

GEOMORPHOLOGY

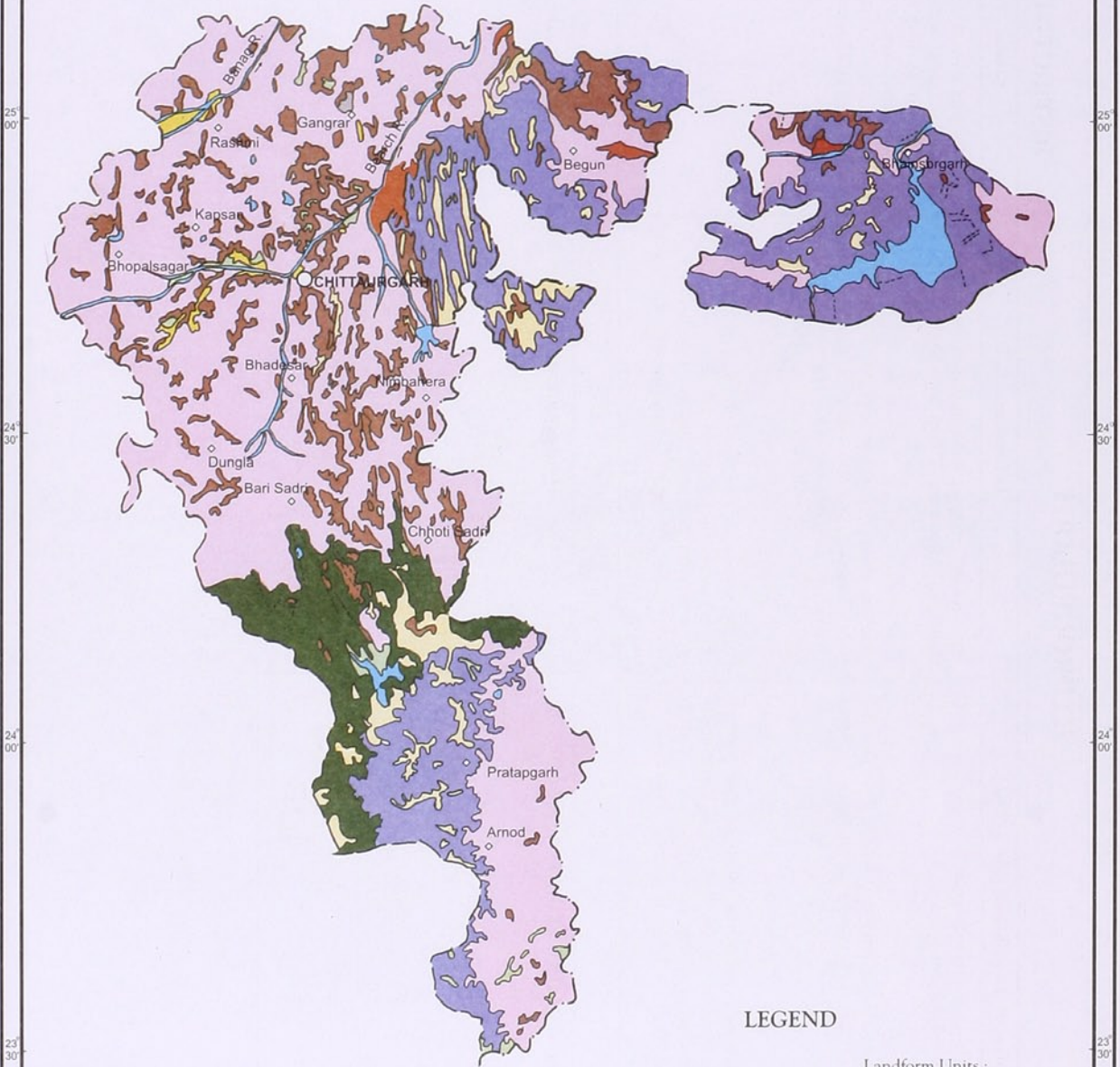
DISTRICT—CHITTAURGARH

Landform Units	Symbol	Lithology / Material / Description	Occurrence in district	Land use/Land cover
Fluvial Origin Alluvial Plain	AP	Mainly undulating land scape formed due to fluvial activity, consisting of gravels, sand, silt and clay. Terrain mainly undulating, produced by extensive deposition of alluvium by river system.	Along west of Banas river and Berach river.	Double crop, open scrub, fallow.
Valley Fill	VF	Formed by fluvial activity, usually at lower topographic locations, comprising of boulders, cobbles, pebbles gravels, sand, silt and clay. The unit has consolidated sediment deposits.	North of Jhakam Dam.	Marginal double crop, single crop (Rabi), river sand.
Ravine	RV	Small, narrow, deep, depression, smaller than gorges, larger than gulley, usually carved by running water.	East of Begun on river Chambal and river Berach near Motipura village.	Open scrub.
Denudational Origin Pediment	P	Broad, gently sloping rock flooring, erosional surface of low relief between hill and plain, comprised of varied lithology, criss crossed by fractures & faults.	Scattered in entire district main concentration along Chittaurgarh town.	Forest, mining, open scrub.
Burried Pediment	BP	Pediment covered essentially with relatively thicker alluvial, colluvial or weathered materials.	Cover almost entire district.	Marginal double crop, single crop (Kharif), fallow, open scrub.
Intermontane Valley	IV	Depression between mountains, generally broad & linear, filled with colluvial deposit.	Scattered in eastern part north of Pratappgarh.	Marginal double crop, single crop (Rabi / Kharif), fallow, open scrub.
Structural Origin Plateau	PT	Formed over varying lithology with extensive, flat, landscapes, bordered by escarpment on all sides. Essentially formed over horizontally layered rocky marked by extensive flat top and steep slopes. It may be criss crossed by lineament.	Eastern north and south west part.	Marginal double crop, single crop (Kharif), open scrub.
Dissected Plateau	DP	Plateau, criss-crossed by fractures forming deep valleys.	South west part around Pratappgarh.	Double crop, single crop (Kharif), open scrub.
Hill Structural Hill	SH	Linear to arcuate hills showing definite trend-lines with varying lithology associated with folding, faulting etc.	North of Gangrar town.	Forest, mining, open scrub.

CHITTAURGARH DISTRICT

GEOMORPHOLOGY

Scale 0 5 10 15 20 km.



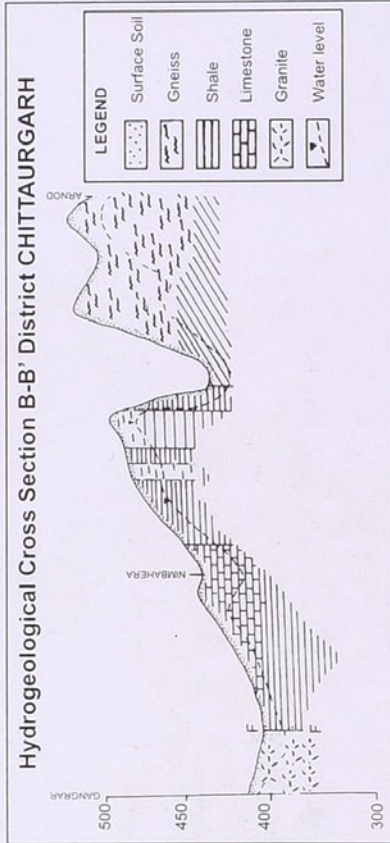
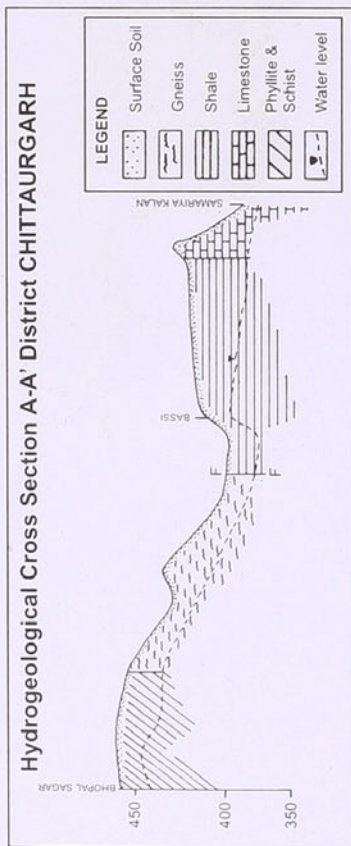
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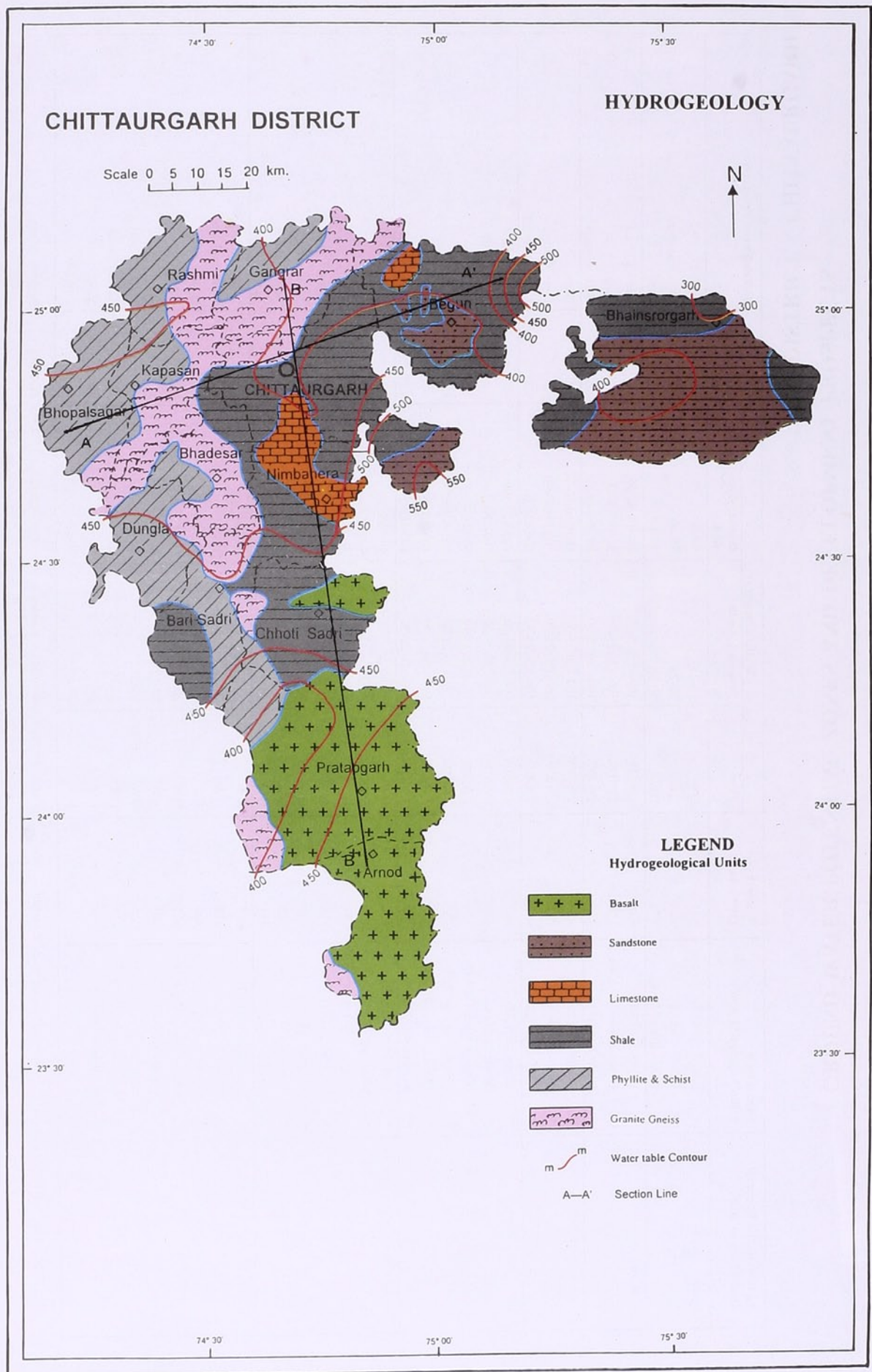
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|---------------------|--|------------------------------|
| Lineaments | - FAULTS/FRACTURE/JOINTS OF VARYING LENGTH AND WIDTH | Landform Units : |
| Water Bodies | - RIVER/POND/RESERVOIR | Fluvial Origin : |
| Hills | - STRUCTURAL/DENUDATIONAL/ LINEAR RIDGE | Alluvial Plain |
| | | Valley Fill |
| | | Ravine |
| | | Denudational Origin : |
| | | Pediment |
| | | Barred Pediment |
| | | Intermontane Valley |
| | | Structural Origin : |
| | | Plateau |
| | | Dissected Plateau |

HYDROGEOLOGY

DISTRICT—CHITTAURGARH

Hydrogeological units	Description of the unit/Geological section	Occurrence	Ground Water flow
Basalt (Upper Cretaceous to Palaeocene)	These are dark grey, olive green to green in colour, compact, vasicular, amygdaloidal and weathered.	The litho unit occupies southern part of the district in Pratagarh, Arnaud and Chhoti sadri blocks.	Ground water flow in southern part of the area comprising Arnaud and Pratagarh blocks has been inferred SE to NW. In other parts flow direction varies from SW to NE or W to E. Hydraulic gradient in major part of the area varies between 1.88 to 2.66 m/km.
Sandstone, limestone and shales (Vindhyan Super Group)	Vindhyan Super Group is represented by Bhandar, Rewa, Kaimur and Semri groups of rocks mainly comprising sandstone, limestone and shales.	Sandstone covers Begun, Bhainsrorgarh and Nimbahera blocks. Limestone occurs in some pockets in Nimbahera, Chittaurgarh and Begun blocks. Shales occupy area around Nimbahera, Chittaurgarh and major part of Begun block.	
Phyllite schist and Granite Gneiss (Pre Aravalli)	These are meta sediments having different grade of metamorphism. Phyllite and schist are soft and friable litho units. Granite gneiss varies in texture and mineralogical composition. It is fine to medium grained porphyritic rock having gneissic structures.	Phyllite and schist occur in north western peripheral area around, Rashmi, Kapasan and Bhopalsagar towns and in western area near Bhadesar, Dungla and Bari Sadri. Granite and gneiss covers area around Gangrar and west of Bhadesar.	



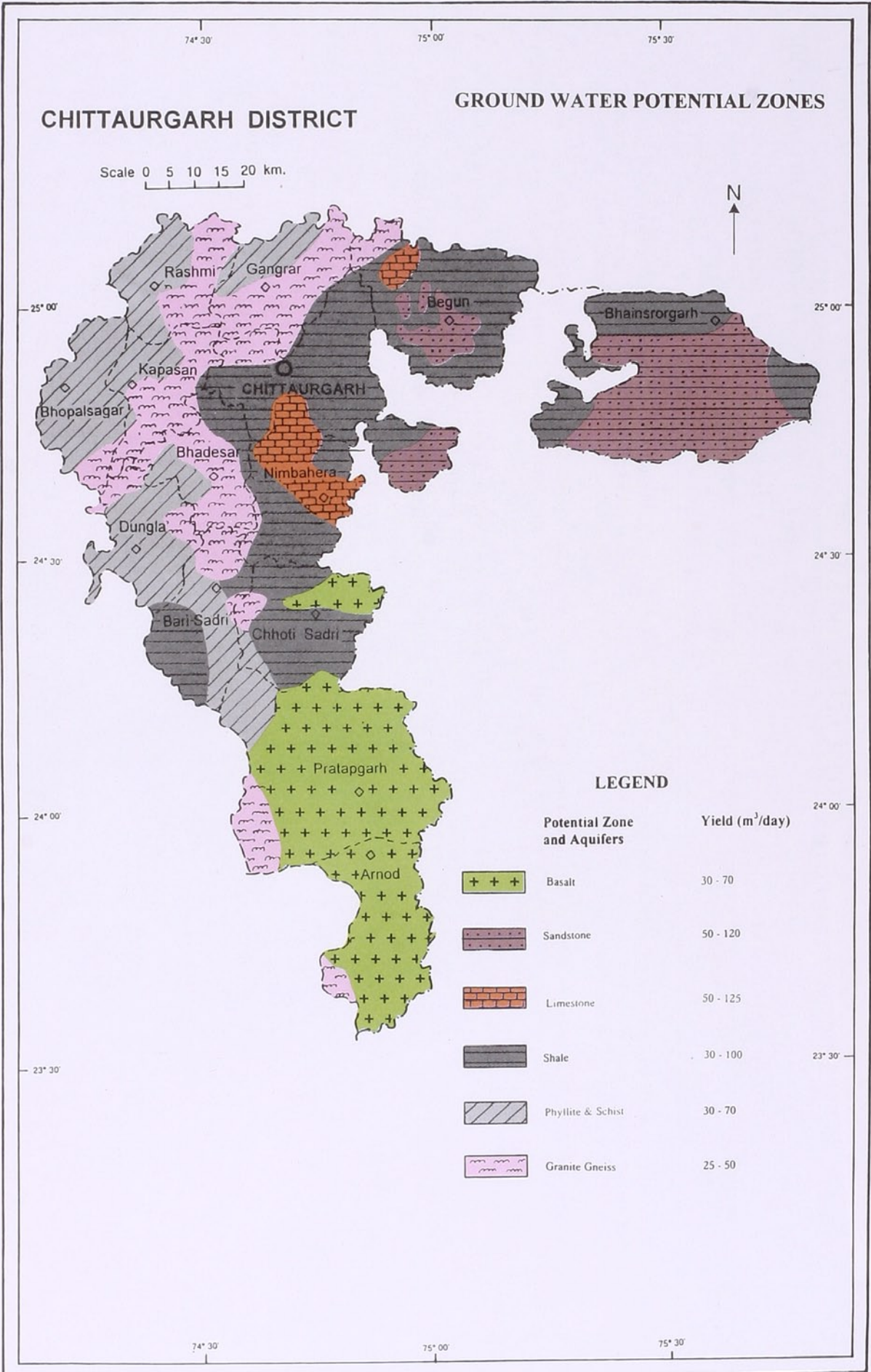


GROUND WATER POTENTIAL ZONES AND DEVELOPMENT PROSPECTS

DISTRICT - CHITTAURGARH

Aquifer in the Potential Zone (Area in Km ²)	Occurrence * Block (Area in Km ²)	Water Level (1997) in m.	Well Parameters		Discharge in m ³ /day	E.C. X10 ⁻⁴ siem/cm	Development Prospects
			Type	Proposed depth in m			
Basalt (1715.34)	* Arnod (606.13)	<15	DW	20-25	30-40	<2	Safe
	* Chhoti Sadri (135.15)	<20	DW	20-25	30-40	<2	Over exploited
	* Pratapgarh (974.06)	<20	DW	20-25	30-40	<2	Safe
Sandstone (697.16)	* Begun (153.80)	<15	TW/DW	100-120/25-30	80-100/40-55	<2	Semi Critical
	* Bhainsrorgarh (451.49)	<20	TW/DW	100-120/25-30	50-80/30-40	<2	Safe
	* Nimbahera (91.87)	<20	TW/DW	100-120/25-30	80-100/40-55	<2	Semi Critical
Limestone (467.09)	* Begun (86.53)	<25	TW/DW	100-120/25-30	100-150/60-70	<2	Safe
	* Chittaurgarh (154.31)	<15	TW/DW	100-120/25-30	100-150/60-70	<2	Semi Critical
	* Nimbahera (226.25)	<25	TW/DW	100-120/25-30	100-150/60-70	<2	Over exploited
Shale (1991.94)	* Begun (318.72)	<25	TW/DW	100-120/25-30	100-120/50-60	<2	Semi Critical
	* Bhadesar (144.53)	<20	TW/DW	100-120/25-30	100-120/50-60	<2	Overdrafted
	* Bhainsrorgarh (327.87)	<20	TW/DW	100-120/25-30	50-100/40-50	<2	Safe
Phyllite and Schist (1551.01)	* Chhoti Sadri (407.23)	<35	TW/DW	120-150/25-30	100-120/50-60	<2	Over exploited
	* Chittaurgarh (408.90)	<25	TW/DW	100-120/25-30	100-120/50-60	<2	Critical
	* Nimbahera (384.69)	<20	TW/DW	100-120/25-30	100-120/50-60	<2	Safe/Critical
Granite Gneiss (1787.53)	* Bari Sadri (136.49)	<20	DW	20-25	40-50	<2	Over exploited
	* Bhadesar (101.41)	<20	DW	20-25	40-50	<2	Safe
	* Bhopalsagar (382.12)	<25	DW	20-25	40-50	<4	Safe
Dungla (267.41)	* Dungla (267.41)	<15	DW	20-25	40-50	<2	Semi Critical
	* Gangrar (154.62)	<20	DW	20-25	40-50	<2	Safe
	* Kapasan (269.19)	<25	DW	20-25	40-50	<4	Semi Critical
Rashmi (239.77)	* Rashmi (239.77)	<25	DW	20-25	40-50	<4	Safe
	* Bari Sadri (291.89)	<15	DW	20-25	40-50	<2	Semi Critical/Safe
	* Begun (67.80)	<15	DW	20-25	40-50	<2	Over exploited
Bhadesar (246.59)	* Bhadesar (246.59)	<20	DW	25-30	40-50	<2	Semi Critical
	* Chittaurgarh (307.38)	<25	DW	20-25	40-50	<2	Semi Critical
	* Dungla (198.02)	<20	DW	20-25	40-50	<2	Semi Critical
Gangrar (252.73)	* Gangrar (252.73)	<25	DW	20-25	40-50	<2	Semi Critical
	* Kapasan (232.82)	<20	DW	20-25	40-50	<2	Semi Critical
	* Pratapgarh (60.30)	<10	DW	20-25	40-50	<2	Safe
Rashmi (197.80)	* Rashmi (197.80)	<25	DW	20-25	40-50	<4	Critical

TW - Tube wells DW - Dug wells Safe - <65% stage of development Semi Critical - 65-85% development Critical - 85-100% development Over exploited - >100% development



WATER LEVEL TRENDS

DISTRICT : CHITTAURGARH

DEPTH TO WATER LEVEL

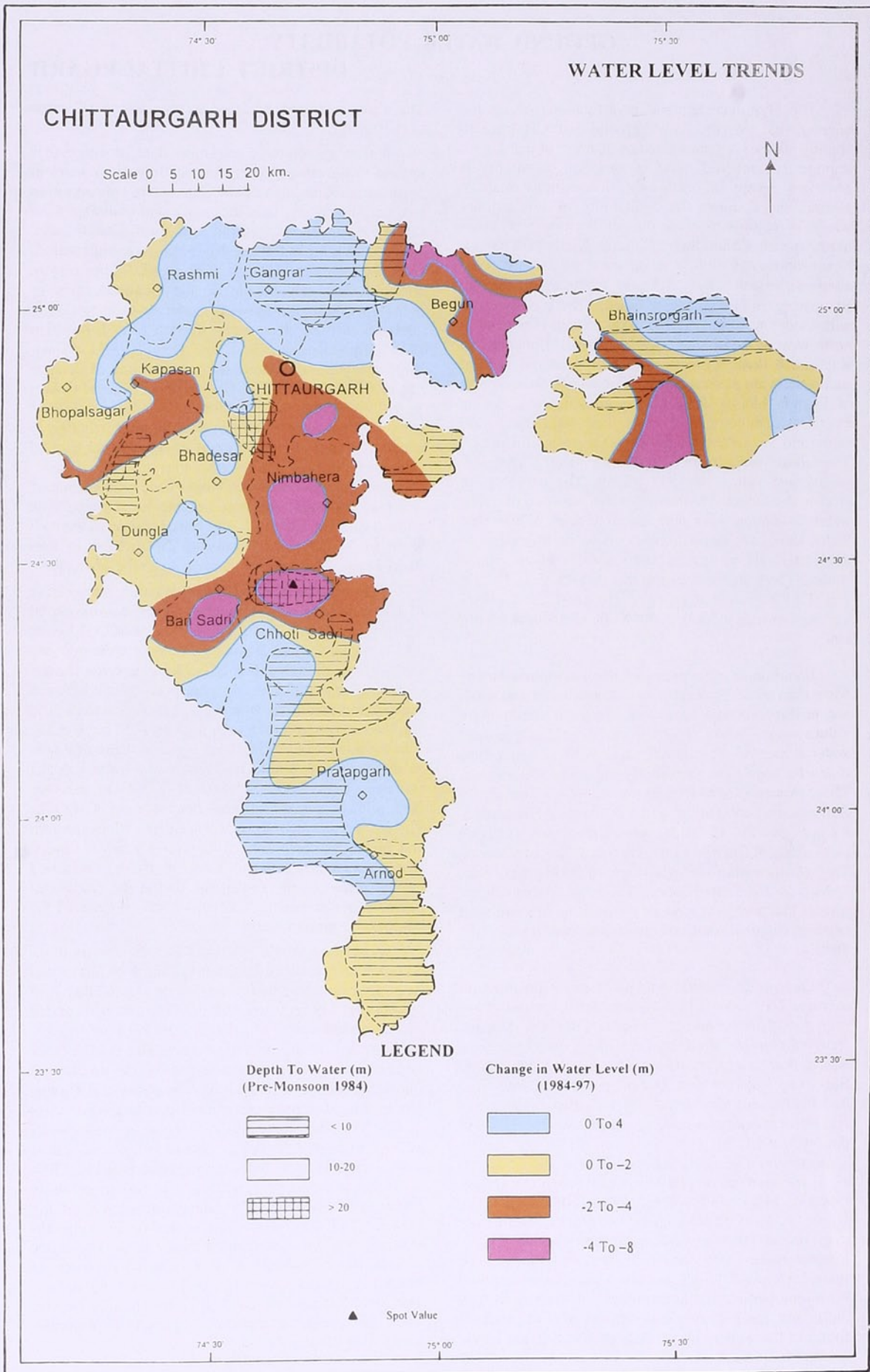
Range in m	Area
< 10	Southern part comprising Chhoti Sadri, Pratapgah and Arnod blocks and area around Gangrar and Bhainsrorgarh and southeast of Bhoapsagar have shallow water level less than 10 m.
10 to 20	Major part of the district lie in this depth to water level range.
> 20	Small area east of Bari Sadri and south of Chittaurgarh have deep water level more than 20 m.

CHANGE IN WATER LEVEL (1984-1997)

Range in m	Area
0 to 4	Area around Gangrar and western part of Chhoti Sadari, Pratapgah and Arnod blocks exhibit rise in water level. Small localised pockets scattered in central part also show rise in water level within the range.
0 to -2	Eastern part of Chhoti Sadari, Pratapgah and Arnod blocks, small pockets west of Chittaurgarh and part of Bhainsrorgarh block show marginal depletion in water level within the range.
-2 to -4	Part of Chittaurgarh, Nimbahera, Bari Sadri, Begun and Bhainsrorgarh blocks exhibit depletion in water level within the range.
-4 to -8	Part of Begun and Bhainsrorgarh blocks and small pockets in Chittaurgarh Nimbahera, Bari Sadri and Chhoti Sadri show steep depletion in water level within the range.

DETAILS OF THE SPOT

Spot code	Village (Block)	Change in water level in m (1984-97)
1.	Jaloda Jageer (Chhoti Sadri)	(-) 11.30



GROUND WATER POTABILITY

DISTRICT CHITTAURGARH

The Hydrogeochemical investigations of ground water reveal that the native ground water is fresh to slightly saline, a characteristics feature of hard rock regions. No specific trend in variation of salinity is observed except in north-west. The salinity map of ground water shows the availability of low salinity waters in major parts of the district. Fresh waters occurs in Pratapgarh, Chhoti Sadri, Gangrar, Nimbahera blocks. Few instances of slightly saline water are also observed along with fresh water of Arnod, Chittaurgarh, Begun, Bhainsrorgarh and Bhadesar blocks. The ground water with moderate salinity (2000-4000 $\mu\text{S}/\text{cm}$) is noticed in north-west of the district covering parts of Bhopalsagar, Kapasan & Rashmi blocks. However, scattered cases of such waters are observed in west of Bari Sadri and north of Dungla blocks. Rest of the ground water having electrical conductivity of more than 4000 $\mu\text{S}/\text{cm}$ are saline and encountered in Bhopalsagar and Rasmi blocks. The salinity varies from 350 $\mu\text{S}/\text{cm}$ to 6200 $\mu\text{S}/\text{cm}$ with an average values of 1342 $\mu\text{S}/\text{cm}$. The bar chart of electrical conductivity illustrates the presence of saline water in Bhopalsagar and Rasmi blocks. While Bari Sadri, Dungla & Kapasan blocks have slightly saline to moderately saline ground water besides saline ground waters. The water analyses reveal that 85.55%, 12.72% and 1.73% well waters have electrical conductivity varying between 0-2000, 2000-4000 and above 4000 $\mu\text{S}/\text{cm}$.

Bicarbonate is the principal anion in ground waters. More than 67.8% ground waters in north-east and south are mixbicarbonate type with electrical conductivity values usually below 1000 $\mu\text{S}/\text{cm}$. About 22.4% ground water occurs in transitional stage with mix-mix type character and fall in the slightly saline class of salinity. These waters exhibit the dominance of alkaline earths and are encountered in parts of Arnod, Kapasan & Rashmi blocks. Chloride type waters are available particularly of Bhainsrorgarh, Dungla & Kapasan blocks. The salinity values are mostly above 2000 $\mu\text{S}/\text{cm}$ with sodium as dominating cation. The considerable salinity reveals that waters in most of the aquifers in north-west exists in sluggish conditions in comparison to rest of the district.

Fluoride has not shown any close relationship with salinity. The sodium bicarbonate type of waters have been found to contain appreciable fluorides. The bar chart of fluoride illustrates that the ground water of Arnod, Bari Sadri, Chhoti Sadri, Pratapgarh, Chittaurgarh, Bhadesar, Kapasan and Rashmi blocks are free from fluoride hazard. Similarly the Begun, Bhainsrorgarh and Nimbhera blocks also have ground water fluorides less than 1.5 mg/L in 93%, 93% and 91% well waters respectively. The fluoride contents between 1.5 to 3.0 mg/L are observed in well waters of Bhopalsagar (50%), Gangrar (14%), and less frequently in Nimbahera (9%), Begun (7%) and Bhainsrorgarh (7%) blocks. The fluoride map reveals that ground waters of Dungla (34%), Bhainsrorgarh (15%) and Gangrar (7%) blocks have fluorides above 3.0 mg/L and may cause fluorosis if used for a long period. The average value of fluoride is 0.79 mg/L and the highest concentration of 7.41 mg/L is found in the well water of Tana of Bhopalsagar block.

The water is sodium bicarbonate type with RSC value of 8.10meq/L.

Nitrate the ultimate oxidation state of nitrogen is present in significant concentrations in ground water in north-west of the district. In general, its concentration has not shown any specific trend with salinity. Low salinity water at few places in Bari Sadri, Chhoti Sadri, Rashmi, Gangrar and Bhadesar blocks have high nitrates ranging between 100 to 200 mg/L. The nitrate contamination may be due to the localized cases of pollution. These waters with moderate salinity (EC > 2000 $\mu\text{S}/\text{cm}$) are observed at Rashmi (30%), Kapasan (30%), Bhopalsagar (37%), and Dungla (30%), block respectively. Besides above, the ground waters of Gangrar (22%), Nimbahera (18%), Bari Sadri (23%) and Chhoti Sadri (9%) blocks are unpotable due to the possibilities of cyanosis in infants and gaestro-intestinal irritation in adults. The bar chart of nitrate illustrates that ground water in Arnod, Pratapgarh, Chittaurgarh, Begun, Bhainsrorgarh and Bhadesar blocks have nitrate contents less than 100 mg/L and thus suitable for drinking. The highest value of 270 mg/L of nitrate is found in the well water of Nikoon with salinity of 2500 $\mu\text{S}/\text{cm}$ in Bari Sadri block. The water is having mix type character.

The ground water is very hard in nature irrespective of degree of its salinity. More than 52% waters have total hardness ranging between 300-600 mg CaCO_3/L while 13.57% waters yield hardness of more than 600 mg CaCO_3/L . Such high values of hardness restricts the use of ground waters for washing purposes while helps in maintaining soil texture during irrigation practices. The hardness varies from 115 to as high as 1410 mg CaCO_3/L in the saline (EC-5000 $\mu\text{S}/\text{cm}$) ground water of Akola in Bhainsrorgarh block. The values of hardness depict that the ground waters in most of the blocks are very hard, with an average of more than 400 mg CaCO_3/L . The ground waters of Pratapgarh, Begun, Bhainsrorgarh and Bhadesar blocks have comparatively low hardness. In north-west the hardness is associated with mineralised ground water. In the rest of the region the calcareous nature of water bearing formations have increased the hardness in ground water.

More than 80.9% ground water can be used for domestic utilization as the salinity along with nitrate and fluoride contents are within safe levels of potability with respect to ICMR recommendations. The area represented by the ground waters of suitable drinking water quality is illustrated in the potability map. The potability of ground water is seriously affected by the nitrate and fluoride contents in Bhopalsagar, Kapasan and Dungla blocks. Irrigation prospects with respect to ground water quality is quite promising. As per anonymous water rating criteria more than 72% and 13.2% ground waters with electrical conductivity upto 1500 & between 1500-2000 $\mu\text{S}/\text{cm}$ respectively are suitable for irrigation on loamy soils. About 12.72% waters with salinity ranging between 2000-4000 $\mu\text{S}/\text{cm}$ can be used for growing salt-tolerant crops on well drained loamy soils. The saline ground waters (salinity > 4000 $\mu\text{S}/\text{cm}$) in south of Bhopalsagar block may not be profitable for agriculture. The ground waters of the district are suitable for live stock consumption except those with very high nitrates along with salinity.

GROUND WATER POTABILITY

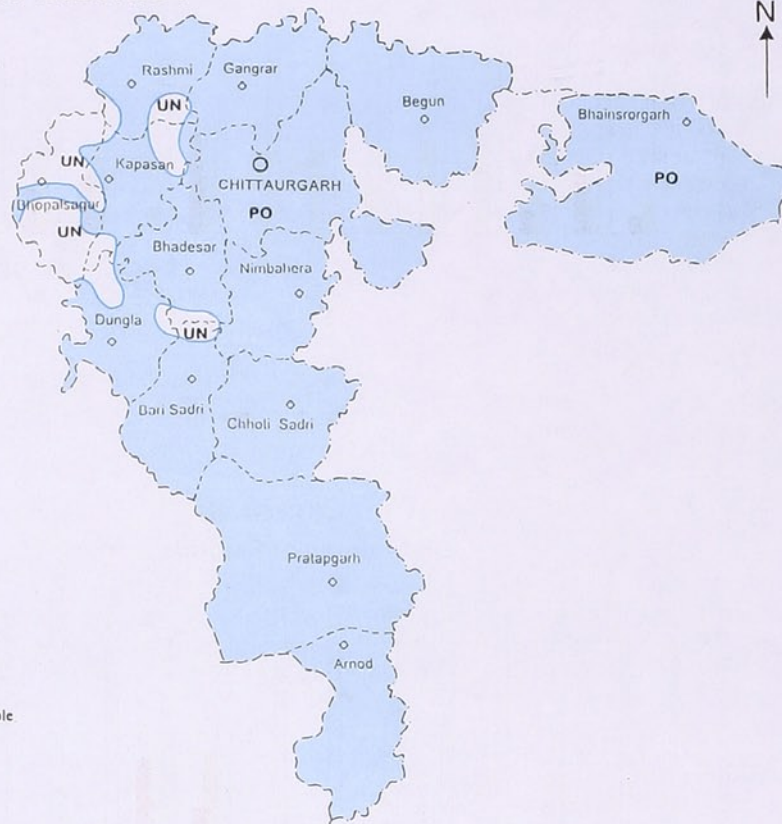
CHITTAURGARH DISTRICT

Scale 0 5 10 15 20 km.



LEGEND

	PO	Potable
	UN	Unpotable

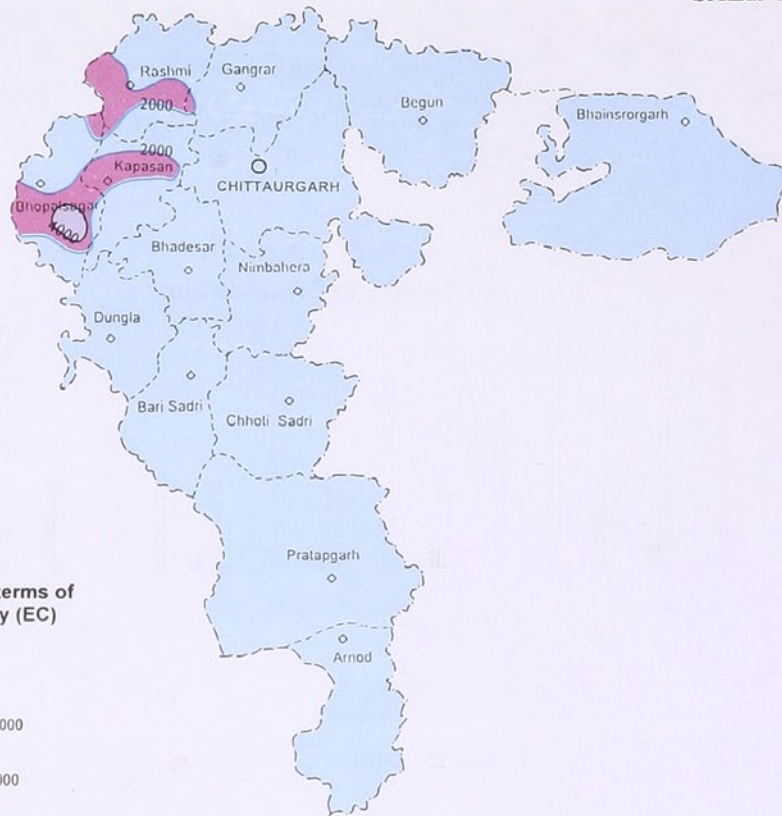


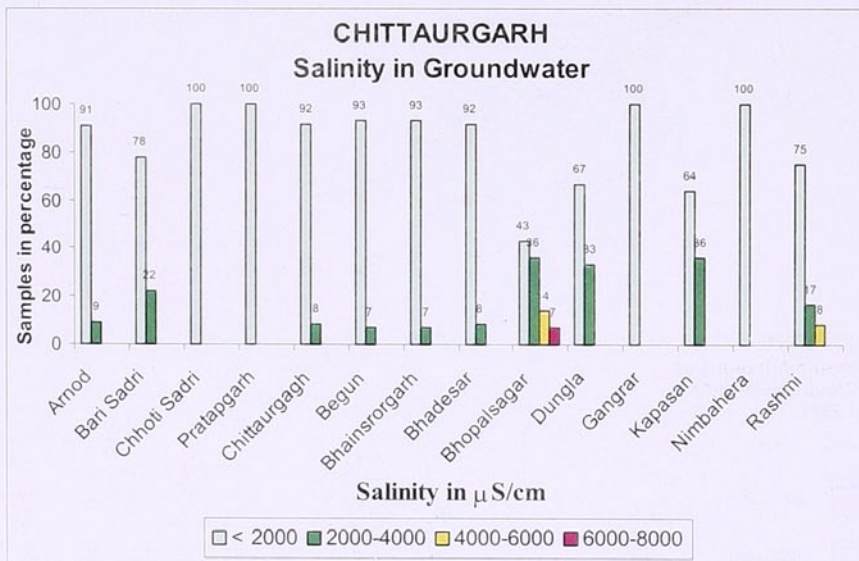
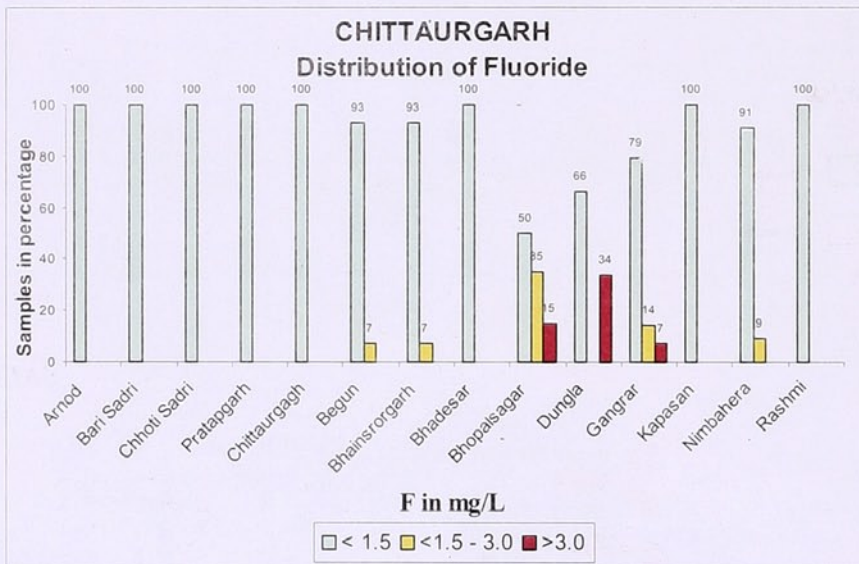
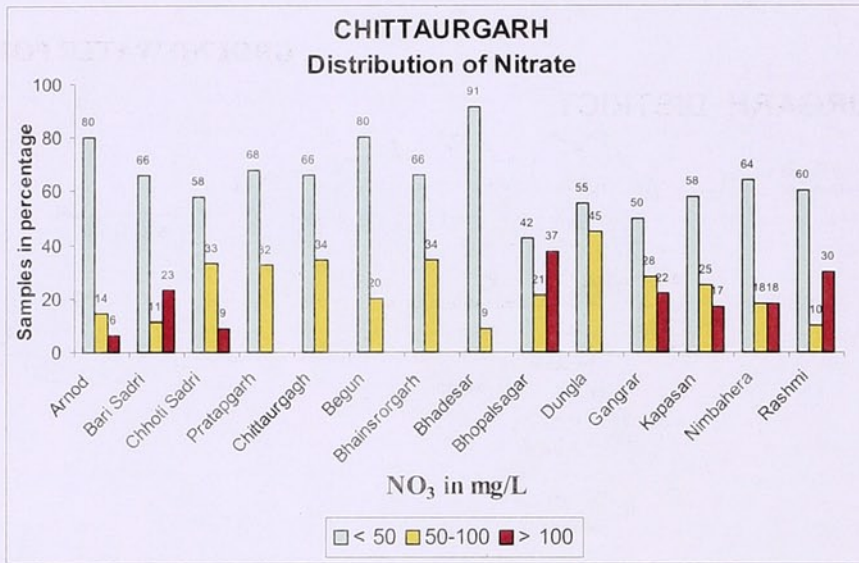
SALINITY

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Salinity measured in terms of Electrical Conductivity (EC) in $\mu\text{S}/\text{cm}$ at 25°C

	< 2000
	2000 - 4000
	4000 - 6000

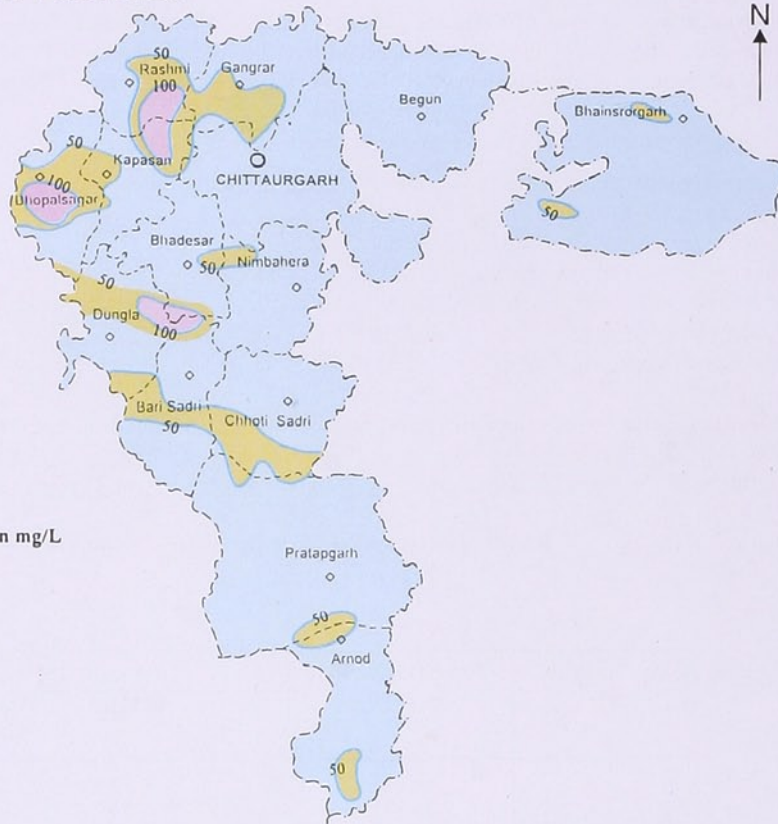




CHITTAURGARH DISTRICT

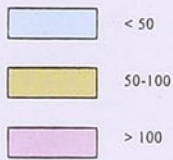
NITRATE DISTRIBUTION

Scale 0 5 10 15 20 km.

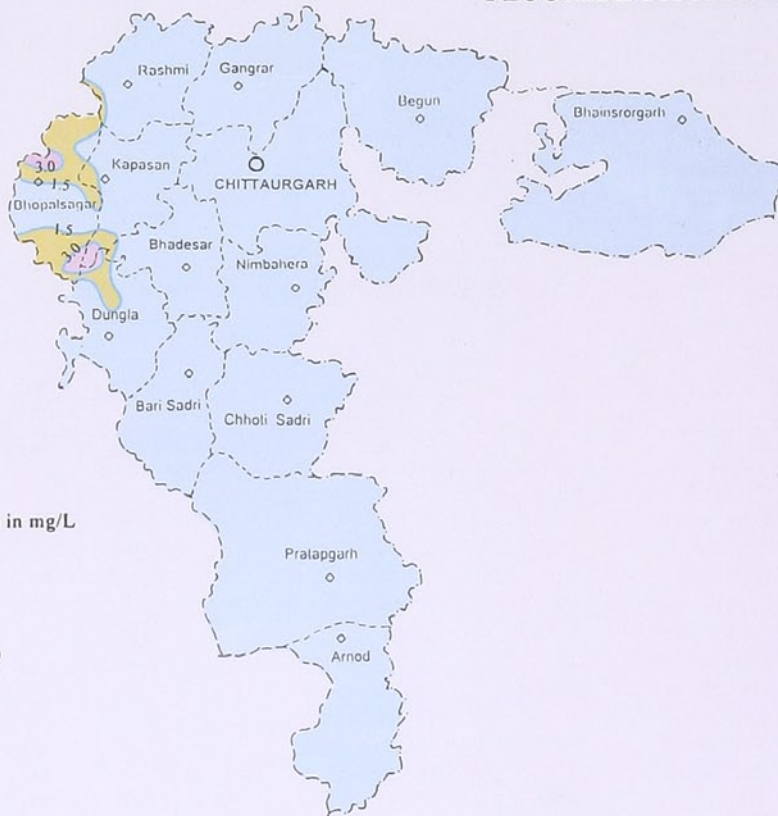


LEGEND

Nitrate Concentration in mg/L



FLUORIDE DISTRIBUTION



LEGEND

Fluoride Concentration in mg/L

