

GEOMORPHOLOGY

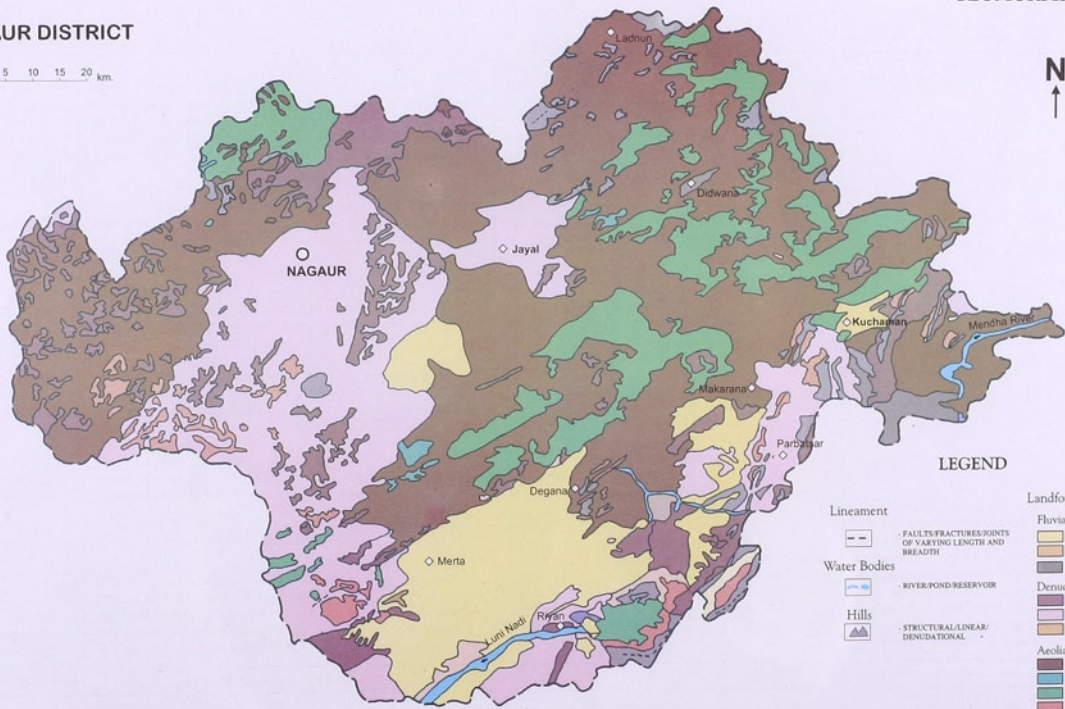
DISTRICT—NAGOUR

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, consists of gravels, sand, silt and clay. Terrain mainly undulating, produced by extensive deposition of alluvium by river system.	Concentrated in southern half surrounding Merta town, north of Kuchera town, east of Kuchaman town & south of Besroli village.	Marginal double crop, single crop (Kharif), open scrub & fallow.
Palaeochannel	PC	Mainly buried on abandoned stream/river courses, comprising of coarse textured material of variable sizes.	Negligible, in east of Merta town.	Double crop.
Salt Encrustation/ Playa	PL	Topographical depressions comprising of silt, clay & soluble salts, usually undrained and devoid of vegetation.	Eastern part of the district.	Salt lake, salt waste.
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 eastern and western part, concentrated in north east of Mundwa town.	Single crop (Rabi / Kharif), open scrub, fallow.
Burried Pediment	BP	Pediment covered essentially with relatively thicker alluvial, colluvial or weathered materials.	Area surrounding Nagaur, north of Jayal and scattered in eastern part.	Marginal double crop, single crop (Kharif), fallow, open scrub.
Intermontane Valley	IV	Depression between mountains, generally broad & linear, filled with colluvial deposit.	In eastern of the district.	Double crop, single crop (Kharif / Rabi), 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 xerophytic vegetation.	Covers maximum portion except area surrounding Nagaur, Merta.	Marginal (Kharif), open scrub.
Dune Valley Complex	DVC	Clusters of dunes and interdunal spaces with undulating topography formed due to wind blown activity comprising of unconsolidated sand and silt.	Concentrated in north east and central part.	Land with or without scrub.
Interdunal Depression	ID	Slightly depressed area in between the dunal complex showing moisture and fine sediments.	Negligible scattered in north west.	Marginal double crop, Single crop (Rabi), fallow.
Obstacle Dune	OD	Formed on windward/leeward sides of obstacle like isolated hills or continuous chain of hill, dune to obstruction in path of sand laden winds. Badly dissected well cemented and vegetated.	On wind ward side of hills.	Marginal Kharif crop, land with or without scrub.
Dune Complex	DC	An undulating plain composed of number of sand dunes.	Negligible scattered in north, north west and central part.	Land with or without scrub.
Hills Linear Ridge	LR	Long narrow low-lying ridge usually barren having high run off may form over varying lithology with controlled strike.	On south eastern margin (negligible).	Barren.
Denudational Hill	DH	Steep sided, relict hills undergone denudation, comprising of varying lithology with joints, fractures and lineaments.	On eastern portion (east of Makrana town).	Forest, open scrub.
Structural Hill	SH	Linear to arcuate hills showing definite trend-lines with varying lithology associated with folding, faulting etc.	West of Sambhar lake.	Open scrub.

NAGOUR DISTRICT

Scale 0 5 10 15 20 km.

GEOMORPHOLOGY



LEGEND

Lineament
- - - - - FAULTS, FRACTURES, JOINTS OF VARYING LENGTH AND BREADTH

Water Bodies
- - - - - RIVER, POND, RESERVOIR

Hills
- - - - - STRUCTURAL/LINEAR/DENUDATIONAL

Landform Units :

Fluvial Origin :
- Alluvial Plain
- Pinnacchannet
- Salt Encroachment/Plays

Denudational Origin :
- Pediment
- Buried Pediment
- Intermittent Valley

Aeolian Origin :
- Eolian Plain
- Dune Complex
- Dune Valley Complex
- Obstacle Dune
- Intertidal Depression

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HYDROGEOLOGY

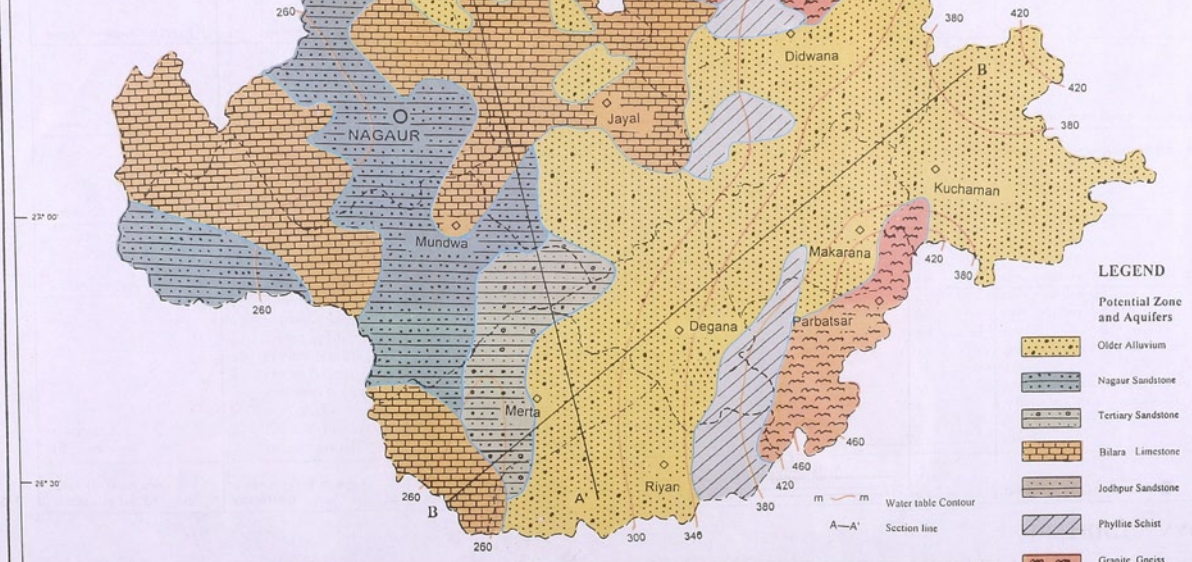
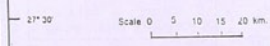
DISTRICT—NAGOUR

Hydrogeological units	Description of the unit/cross section	Occurrence	Ground Water flow
Older Alluvium (Quaternary)	It comprises unconsolidated to semi consolidated sand, silt, clay and kaunkar with occasional gravel beds. Due to undulating bed rock topography, thickness of the formation varies considerably. Eastern part has maximum thickness of about 100 m. It reduces further westward and major part of the area has thickness between 30 to 50 m.	The litho unit occupies major part of the area. South eastern peripheral part in Riyan and Parbatsar blocks and some pockets in Makrana block are only exception which are occupied by crystallines. Alluvium cover nearly 43% potential area in parts of Kuchaman, Didwana, Riyan, Degana and Makrana blocks beside small pockets in Jayal, Parbatsar, Merta and Ladnun blocks.	The general direction of ground water flow has been inferred from water table contour as south east to north west. Local variations like ground water mounds and troughs have been noticed in Mundwa, Makrana and Jayal blocks. In south eastern part hydraulic gradient has been worked out as 8.5 m/km which reveals lower permeability aquifers underlying in the region. In other parts, it varies from 3.6 m/km.
Palana Sandstone Tertiary (Eocene)	It includes gritty and ferruginous sandstone with sequences of shale, siltstone and clay beds. In northern part, thickness of the litho unit has been tapped more than 200 m.	It mainly spreads in Merta block and extends upto the peripheral region of adjoining Degana, Jayal and Merta blocks. The litho unit encompasses nearly 5% potential area.	
Nagaur Sandstone (Marwar Super Group)	It is buff red to dark coloured, fine to coarse grained quartzitic sandstone interbedded with anhydrite and gypsum beds. Thickness of the litho unit in Nagaur block has been recorded more than 100m.	It occupies Mundwa, Nagaur, Jayal and Merta blocks. The litho unit encompasses nearly 20% potential area.	
Bilara Limestone (Marwar Super Group)	It is white to grey coloured, massive cherty and stramatolitic limestone. Thickness of the aquifer near Nagaur has been tapped more than 300 m.	It covers major part of Nagaur, Mundwa and Jayal blocks and some pockets in Ladnun and Merta blocks. The litho unit cover nearly 20% potential area.	
Jodhpur Sandstone (Marwar Super Group)	It is purple to brown in colour, fine to coarse grained, micaceous sandstone. Thickness of the litho unit and depth of the basement varies considerably and tapped at several sites more than 100 m.	It occurs in three isolated pockets in Mundwa, Ladnun and Merta blocks, where lie in western, northern and south western part respectively. The litho unit occupies nearly 1% potential area.	
Schist Gneisses (Bhilwara Super Group)	These comprise porphyritic and non-porphyritic gneissic complex associated with aplite, amphibolite, schist and augen gneiss. Schist and gneiss are grey to dark coloured, medium to coarse grained compact rock. This litho unit generally underlies the alluvium having varied thickness.	These formations occupy south eastern part of the district in Parbatsar, Riyan and Makrana blocks. The north western part of Didwana, western peripheral area of Degana, eastern part of Ladnun and small area in Kuchaman have phyllite and schist aquifers. These litho unit occupy nearly 11% potential area.	

For cross section(s) please see page no. 548

NAGGAUR DISTRICT

HYDROGEOLOGY



LEGEND

Potential Zone and Aquifers

- Older Alluvium
- Nagaur Sandstone
- Tertiary Sandstone
- Bilara Limestone
- Jodhpur Sandstone
- Phyllite Schist
- Granite, Gneiss

m m Water table Contour

A—A' Section line

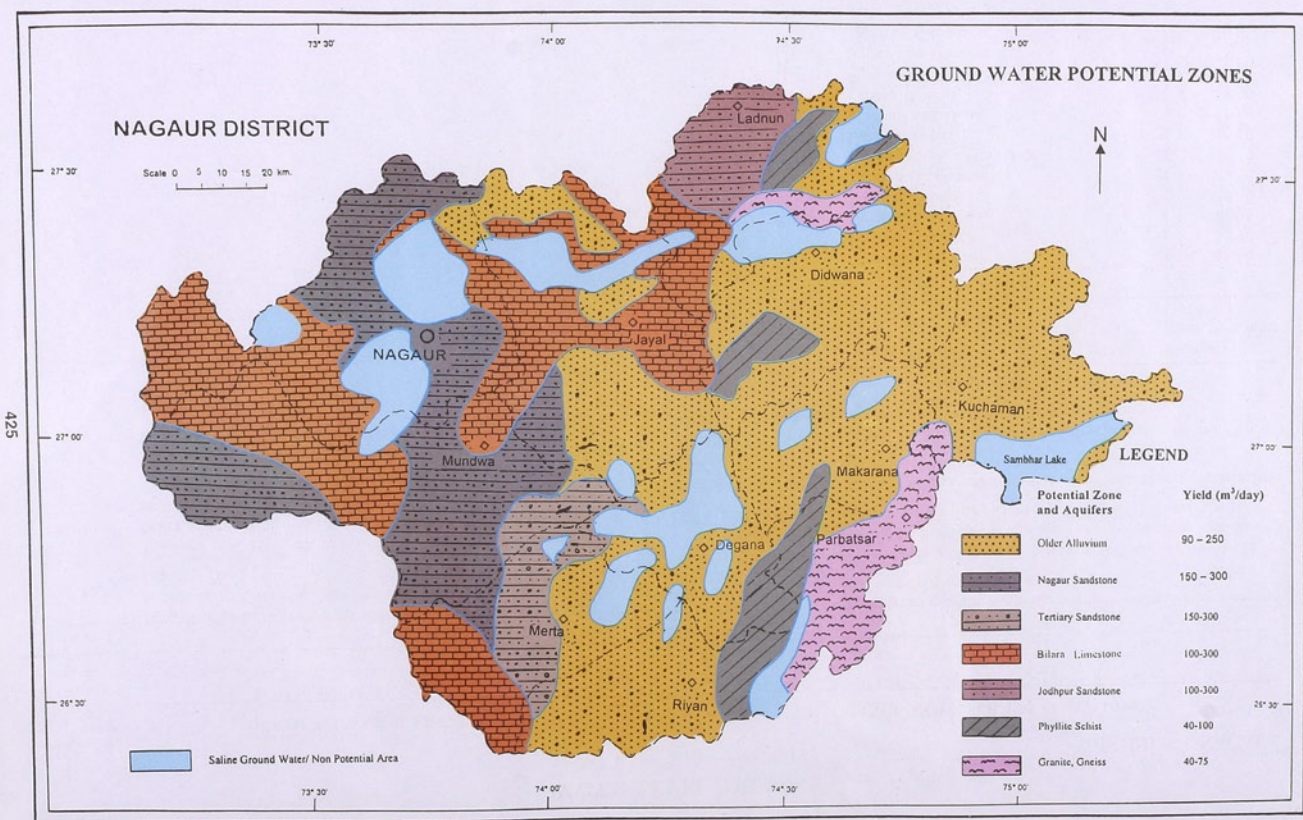
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GROUND WATER POTENTIAL ZONES AND DEVELOPMENT PROSPECTS

DISTRICT - NAGOUR

Aquifer in the Potential Zone (Area in Km ²)	Occurrence * Block (Area in Km ²)	Water Level (1997) in m.	Well Parameters			E.C. X10 ³ μ siem/cm	Development Prospects
			Type	Proposed depth in m	Discharge in m ³ /day		
Older Alluvium (5681.98)	* Degana (804.50)	30-40	TW/DCB	100-125/50-100	100-200	4-8	Critical
	* Didwana (1089.75)	25-35	TW/DCB	100-150/50-100	100-200	<4	Critical
	* Jayal (407.08)	25-50	TW/DCB	75-125/40-75	100-250	4-8	Northern part safe & southern - Over exploited
	* Kuchaman (1057.13)	15-40	TW/DCB	80-125/30-75	100-250	<4	Southern peripheral critical & rest Over exploited
	* Ladnun (125.25)	15-25	TW/DW	30-50/100-125	100-250	<4	Safe
	* Makrana (733.83)	35-45	TW/DCB	50-75/100-150	100-250	4-8	Southern part critical, North eastern overexploited
	* Merta (250.00)	20-30	TW/DCB	50-100/80-125	100-250	4-8	Critical
	* Parbatsar (375.43)	30-45	TW/DW	30-40/80-125	100-250	<4	Over exploited
	* Riyan (839.01)	25-45	TW/DW	30-40	100-200	<4	Over exploited
Palana Sandstone (1005.34)	* Degana (286.79)	35-45	TW/DCB	100-150/50-75	150-300	4-8	Over exploited
	* Jayal (170.25)	35-40	TW/DCB	100-150/50-100	150-300	<4	Over exploited
	* Merta (435.80)	45-60	TW/DCB	100-150/50-100	250-300	<4	Over exploited
	* Mundwa (112.50)	40-50	TW/DCB	100-150/50-100	100-300	<4	Over exploited
Nagaur Sandstone (2505.10)	* Jayal (521.00)	30-60	TW/DCB	100-150/50-100	100-300	4-8	Safe
	* Merta (287.50)	55-65	TW/DCB	100-150/50-100	250-300	<4	Over exploited
	* Mundwa (812.50)	40-50	TW/DCB	100-150/50-100	100-300	<4	Over exploited
	* Nagaur (884.10)	20-35	TW/DCB	75-100/30-60	100-250	<4,4-8	Northwestern safe, Northeastern and southern critical
Bilara Limestone (3363.59)	* Jayal (626.25)	30-60	TW/DCB	100-150/50-100	100-350	4-8	Eastern part semi critical, western critical
	* Ladnun (168.75)	50-60	TW/DCB	100-150/50-100	100-300	<4	Safe
	* Merta (325.00)	45-60	TW/DCB	100-175/50-125	200-400	<4	Over exploited
	* Mundwa (857.29)	55-80	TW/DCB	100-150/50-100	100-400	<4	Critical
	* Nagaur (1386.30)	50-60	TW/DCB	100-150/50-100	100-400	4-8	Safe
Jodhpur Sandstone (1341.33)	* Didwana (62.50)	35-45	TW/DCB	100-150/50-80	100-300	<4	Safe
	* Ladnun (773.58)	25-45	TW/DCB	100-150/50-100	100-300	<4	Critical
	* Merta (80.25)	35-45	TW/DCB	100-125/50-100	200-400	<4	Over exploited
	* Mundwa (425.00)	40-50	TW/DCB	100-150/50-100	100-400	<4	Over exploited
Phyllite, Schist & Gneiss (2481.16)	* Degana (112.05)	10-40	TW/DW	100-125/50-75	100-150	<4	Critical
	* Didwana (485.34)	15-25	DW	40-60	75-100	<4	Critical
	* Kuchaman (68.75)	15-20	DW	30-50	75-100	4-8	Safe
	* Ladnun (381.25)	<25	DW	30-50	75-100	4-8	Safe
	* Makrana (331.25)	35-40	TW/DCB	100-125/50-75	75-200	4-8	Safe
	* Parbatsar (696.27)	15-25	TW/DW	75-100/30-40	75-100	<4	Over exploited
	* Riyan (406.25)	20-35	TW/DW	75-100/30-40	75-100	<4	Over exploited

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



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WATER LEVEL TRENDS

DISTRICT : NAGOUR

DEPTH TO WATER LEVEL

Range in m	Area
< 20	Part of Riyan, Degana, Parbatsar, Kuchaman blocks situated in the catchment of Luni river, has shallow water level. Part of Ladnun, and Didwana blocks and pockets scattered in other block also have depth to water level less than 20 m.
20 to 40	Major part of the district, leaving aside southeastern, northern and western peripheral area with pockets scattered in other blocks, have depth to water level between the range.
> 40	Area west of Nagaur and pockets scattered in other blocks have deep water level more than the range.

CHANGE IN WATER LEVEL (1984-1997)

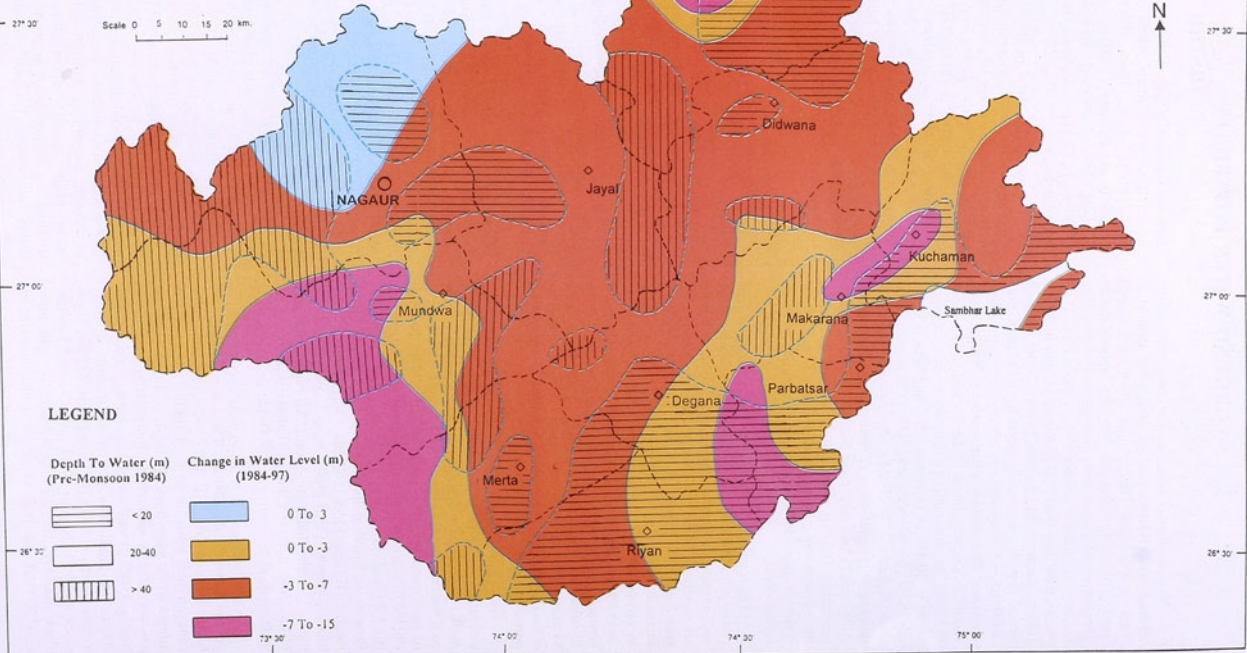
Range in m	Area
0 to 3	Northwestern part of Nagaur block is exception which exhibit marginal rise in water level within the range:
0 to -3	Part of Riyan, Degana, Parbatsar, Makrana and Kuchaman blocks in southeastern and Mundwa and Merta blocks in southwestern boundary of the district have marginal depletion in water level between the range.
-3 to -7	Major part of the district, leaving aside south eastern and southwestern area, has depletion in water level between the range.
-7 to -15	Part of Mundwa, and Merta blocks and pockets in Kuchaman and Degana has steep depletion in water level between the range.

DETAILS OF THE SPOT

Spot code	Village (Block)	Change in water level in m (1984-97)
1.	Bitan (Merta)	(-) 15.20
2.	Dhanuppa (Merta)	(-) 18.90
3.	Ferwasi (Ladnun)	(-) 15.90
4.	Gotan (Merta)	(-) 26.95
5.	Kheduli (Merta)	(-) 10.40
6.	Khariya (Kuchaman)	(-) 20.42
7.	Kukanwali (Kuchaman)	(-) 16.10
8.	Luniwas (Merta)	(-) 16.20
9.	Makrana (Makrana)	(-) 16.40
10.	Pundlu (Merta)	(-) 18.00
11.	Sirsala (Merta)	(-) 16.05
12.	Shyampura (Parbatsar)	(-) 15.51
13.	Talanpur (Merta)	(-) 20.05

NAGOUR DISTRICT

WATER LEVEL TRENDS



GROUND WATER POTABILITY

DISTRICT NAGOUR

Nagaur district ranks as the most problematic district with reference to ground water quality in western Rajasthan. High concentration of dissolved salts, nitrate and fluoride are the major quality problems associated with the ground water. The salinity measured as electrical conductivity (EC) varies from less than 500 $\mu\text{S}/\text{cm}$ to as high as 32000 $\mu\text{S}/\text{cm}$ (Jaswantgarh; Ladnun block). Water analyses reveal that 34.1% ground waters have EC more than 4000 $\mu\text{S}/\text{cm}$ showing moderately saline to saline character. Such waters occur mostly in Nagaur block (60.8%), Degana block (54.5%) and Jayal block (52.2%). In other blocks, the occurrence of such water is 30.4% in Didwana, 25% in Merta, 23% in Riyan, 42.1% in Makrana, 30% in Kuchaman and 28% in Ladnun blocks. In Mundwa and Parbatsar blocks, the ground water is relatively fresh in nature. Alluvium, Palana sandstone, Nagaur sandstone, Bilara sandstone, Jodhpur sandstone, schist and gneiss are the main water bearing formations. The quality of water is poor in alluvium as compared to other formations.

The concentration of various chemical constituents in water varies from place to place and with respect to various formations. The fresh waters are mostly calcium or calcium-magnesium bicarbonate type but finally changes to sodium chloride type with increase in salinity. The percentage of water falling in various type of water is fresh (32%), mixed (33%) and chloride type (35%). It is seen that the chemical character of ground water changes significantly from bicarbonate type of water to chloride type from south to north. The southern and eastern part of district is a major recharge zone whereas central and northern part constitutes the discharge zone.

The ground water having health affecting constituents like fluoride beyond certain level (>1.5 mg/L) become unsuitable for drinking. Nearly 61.3% well waters have fluoride above 1.5 mg/L. Occurrence of such water is even more in Degana (79%), Nagaur (89.8%), Makrana (70.1%), Ladnun (64.3%), Riyan (61.8%) and Jayal (65.7%) blocks. High value of fluoride is found at many places viz., Baorla (30.0 mg/L; Degana block), Galdi (32.1 mg/L; Jayal block), Somera (75.0 mg/L; Jayal block), Leri (34.0 mg/L; Ladnun block) and Mori (17.0 mg/L; Makrana block). The highest value of fluoride is observed as 90.0 mg/L in the well water of Ditiad in Jayal block.

Nitrate occurs as a major toxic constituent in ground water of the district. The Indian Council of Medical Research (ICMR) has recommended concentration limit of 20 mg/L nitrate in water for infants while more than 100 mg/L of nitrate in water has not been recommended for adult consumption. Nearly, 41.4% ground waters have nitrate concentration above 100 mg/L. The percent distribution of such waters is even more in Didwana block (73.9%), Jayal block (60.9%), Nagaur block (45.5%) and Ladnun block (68.0%). The maximum nitrate concentration of 4750 mg/L has been observed in ground water in

Jaitpura (Degana block). However, high values of nitrate also occur at many places viz., Motus (2900 mg/L; Merta block), Basni Baliwa (1033 mg/L; Nagaur block), Panchori (1650 mg/L; Mundwa block), Geiroda Khara (1780 mg/L; Ladnun block), Dhawa (1300 mg/L; Ladnun block) nad Daorat (2100 mg/L; Didwana block).

Despite of salinity problem, the district is characterised by low hardness in ground water. This is due to low percentage of calcium and magnesium ions in water. Nearly, 51.9% ground water shows hardness in range of 0-300 mg/L. The percentage of such water is more in Didwana (65.2%), Merta (56.3%), Parbatsar (81.3%), Makrana (68.4%), Kuchaman (65.0%) and Mundwa (52.9%) blocks. Only 19% ground water shows hardness above 600 mg/L. Such waters are least in Parbatsar block (0.0%) and highest in Degana block (36.4%). The minimum and maximum values of hardness have been observed as 37 mg/L (Nimbrikallan; Degana block) and 2450 mg/L (Bhaiyakallan; Makrana block).

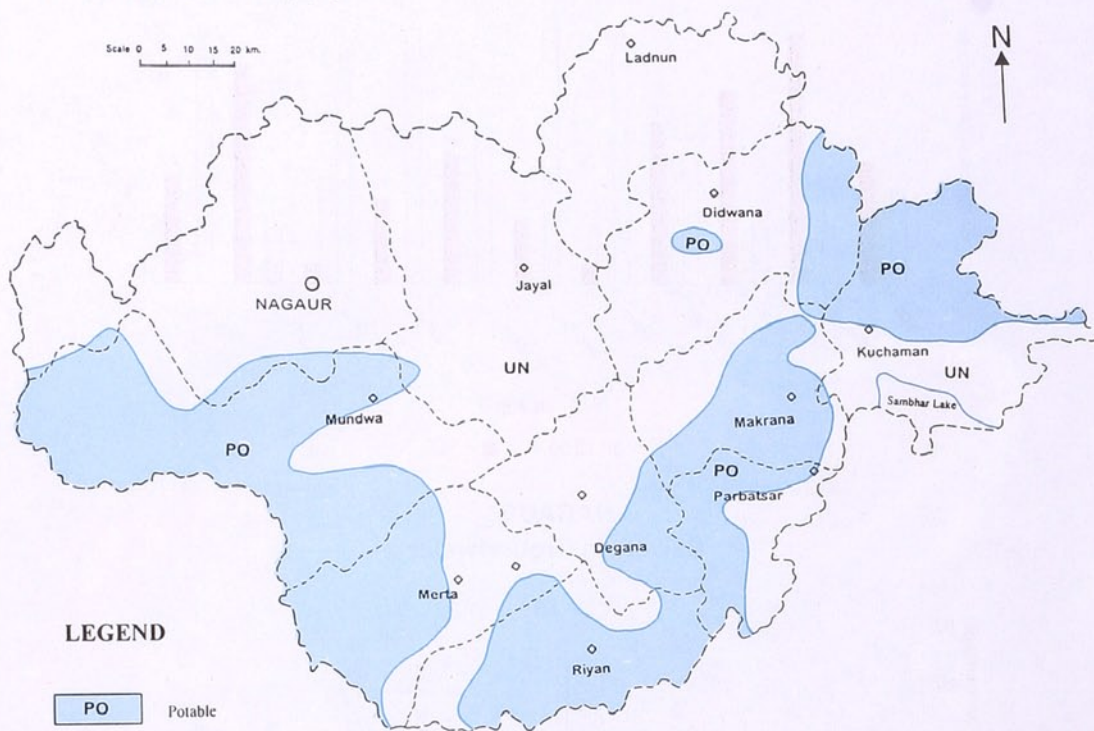
In the district where sandy soil occurs, waters upto EC 8000 $\mu\text{S}/\text{cm}$ may be used for irrigation depending upon the salt tolerance of crops. It is observed that waters having EC more than 8000 $\mu\text{S}/\text{cm}$ (12.4%) mostly occur in eastern and central part of the district covering Degana, North of Jayal, South of Kuchaman and western part of Nagaur block. Irrigation with water having high concentration of sodium impairs the soil permeability. Waters having sodium more than 70% prove to be harmful to soil. Apart from sodium percentage, residual sodium carbonate (RSC) more than 2.0 meq/L may cause alkalinity problem in soil. The ground water in Degana (81.8%), Didwana (86.9%), Jayal (60.9%), Nagaur (77.3%), Merta (75%), Parbatsar (68.8%), Riyan (53.8%), Makrana (77.8%), Kuchaman (50.0%), Mundwa (47%) and Ladnun (56%) blocks have sodium percentage above 70. Likewise, the RSC is observed more than 2.0 meq/L in Degana (59.1%), Didwana (69.6%), Jayal (34.8%), Nagaur (31.8%), Merta (31.3%), Parbatsar (56.3%), Riyan (23.1%), Makrana (72.2%), Kuchman (35%), Mundwa (29.4%) and Ladnun (44%) blocks. Such waters for irrigation require proper gypsum treatment to neutralise alkalinity problems.

The integrated map of drinking water quality based on ICMR standards shows considerable area non-conforming to the standards for one or more constituents amongst salinity, fluoride and nitrate content. It is observed that only 33.5% ground water in the district have potable quality of water. In Degana, Jayal, Ladnun, Nagaur and Didwana blocks, the water quality is severely affected by salinity, nitrate or fluoride concentration. Part of Merta block in south also have inferior water quality on account of fluoride and nitrate. The ground water in these areas needs quality management by way of desalination, defluoridation or denitrification so as to make them suitable for human consumption.

GROUND WATER POTABILITY

NAGAUR DISTRICT

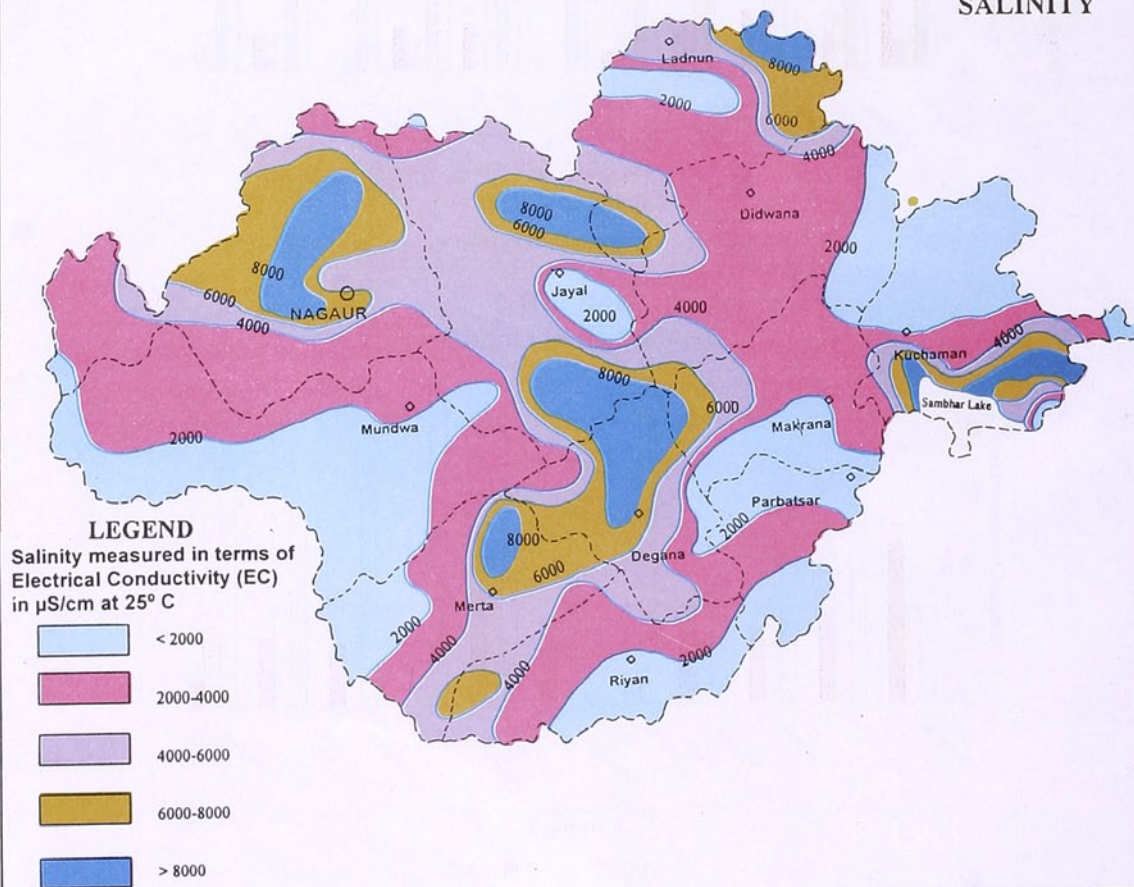
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LEGEND

- PO Potable
- UN Unpotable

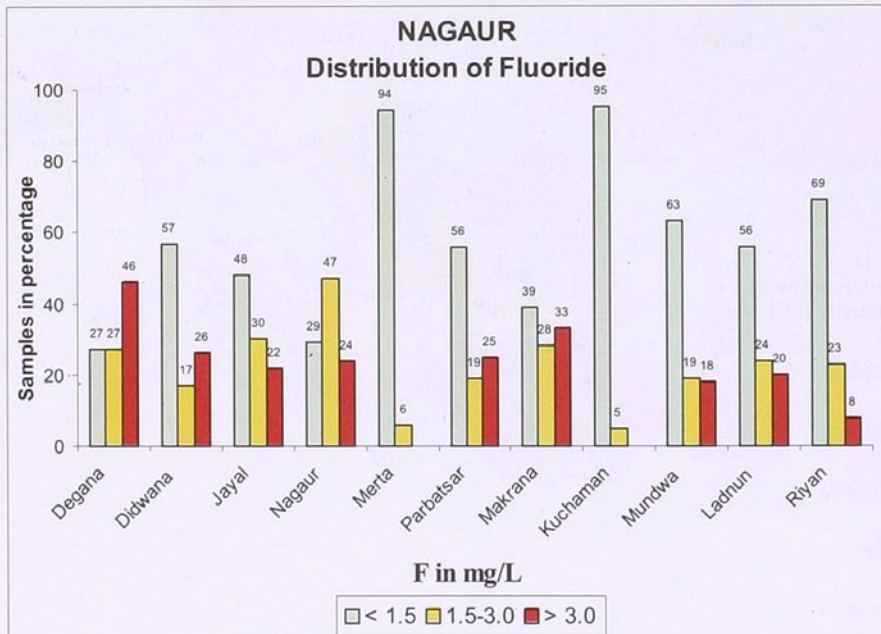
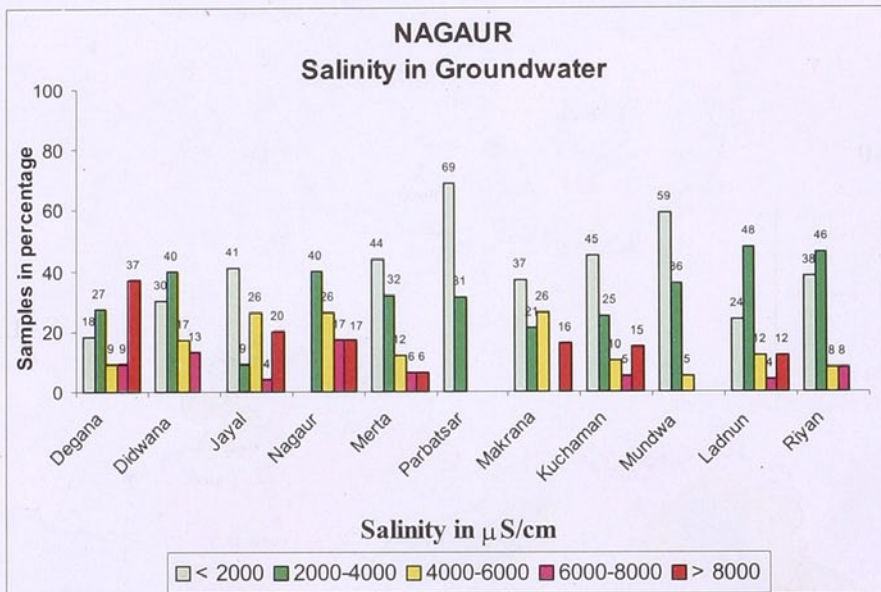
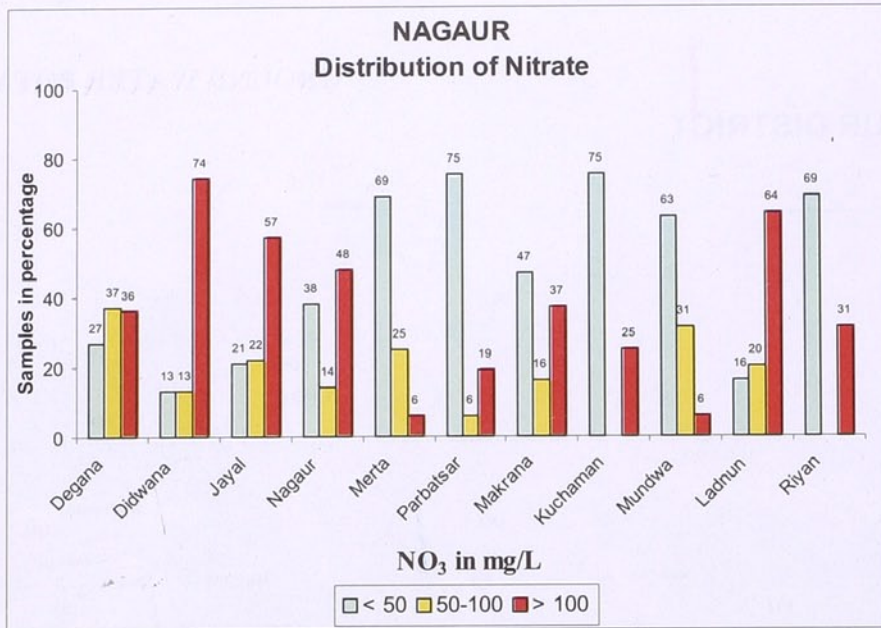
SALINITY



LEGEND

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

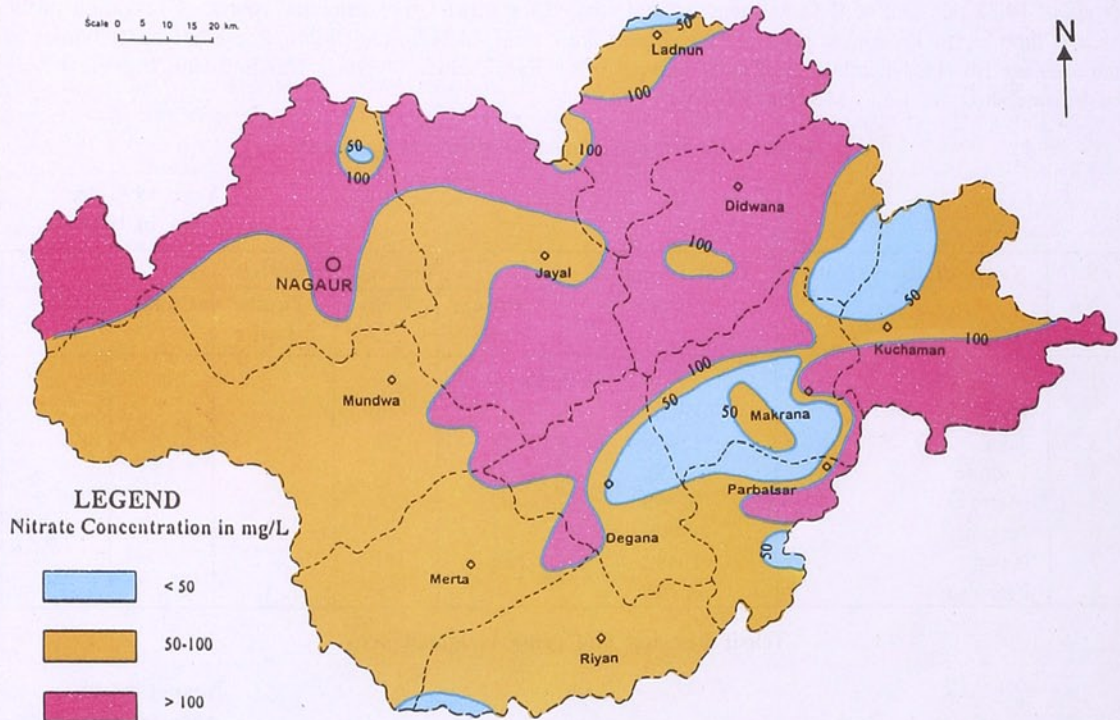
- < 2000
- 2000-4000
- 4000-6000
- 6000-8000
- > 8000



NAGOUR DISTRICT

NITRATE DISTRIBUTION

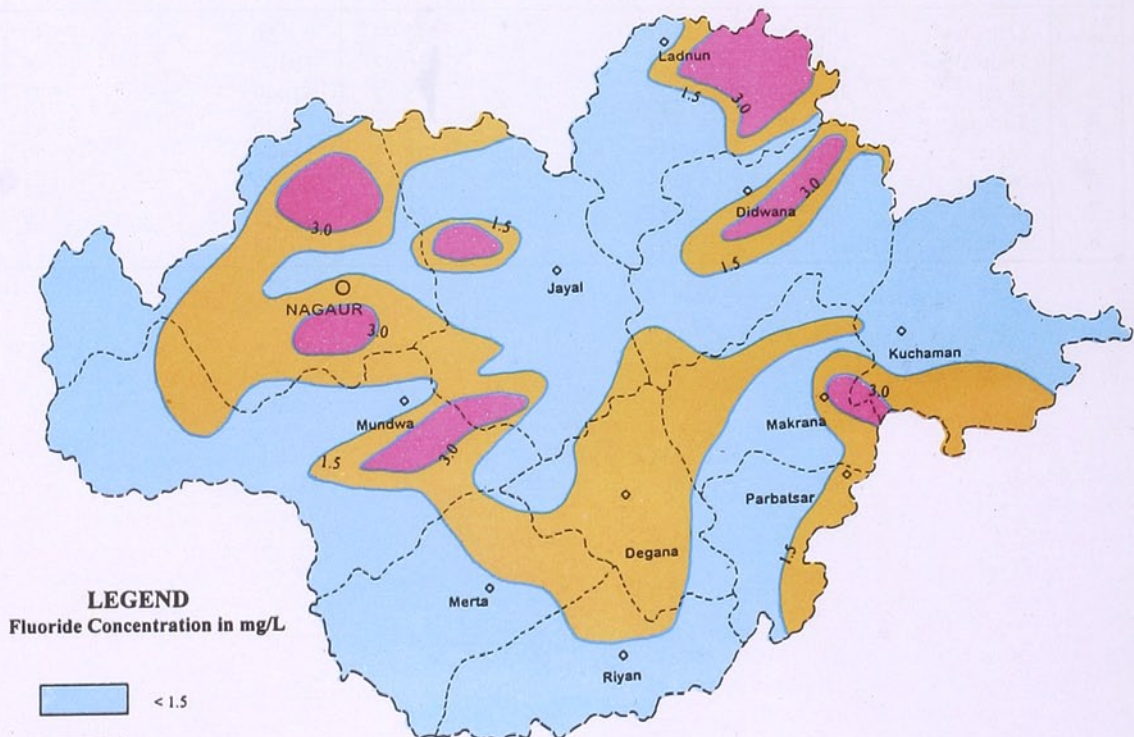
Scale 0 5 10 15 20 km.



LEGEND
Nitrate Concentration in mg/L

- < 50
- 50-100
- > 100

FLUORIDE DISTRIBUTION



LEGEND
Fluoride Concentration in mg/L

- < 1.5
- 1.5-3.0
- > 3.0