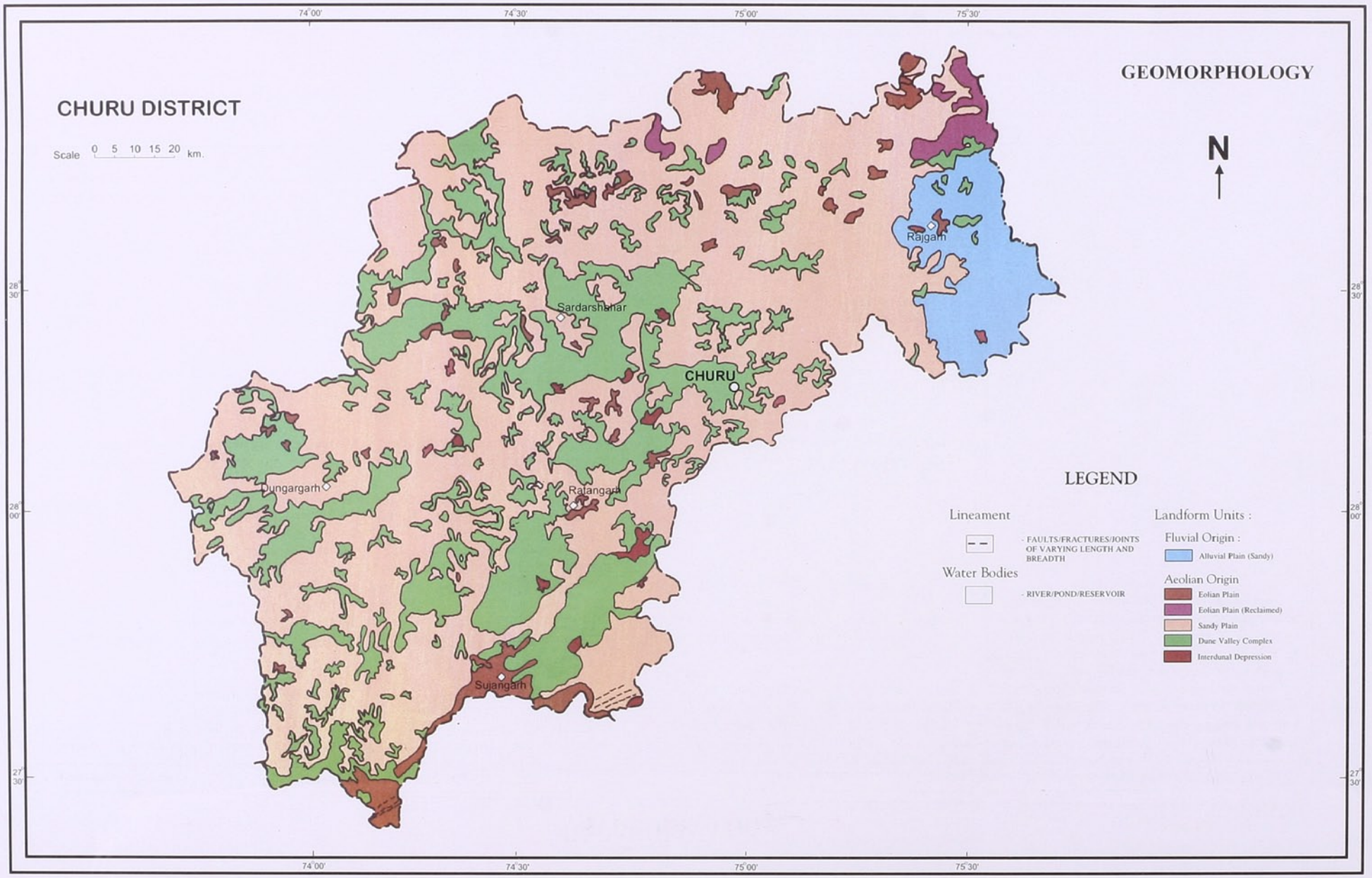
GEOMORPHOLOGY

DISTRICT—CHURU

Landform Units	Symbol	Lithology / Material / Description	Occurrence in district	Land use/Land cover
Fluvial Origin				
Alluvial Plain (Sandy)	AP (S)	Flat to gentle undulating plain formed due to fluvial activity, mainly consisting of gravels, sand, silt and clay unconsolidated material of varying lithology, predominantly sand along river.	In east and north eastern part, surounding Rajgarh town.	Marginal double crop, single crop (Kharif), fallow, open scrub.
Aeolian Origin				
Eolian Plain	EP	Formed by aeolian activity, with sand dunes of varying heights, size, slope. Long stretches of sand sheet. Gentle sloping flat to undulating plain, comprised of fine to medium grained sand and silt. Also scattered xerophatic vegetation.	Negligible, scattered in entire district.	Single crop (Kharif), open scrub, fallow.
Eolian Plain (Reclaimed)	EP (R)	Gently sloping with sheet of sand or sand dunes. Scattered xerophytic vegetation.	Negligible in north and northeast.	Marginal double crop, single crop (Rabi / Kharif), fallow.
Sandy Plain	SP	Formed of aeolian activity, wind blown sand with gentle sloping to undulating plain, comprising of coarse sand, fine sand, silt & clay.	Cover major portion, scattered in entire district.	Single crop (Kharif), open scrub, fallow, sand patches.
Dune Valley Complex	DVC	Clusters of dunes and interdunal spaces with undulating topography formed due to wind blown active sand, comprising of unconsolidated sand and silt.	Scattered in entire district.	Marginal Rabi crop, single crop (Kharif), fallow land, sand patches.
Interdunal Depression	ID	Slightly depressed area in between the dunal complex showing moisture and fine sediments.	Negligible in north of Jasrasar village.	Marginal Rabi crop, single crop (Kharif), sand patches fallow.

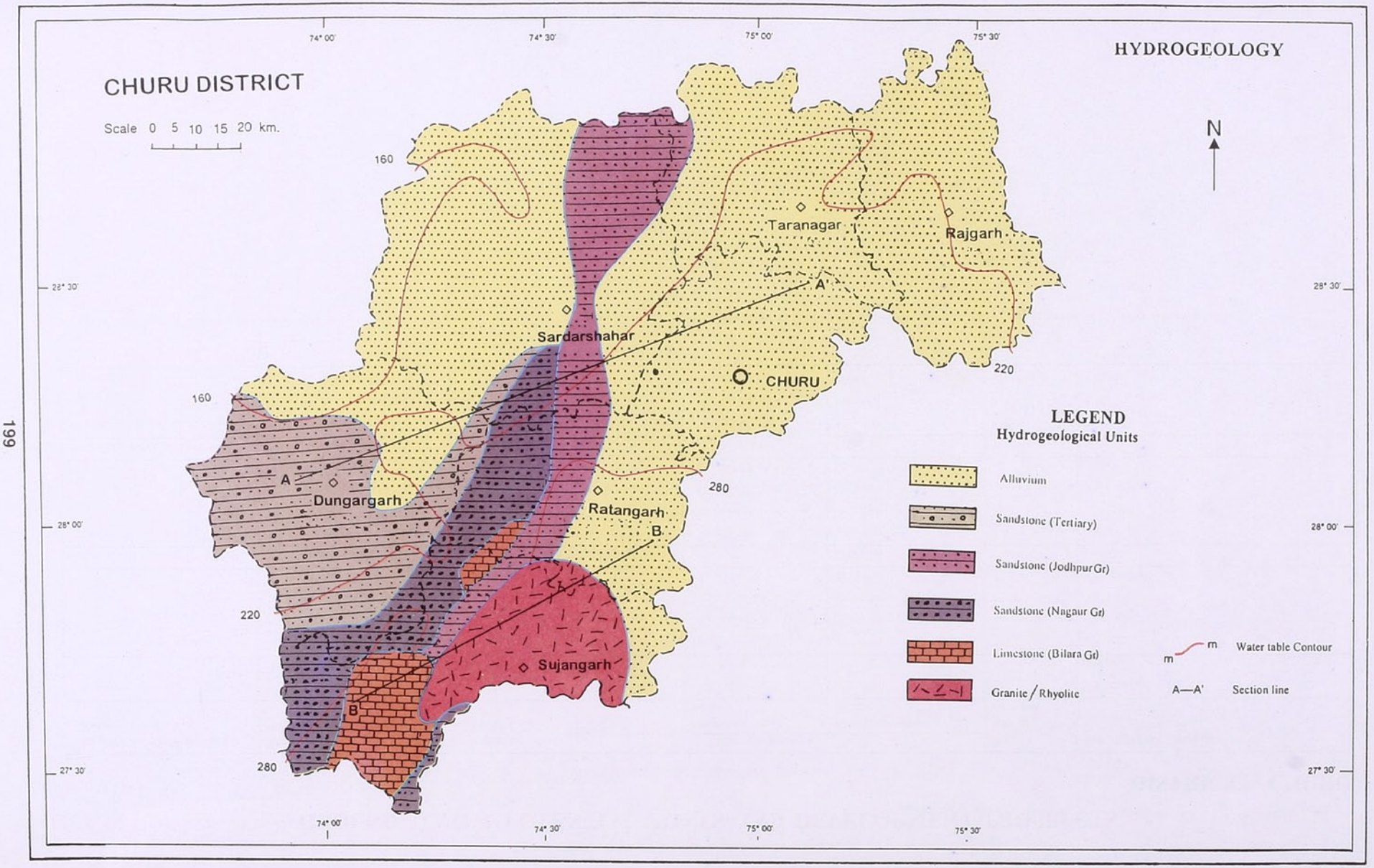

GEOMORPHOLOGY
CHURU DISTRICT
Scale 0 5 10 15 20 km.
N
74°00'
74°30'
75°00'
75°30'
28°30'
28°00'
27°30'
Rajgarh
Sardarshahar
CHURU
Dungargarh
Ratangarh
Sujangarh
LEGEND
Lineament
- FAULTS/FRACTURES/JOINTS OF VARYING LENGTH AND BREADTH
Water Bodies
- RIVER/POND/RESERVOIR
Landform Units :
Fluvial Origin :
Alluvial Plain (Sandy)
Aeolian Origin
Eolian Plain
Eolian Plain (Reclaimed)
Sandy Plain
Dune Valley Complex
Interdunal Depression

HYDROGEOLOGY

DISTRICT—CHURU

Hydrogeological units	Description of the unit/Geological section	Occurrence	Ground Water flow
Alluvium (Quaternary)	It comprises fine to coarse sand, kankar and clays interspersed gravel beds. Thickness of the litho unit is more in western part where it overlies Tertiary formations. In area north of Dungargarh older alluvium has thickness upto 100 m.	The litho unit occupies major part of the district. South western and southern part and localised pockets around Sujangarh are however exception, where area is occupied by other rock units. Alluvium cover nearby 50% area of the potential zone.	The general direction of ground water flow has been inferred from water table contours as south east to north west. Tectonic features and barrier boundaries has often modified flow direction. In area south of Rajgarh and Dungargarh ground water flow has been noticed south west to north east and west to east respectively. Hydraulic gradient is more in south western part which reveals low permeability aquifers in the region.
Tertiary sandstone (Eocene)	It is loosely consolidated, coarse to gritty sandstone, intercalated with shales, claystones and gravel beds and overlies Nagaur sandstone. The litho unit has maximum thickness southwest of Dungargarh and gradually reduces eastward. Cross section reveals major longitudinal fault passing through central part and dividing entire area into two distinct stratigraphic domains. Alluvium overlies precambrian in area east of the fault, while comprises thick Paleozoic, Tertiary and quarternary sediments in the western part. Parallel cross faults have also been inferred in different parts.	The litho unit is confined to Dungargarh block. Tertiary sandstone occupies nearly 17% potential area.	
Nagaur Sandstone (Marwar Super Group)	It is deep brown to red colour, fine to medium grained sandstone interclated with shales and evaporite sequences.	It covers extensive area in Dungargarh and Sujangarh blocks and spreads in the peripheral part of adjoining Ratangarh and Sardarshahar blocks.	
Bilara Limestone (Marwar Super Group)	It is grey to buff coloured hard and compact dolomitic limestone interbedded with shale and cherty bands. At places, limestone is cavernous.	It occurs in Sujangarh block where covers southern peripheral area. Bilara limestone share nearly 8% area to potential zone.	
Jodhpur Sandstone (Marwar Super Group)	It is generally of red, brown and pink colour, fine to coarse grained gritty sandstone. This litho unit is hard and compact and at places intercalated with shales.	It occurs as narrow elongated band trending north south, but north of Sardarshahar width suddenly increases.	
Granite Rhyolite (Post Delhi Intrusives) & Phyllite, schist and Quartzite (Delhi Super Group)	Rhyolite is generally massive, fine grained with wide spaced open joints and fractures. Granite is dark grey in colour, coarse grained and at places have joints. Phyllite and schists are green to dark grey colour and well foliated and jointed.	All litho units together occupy small area in southern part of Sujangarh block and due to compact nature of this units these have not been included in potential area.	

For cross section(s) please see page no. 546

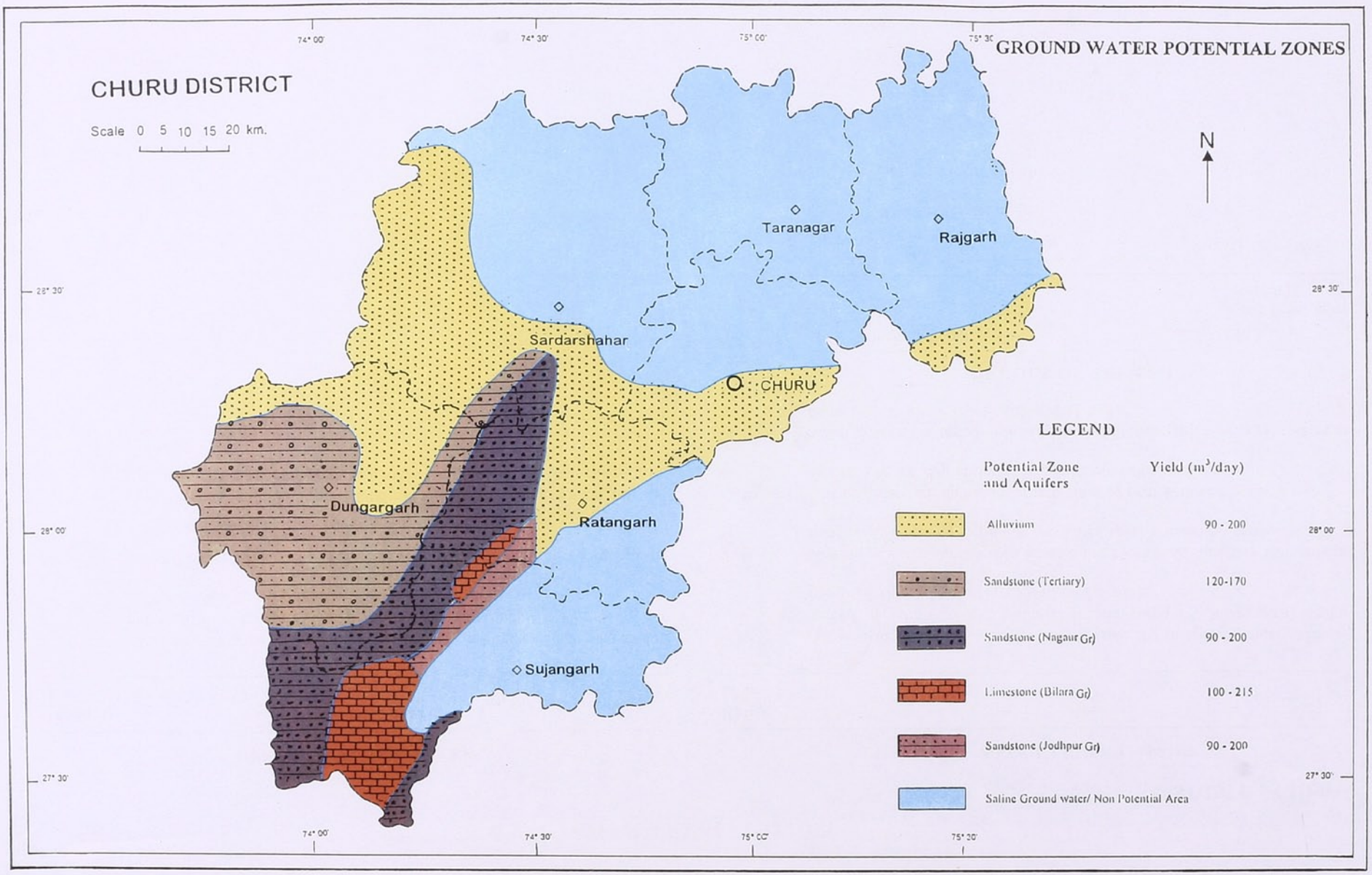

HYDROGEOLOGY
CHURU DISTRICT
Scale 0 5 10 15 20 km.
N
74° 00'
74° 30'
75° 00'
75° 30'
28° 30'
28° 00'
27° 30'
160
220
280
Taranagar
Rajgarh
Sardarshahar
CHURU
Dungargarh
Ratangarh
Sujangarh
A
A'
B
B
LEGEND
Hydrogeological Units
Alluvium
Sandstone (Tertiary)
Sandstone (Jodhpur Gr)
Sandstone (Nagaur Gr)
Limestone (Bilara Gr)
Granite / Rhyolite
m
m
Water table Contour
A—A'
Section line

GROUND WATER POTENTIAL ZONES AND DEVELOPMENT PROSPECTS

DISTRICT - CHURU

Aquifer in the Potential Zone (Area in Km²)	Occurrence * Block (Area in Km²)	Water Level (1997) in m.	Well Parameters			E.C. X10³µ siem/cm	Development Prospects
			Type	Proposed depth in m	Discharge in m³/day		
Younger Alluvium (1920.23)	* Sardarshahar (1178.70)	50-75	TW/DCB	150-250/80-100	110-200	<6	Safe/critical
	* Dungargarh (741.63)	25-85	TW/DCB	150-300/80-100	90-150	<6	Safe
Older Alluvium (1361.21)	* Churu (446.26)	30-40	TW/DCB	100-110/50-75	100-175	<6	Critical
	* Rajgarh (324.25)	35-50	TW/DCB	100-120/60-70	100-200	<6	Critical
	* Ratangarh (462.31)	35-45	TW/DCB	100-125/60-80	100-180	<6	Safe
	* Sardarshahar (128.39)	35-45	TW	100-125	80-200	<2,2-4	Critical/Safe
Tertiary Sandstone (1049.84)	* Dungargarh (1049.84)	60-120	TW/DCB	150-250/80-120	100-170	<6	Safe
Nagaur Sandstone (1267.31)	* Ratangarh (186.21)	70-80	TW/DCB	150-175/90-110	180-200	2-4	Safe
	* Sardarshahar (101.89)	50-90	TW/DCB	150-200/60-110	100-180	<4	Critical
	* Dungargarh (532.95)	45-90	TW/DCB	150-275/80-120	70-100	<6	Safe
	* Sujangarh (446.26)	25-80	TW/DCB	150-200/35-95	90-100	<6	Safe
Bilara Limestone (487.99)	* Sujangarh (487.99)	60-75	TW/DCB	150-200/50-90	100-215	<6	Safe
Jodhpur Sandstone (353.66)	* Ratangarh (158.59)	50-80	TW/DCB	150-175/90-110	120-200	2-4	Safe
	* Sardarshaharr (111.60)	45-70	TW/DCB	150-200/60-90	100-160	2-4	Safe
	* Sujangarh (83.47)	40-70	TW/DCB	150-200/50-90	90-110	<6	Critical

TW - Tube wells **DCB** - Dug cum borewells **Safe** - <65% stage of development **Semi Critical** - 65-85% development **Critical** - 85-100% development **Over exploited** - >100% development


GROUND WATER POTENTIAL ZONES
CHURU DISTRICT
Scale 0 5 10 15 20 km.
N
74° 00'
74° 30'
75° 00'
75° 30'
28° 30'
28° 00'
27° 30'
Taranagar
Rajgarh
Sardarshahar
CHURU
Dungargarh
Ratangarh
Sujangarh
LEGEND
Potential Zone and Aquifers
Yield (m³/day)
Alluvium
90 - 200
Sandstone (Tertiary)
120-170
Sandstone (Nagaur Gr)
90 - 200
Limestone (Bilara Gr)
100 - 215
Sandstone (Jodhpur Gr)
90 - 200
Saline Ground water/ Non Potential Area

WATER LEVEL TRENDS

DISTRICT : CHURU

DEPTH TO WATER LEVEL

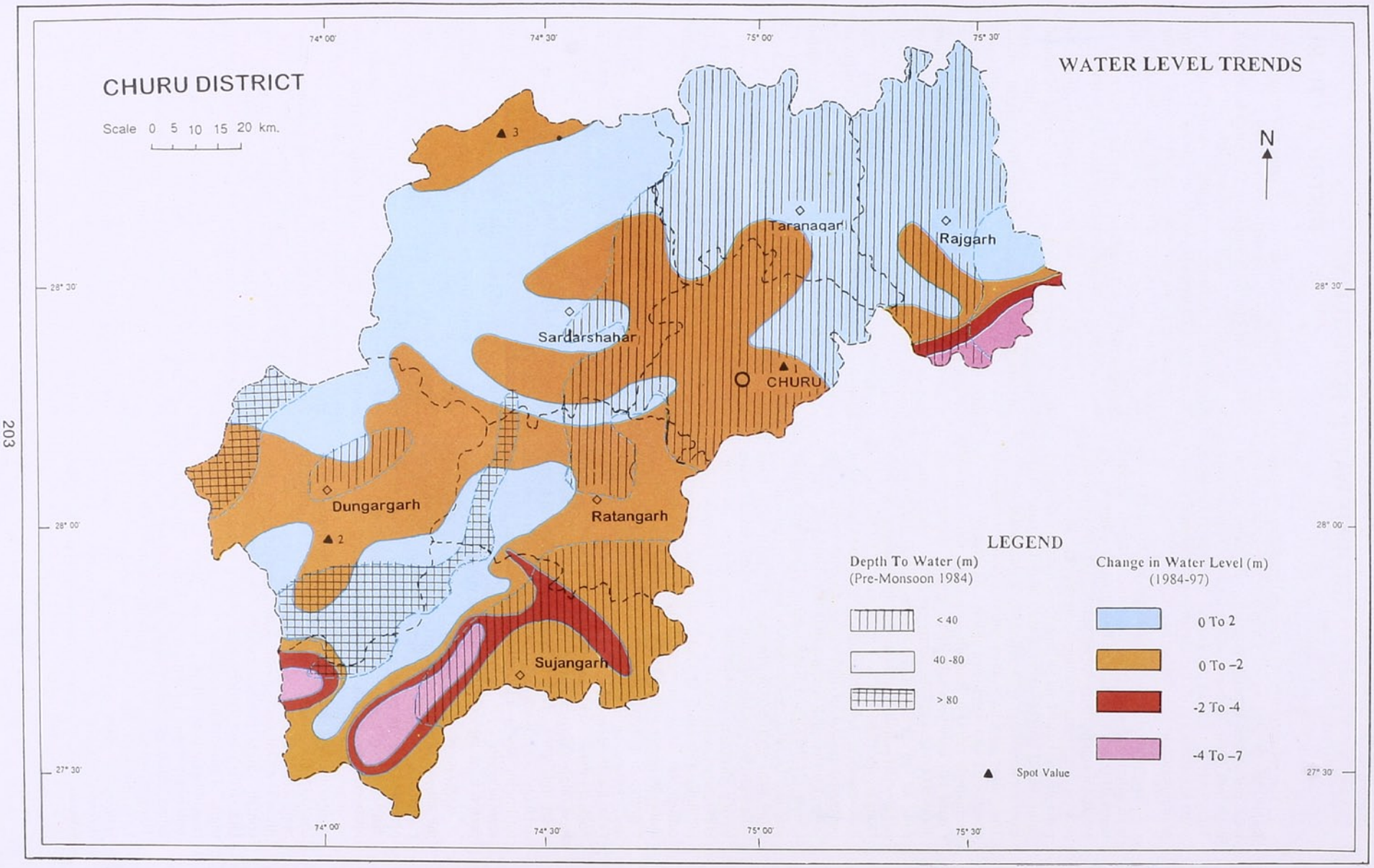
Range in m	Area
< 40	Taranagar, Sujangarh, Rajgarh and Sardarshahar blocks categorised as non potential area due to saline ground water and thick clay horizons has shallow water level less than 40 m.
40 to 80	Ground water potential area generally has depth to water level within the range.
> 80	Part of Dungarpur and peripheral region of adjoining Sujangarh and Ratangarh blocks have deep water level ranging more than 80 m.

CHANGE IN WATER LEVEL (1984-1997)

Range in m	Area
0 to 2	Area north of Sardarshahar extending upto the district boundary mainly spread in saline ground water zone and south of Dungargarh exhibit marginal rise in water level within the range.
0 to -2	Ground water potential area around the block head quarters in southern part hsow marginal depletion in water level within the range.
-2 to -4	Part of Sujangarh and Dungargarh situated near southern boundary of the district exhibit depletion in water level within the range.
-4 to -7	Small pockets localised in Sujangarh and Dungargarh blocks exhibit 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.	Lakhau (Churu)	(-) 6.66
2.	Salasar (Dungargarh)	(-) 7.93
3.	Raipura (Sardarshahar)	(-) 6.43


CHURU DISTRICT
Scale 0 5 10 15 20 km.
WATER LEVEL TRENDS
N
74° 00'
74° 30'
75° 00'
75° 30'
28° 30'
28° 00'
27° 30'
Taranagar
Rajgarh
Sardarshahar
CHURU
Dungargarh
Ratangarh
Sujangarh
3
2
1
LEGEND
Depth To Water (m)
(Pre-Monsoon 1984)
< 40
40 -80
> 80
Change in Water Level (m)
(1984-97)
0 To 2
0 To –2
-2 To -4
-4 To –7
Spot Value

GROUND WATER POTABILITY

DISTRICT CHURU

The district lies in the arid zone of western Rajasthan. In absence of surface water resources the local population depends primarily on ground water to meet out their drinking and irrigation requirements. Therefore, the quality of ground water is assuming a great importance with the rise in population and growth of industries in the district.

The ground water is characterised by medium to high salinity as seen from the salinity map of ground water. Fresh to slightly saline ground water having electrical conductivity values below 2000 µS/cm occurs in west, i.e., parts of Dungargarh blocks. The western parts of Sardarshahar, Sujangarh, Ratangarh alongwith some small patches near Churu and Rajgarh blocks have ground water with salinity less than 4000 µS/cm. The saline ground waters are widely distributed in north, east and south-east. Thus, the ground water is exclusively saline in Rajgarh, Taranagar, Ratangarh and Churu blocks where salinity of ground water exceeds 8000-10000 µS/cm. The salinity of ground water ranges from as low as 850 to as high as 25000 µS/cm. The bar chart of salinity indicates that the ground water from Dungargarh (93.10%) and Ratangarh (72.72%) blocks have more or less low salinity (EC<4000 µS/cm) as compared to rest of the blocks. On the contrary, the ground water of Rajgarh (38.09%), Taranagar (60%), Churu (21.05%) and Sardarshahar (15%) are salinity infested, i.e., electrical conductivity of ground water are more than 8000 µS/cm. In general, Churu district has saline (20.9%) to highly saline (17.15%) ground water having electrical conductivity ranging between 5000-8000 and more than 8000 µS/cm showing the availability of limited potable ground water. The predominant cation and anion in ground waters are sodium and chloride respectively. More than 56% waters are of sodium-chloride type and are distributed throughout the district covering north east, central and south-east part. Few localised patches are also found in west. The analysis data reveals that sodium-chloride type waters have high electrical conductivity and usually exist in discharge zone. The influence of aridity and base exchange phenomenon taking place between the infiltrating water and information material is clearly seen in north, east and south-east of the district by the presence of highly saline ground waters.

Nitrate the ultimate oxidation state of nitrogen is the source of pollution in ground water. Out of many contributing factors of nitrate contamination, it is observed that the main cause of nitrate hazard in the district is the legume crops. The legume crop takes nitrogen from the atmosphere and fixed it in the soil as nitrate. The nitrate thus formed are often more than plants need as such surplus nitrate is available for leaching. The ground water is characterised by unusually high concentration of nitrate. The map of nitrate illustrates that low salinity waters particularly in west contain high nitrates except few patches around Dungargarh and Sardarshahar where it is less than 100 mg/L. Thus nitrate concentration does not have any resemblance with salinity. At many places high salinity waters are found to contain low nitrate while slightly saline waters are characterised with high nitrate contents. The concentration of nitrate ranges from 6 to 995 mg/L in the well water of Sarothia in Sujangarh with salinity of 4600 µS/cm. The bar chart shows the different ranges of nitrate in ground waters. Its concentration is present in hazardous levels. More than 79% ground water in the district have nitrate contents above 100mg/L, with an average value of 270mg/L. The average nitrate concentration in various blocks is 294mg/L in Churu, 259mg/L in Dungargarh, 199mg/L in Rajgarh, 285 mg/L in Ratangarh, 247mg/L in Sardarshahar, 327mg/L in Sujangarh and 185mg/L in Taranagar. The trend is clearly seen from the bar chart which reveal the presence of very high nitrate concentration in ground water of all the blocks. Only 31.25%, 28.95% & 50% ground water from Rajgarh, Sardarshahar and Taranagar blocks have nitrates less than 100 mg/L. Most of these waters are saline.

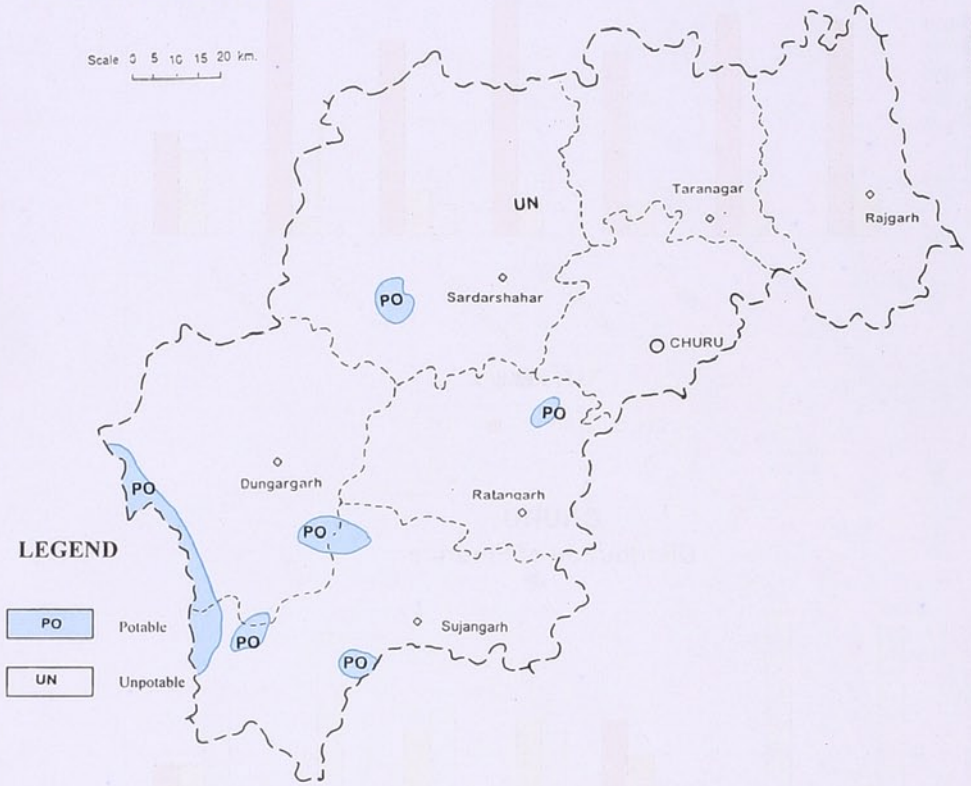
Fluoride is regarded as an essential constituent of drinking water with regard to prevention of dental carries in children and on the same time large concentration may cause chronic fluorosis in adults. The fluoride map indicates that high fluorides are associated with saline waters in east and south-east. It is seen from bar chart that fluoride contents in 81.25%, 82.76% & 78.12% well waters of Churu, Dungargarh and Sujangarh ranges between 0 to 1.5 mg/L. The fluoride concentration above 1.5 mg/L are noticed in well waters of Rajgarh (75%), Ratangarh (57.89%), Sardarshahar (55%) and Taranagar (100%) blocks. The highest concentration is 11.6 mg/L in the well water of Sobhasar with salinity of 4600 µS/cm. Regular intake of water of high fluoride may cause endemic cumulative fluorosis in children and adults. No relationship of fluoride with alkalinity or salinity of ground water is observed. The ground water is free from fluoride hazard as more than 50.6% well waters are found to contain less than 1mg/L of fluoride and occurs in west. The factors like low solubility of calcium fluoride and absorption of fluoride by the aquifer material usually keep the concentration in low levels.

The very high hardness in ground waters restrict their domestic suitability. The hardness ranges from 45 to 2060 mg $CaCO_3$/L with an overall average of 532 mg $CaCO_3$/L. However, the average hardness of ground water is comparatively low (386 mg $CaCO_3$/L) in Dungargarh whereas all other blocks have very hard waters with hardness of more than 500 mg $CaCO_3$/L. The analysis revel the increase in the concentration is mainly due to mineralization of the ground waters.

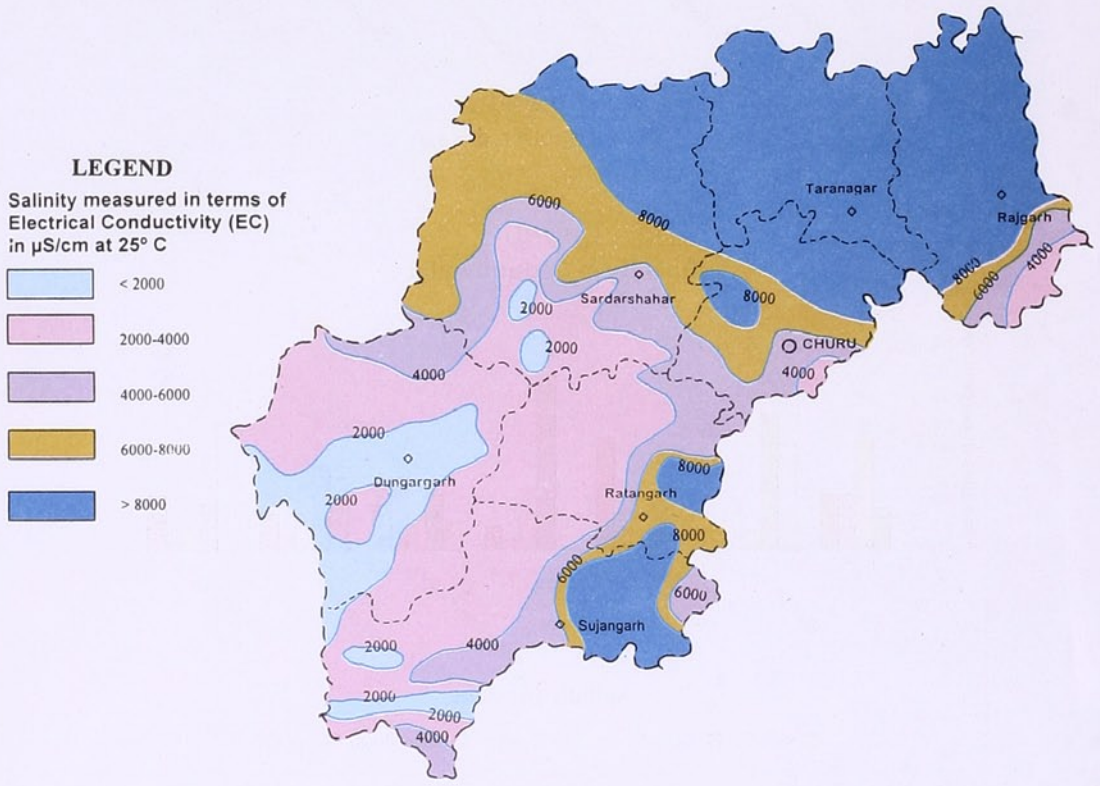
The suitability of ground waters for drinking reveals that 55.36% ground water can be used for drinking under the relaxed level of dissolved solids (3000 mg/L) as per ICMR potability recommendation provided other harmful constituents are with in recommended levels of potability. The presence of abnormally high nitrate contents in low salinity waters in the district (particularly in west) have rendered the ground water unsuitable for drinking. On the contrary, the unusually high salinity prevailing in ground water of north and western region has created the acute shortage of potable water. Irrigation potential in Dungargarh block and western parts of Sardarshahar, Sujangarh and Ratangarh block is very promising due to the presence of low salinity ground waters with electrical conductivity less than 4000 µS/cm and the soils are sandy. On the other side well waters with electrical conductivity values from 4000-8000 µS/cm occur in south east of Ratangarh, around Churu and parts of Rajgarh blocks for growing semi to salt-tolerant crops. The 17.15% ground waters of north-east and eastern parts of Sujangarh are very saline with electrical conductivity value far above 8000 µS/cm and should be considered unsuitable for irrigation.

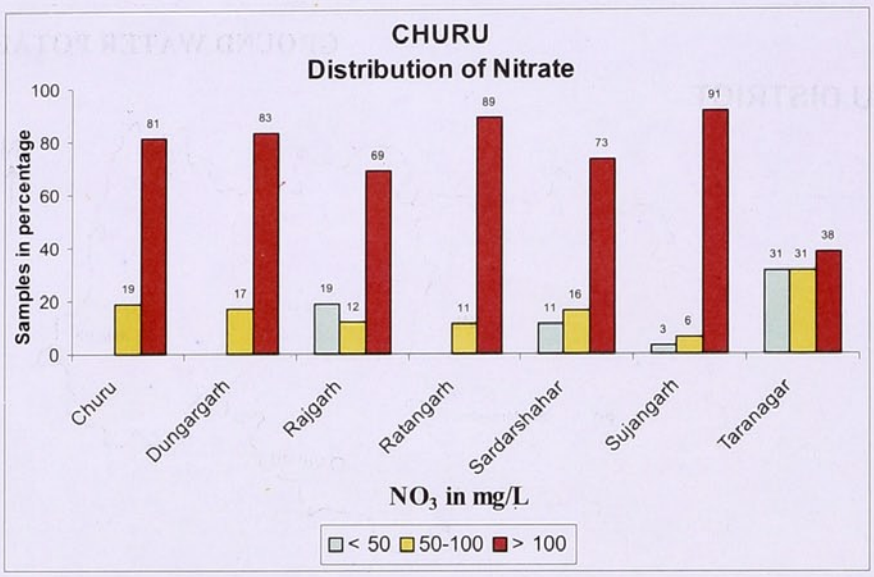
GROUND WATER POTABILITY

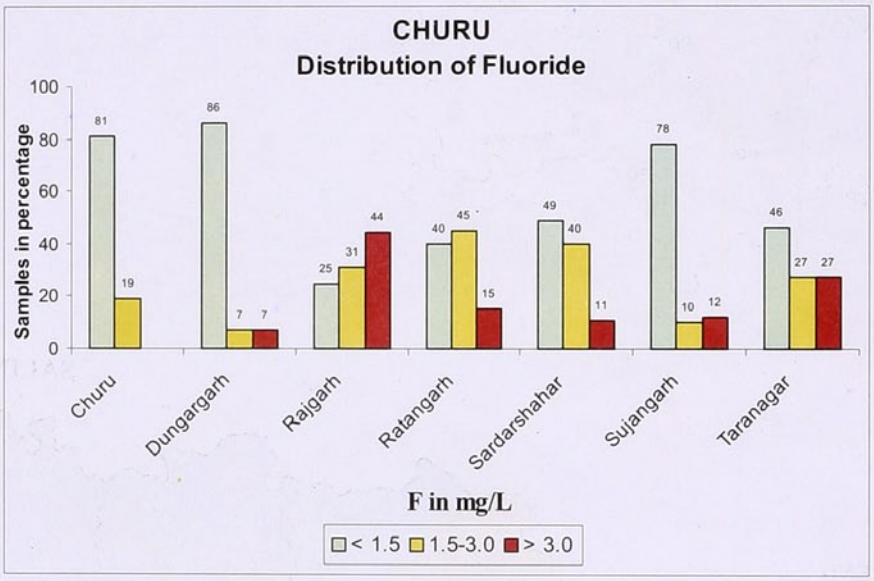
CHURU DISTRICT

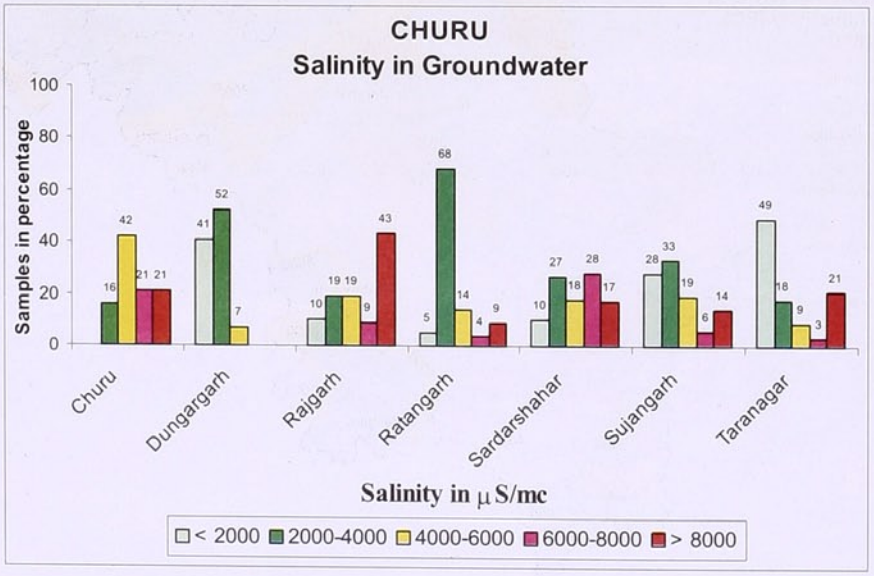


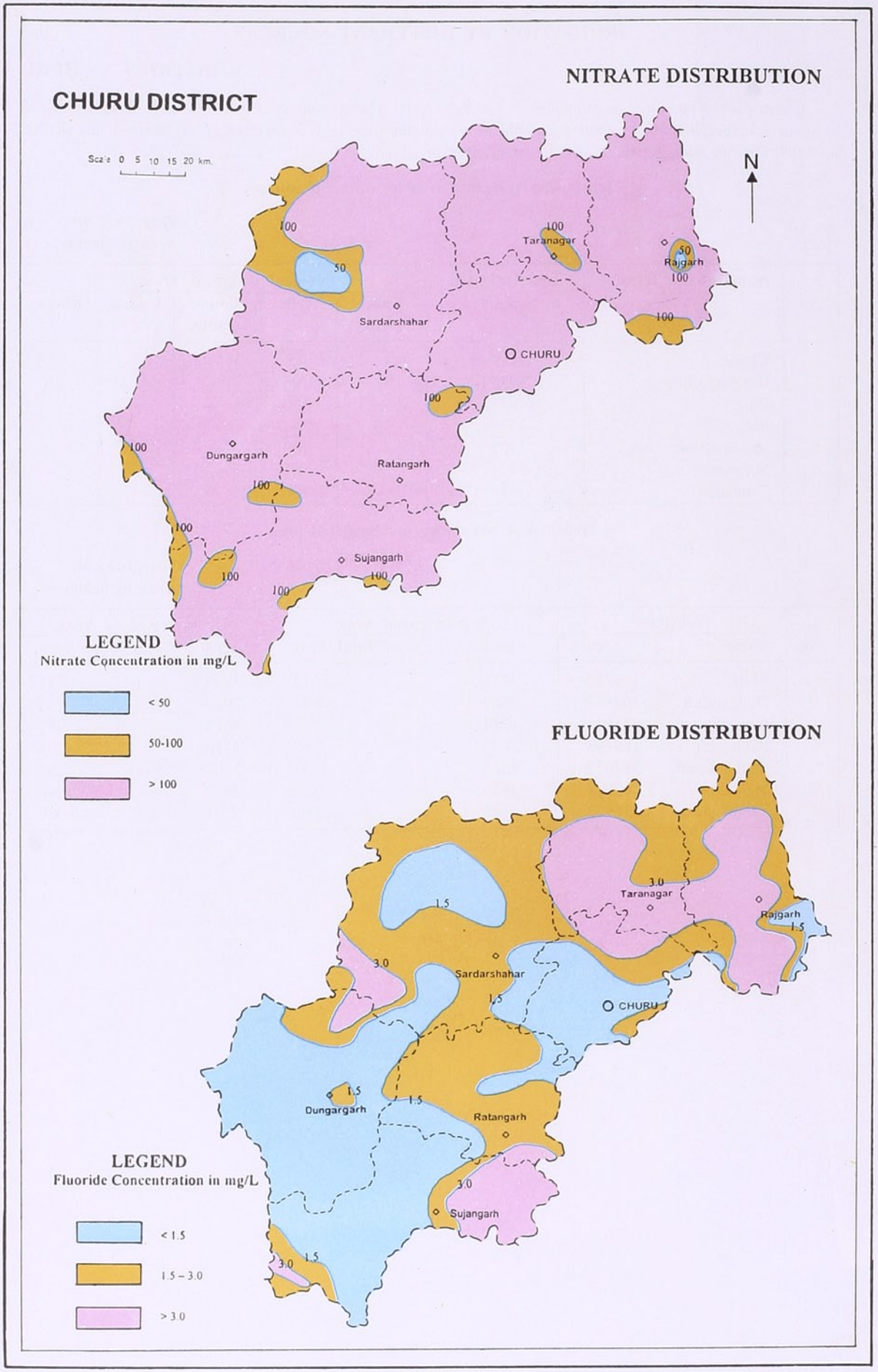
SALINITY




CHURU
Distribution of Nitrate
Samples in percentage
100
80
60
40
20
0
19 81
17 83
19 12 69
11 89
11 16 73
3 6 91
31 31 38
Churu
Dungargarh
Rajgarh
Ratangarh
Sardarshahar
Sujangarh
Taranagar
NO3 in mg/L
< 50
50-100
> 100


CHURU
Distribution of Fluoride
Samples in percentage
100
80
60
40
20
0
81 19
86 7 7
25 31 44
40 45 15
49 40 11
78 10 12
46 27 27
Churu
Dungargarh
Rajgarh
Ratangarh
Sardarshahar
Sujangarh
Taranagar
F in mg/L
< 1.5
1.5-3.0
> 3.0


CHURU
Salinity in Groundwater
Samples in percentage
100
80
60
40
20
0
16 42 21 21
41 52 7
10 19 19 9 43
5 68 14 4 9
10 27 18 28 17
28 33 19 6 14
49 18 9 3 21
Churu
Dungargarh
Rajgarh
Ratangarh
Sardarshahar
Sujangarh
Taranagar
Salinity in μS/mc
< 2000
2000-4000
4000-6000
6000-8000
> 8000


NITRATE DISTRIBUTION
CHURU DISTRICT
Scale 0 5 10 15 20 km.
N
100
50
100
Taranagar
50
Rajgarh
100
100
Sardarshahar
CHURU
100
100
Dungargarh
Ratangarh
100
100
Sujangarh
100
100
LEGEND
Nitrate Concentration in mg/L
< 50
50-100
> 100
FLUORIDE DISTRIBUTION
3.0
Taranagar
1.5
Rajgarh
1.5
3.0
Sardarshahar
1.5
CHURU
1.5
1.5
Dungargarh
Ratangarh
3.0
Sujangarh
3.0
1.5
LEGEND
Fluoride Concentration in mg/L
< 1.5
1.5 – 3.0
> 3.0