamtari	Kurud	13678.84	10206.90	509.01	10715.91	613.94	2858.00

Table-8: Categorization of assessment

District	Block	Stage of Ground water development (%)	Categorisation
Dhamtari	Kurud	78.34	Semi critical

Categorisation: The Kurud block falls in semi critical category. The stage of Ground water development is 78.34%. The Net Ground water availability is 13678.84 Ham. The Ground water draft for all uses is 10715.91 Ham.

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 except Fe concentration which is detected as 1.91 mg/l as detected in Kosmarra village. So there is need of installing Iron filter at places where iron concentration is higher than permissible limit. The EC value for phreatic aquifer varies from 446 to 1540 micro Siemens per cm at 25^{0}c.

4. Issues and Management Plan:

Aquifer wise space available for recharge and proposed interventions: The Volume of porous space available for recharge (m^3) in all the formations after taking consideration of Sp yield for respective formations and considering the void space depth i.e. the desirable thickness of unsaturated zone (not considering the top 3m of the average post monsoon water level) has not been available. Although the block comes under semi critical category but due to hydrogeological constraint it cannot be artificially recharged. So the resource enhancement can be achieved by reducing the ground water draft.

Issues: Stage of ground water development in Kurud Block is relatively high (78.34%) and hence categorises as semi critical. The reasons behind very high development of groundwater is as follows.

1) Around 34 % of the irrigation is contributed by groundwater which ultimately results excessive withdrawal of groundwater.
2) Inherent hydrogeological character of aquifer which have very low yield and transmissivity as discussed above in chapter 2. The fractures are also very localised.
3) In summer farmers are cultivating summer rice which require upto 1500 mm of irrigation water.

Management Plan:

1. As several studies clearly indicate that the summer rice requirement of irrigation water is very high i.e. 1500 mm, so the framers need to discourage the take the summer rice. Instead of taking summer rice the farmers should be encouraged to take less water consuming crop such as Maize/ Finger Millet (Ragi) which require only 500 mm of water which is one tenth of the irrigation water required by summer rice.
2. After replacing the 50 % paddy in summer season with Maize/ Ragi, groundwater draft will also be reduced in command area which will results in further lowering the groundwater development up to 60 %. (Table-11).
3. 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.

4. In command or non-command area wherever ground water has been used for field irrigation should be replaced immediately with micro irrigation methods such as sprinklers, drip irrigation etc.
5. There are other factors also need to be considered simultaneously with above points.
    a. 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.
    b. Need for the incentives, assured prices, better marketing for the farmers shifting their crop to less water consuming crops.
    c. Supports for the technology development for harvesting and disposal of by products in agriculture fields which will also increase the fertility of soil.
    d. More model crop specific to the area may be developed which consume less water.
    e. Animal grazing in summer is also a common problem so group or community fencing is required.
    f. Mass awareness may be carried out through training programmes and with the help of other media like print, electronics and social media.
6. For the discouragement of farmers taking summer rice the following steps may be taken into consideration.
    a. Mass awareness to farmers regarding the depleting of water level due to summer rice.
    b. If there is tubewell irrigation to paddy field, then no subsidy or no free electricity to those farmers. 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 strengthen for farmers cultivating summer rice.
    c. Even if the farmers using solar pump or other method for ground water irrigation to summer paddy fields then it should not be through field irrigation.

Table-11: 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	Available Resource	Improved Status of Development
		Paddy	Maize					
Kurud	19358	1.5	0.5	1	19358	4077.06	13678.84	60 %