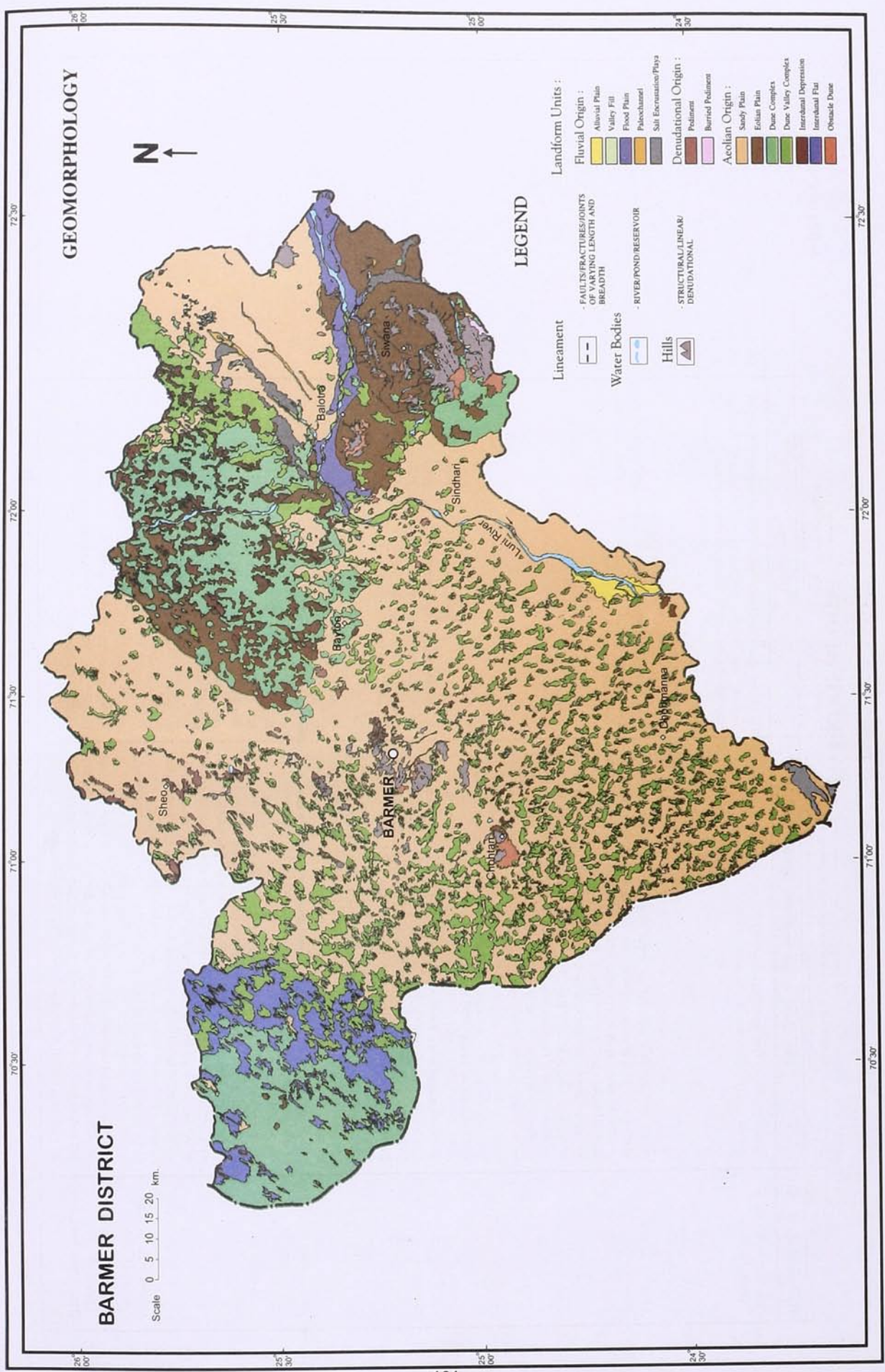


GEOMORPHOLOGY

DISTRICT—BARMER

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 gravel, sand, silt and clay. Terrain mainly undulating, produced by extensive deposition of alluvium.	Along river Luni.	Marginal double crop, single crop area (Kharif / Rabi), open scrub.
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.	Negligible in eastern part.	Marginal double crop area, open scrub.
Flood Plain	FP	The surface or strip of relatively smooth land adjacent to a river channel formed by river and covered with water when river over flows its bank. Normally subject to periodic flooding.	Along river Luni.	Marginal double crop, single crop, Kharif, fallow, open scrub.
Palaeochannel	PC	Mainly buried on abandoned stream/river courses, comprising of coarse textured material of variable sizes.	In north eastern part.	Double crop, open scrub.
Salt Encrustation/ Playa	SE/PL	Topographical depressions comprising of clay, silt, sand and soluble salts, usually undrained and devoid of vegetation.	Southern tip (rann of Kutch) and north east.	Salt quarries and 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.	Around hills in eastern part, central part, near Barmer town.	Marginal Kharif, open scrub.
Burried Pediment	BP	Pediment covered essentially with relatively thicker alluvial, colluvial or weathered materials.	In northern and eastern part.	Land with or without scrub.
Eolian Origin 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 (except north, east and western tip).	Land with or without scrub.
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.	In eastern and northern part.	Marginal Kharif crop, land with or without scrub.
Dune Complex	DC	An undulating plain composed of number of sand dunes.	In western part.	Marginal double crop, single crop (Kharif), fallow.
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.	Major portion in north east, scattered in entire district.	Land with or without scrub.
Obstacle Dune	OD	Formed on windward/leeward sides of obstacle like isolated hills or continuous chain of hills, dune to obstruction in path of sand laden winds. Badly dissected well cemented and vegetated.	Wind word side of hills.	Marginal double crop, single crop (Kharif / Rabi).
Interdunal Flat	IF	Flat, narrow land between dunes.	Scattered in central and western part.	Marginal double crop, single crop (Kharif), fallow.
Interdunal Depression	IDD	Slightly depressed area in between the dunal complex showing moisture and finer sediments.	Scattered in northern part.	Marginal double crop, single crop (Kharif), fallow.
Hills Denudational Hills	DH	Steep sided, relict hills undergone denudation, comprising of varying lithology with joints, fractures and lineaments.	In eastern, central part (scattered).	Marginal Kharif crop, open scrub.



GEOMORPHOLOGY



BARMER DISTRICT

Scale 0 5 10 15 20 km.

LEGEND

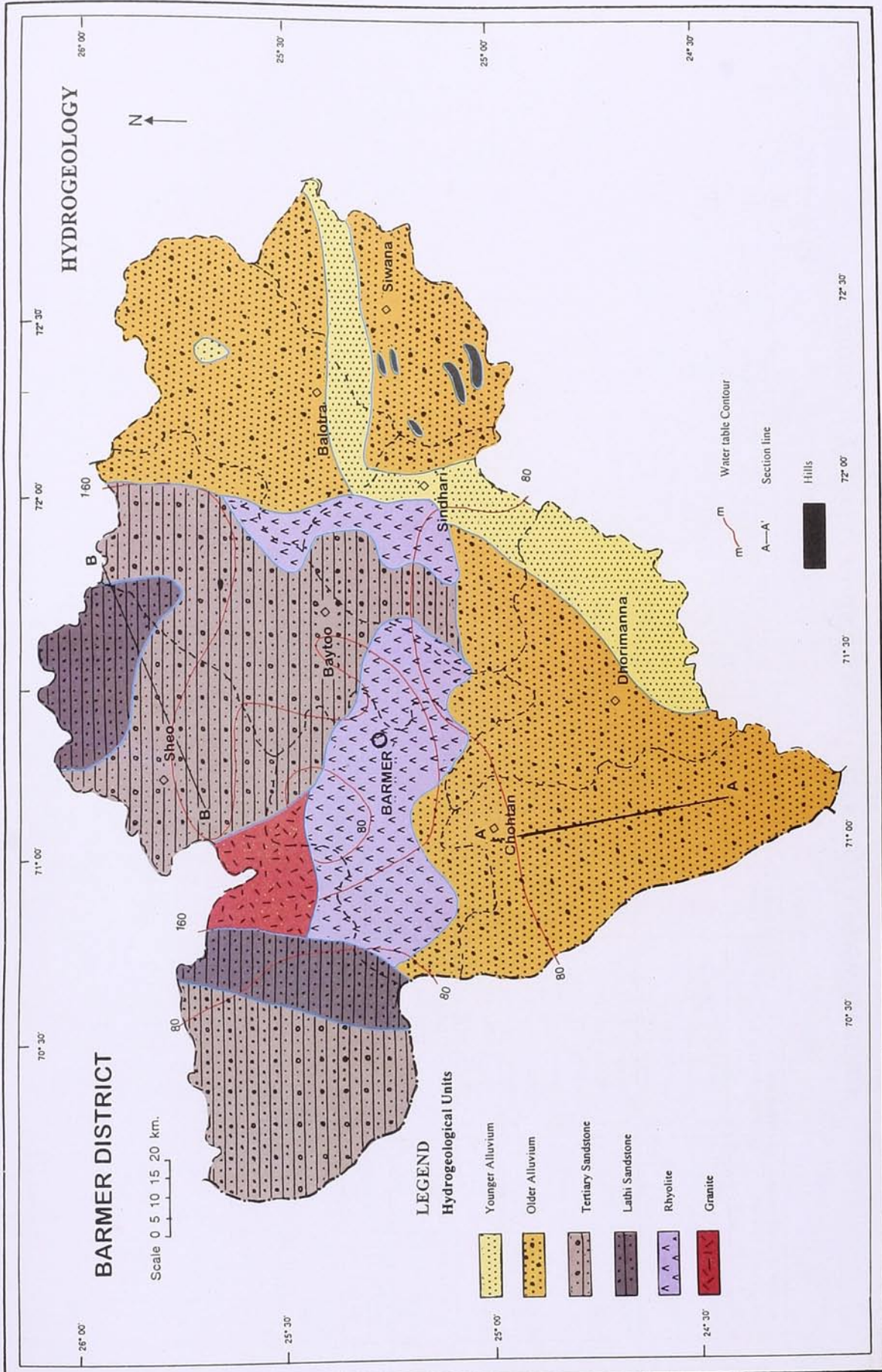
- Lineament**
- FAULTS/FRACTURES/JOINTS OF VARYING LENGTH AND BREADTH
- Water Bodies**
- RIVER/POND/RESERVOIR
- Hills**
- ▲ STRUCTURAL/LINEAR/DENUDATIONAL
- Landform Units :**
- Fluvial Origin :**
- Aluvial Plain
 - Valley Fill
 - Flood Plain
 - Paleochannel
 - Salt Escrumation/Playa
- Denudational Origin :**
- Denudational Pediment
 - Buried Pediment
- Aeolian Origin :**
- Sandy Plain
 - Eolian Plain
 - Dune Complex
 - Dune Valley Complex
 - Interdunal Depression
 - Intradunal Flat
 - Obstacle Dune

HYDROGEOLOGY

DISTRICT—BARMER

Hydrogeological units	Description of the unit/cross section	Occurrence	Ground Water flow
Younger Alluvium (Quaternary)	It comprises aeolian and fluvial deposits comprising sand, silt, clay, gravel and pebbles in varying proportions.	It encompasses extensive area in Dhorimanna, Sindhari, Siwana and Balotra blocks. Flood plains and drainage courses of Luni and its tributaries also have alluvial aquifer.	The general direction of ground water flow as inferred from water table contours is from north to south. Physiographic set up in central, eastern and south eastern area regulates ground water flow towards south east and south western direction. Thick clay sequences in the central part restricts ground water flow northward. A basin structure has also been demarcated in area between Barmer and Sheo.
Older Alluvium (Quaternary)	The litho unit is composed of upper medium to coarse sand with gravel, kankar and rock fragments of rhyolite and granite, and lower predominantly clayey layers with some coarse sand and gravel. Cross section Sarup Ka Tala - Banne Ka Tala shows thickness of the sediments is minimum at village Sanwara, block Chohitan (42 m) where crystalline basement of Malani rhyolite separates two basins, i.e., south western of Sanwara comprises quarternary sediments and north eastern of Tertiary deposits. Another section Chohitan-Sinhania indicate depth of the basement near villages Chohitan (92 m) and Netrad (105 m) increases southward and to more than 200 m. Cross section along Luni river shows maximum thickness of the sediments at village Gandhav of Dhorimanna block (300 m).	It occupies wide spread area in eastern and south eastern part of the district covering Balotra, Siwana, Chohitan, Dhorimanna and Sindhrī blocks.	
Sandstone (Tertiary)	Barmer sandstone is white and grey siliceous sandstone with occasional bands containing well sorted pebbles of Malani volcanics. It is bounded by thick clay deposits in the north around Sheo and Crystalline formations in western and southern parts. Cross section Bhadka-Baytoo shows thickness of sandstone is limited and major facies is argillaceous containing bentonite and shales. Other sections Munaba - Mapudi, Goonga-Undu indicate fault near villages Gadra Road and Bhinyar of Sheo block which separates thick Tertiary formations from Lathi. This area having shallow crystalline basement at depth of about 103 m.	It encompasses central part, north western and western peripheral area in Sheo and Baytoo blocks. In central part due to thick clay sequences some pockets have been included into ground water potential zones.	
Lathi Sandstone (Jurassic)	It is white, grey friable sandstone intercalated with beds of ferruginous sandstone and shales. In area east of Sheo, Lathi sandstone is of grey colour, coarse grained and friable interbedded with ferruginous sandstone and shales, while in western part represented by coarse grained sandstone comprising well sorted quartz grains. A cross section Asardi-Mapudi indicates that depth of the basement increases northward. A bore hole near village Undu indicate thickness of the Lathi sandstone about 108 m.	It is confined to Sheo block where occurs in three localised area situated in northern and western part. Due to shallow basement, part of the aquifer has been demarcated in ground water potential area.	
Jalor/Siwana granite -Malani rhyolite (Post Delhi Intrusives)	Malani volcanics comprise black dark brown to pink rhyolite containing phenocrysts of quartz and feldspar in glassy matrix. Volcanic ash, tuff and breccia has also been observed at places. Jalor and Siwana granites are pink in colour, fine to coarse grained having phenocrysts of feldspar.	These cover central part of the district mainly comprising Barmer and Sheo blocks. Granite and Rhyolite occupy nearly 12% potential area.	

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

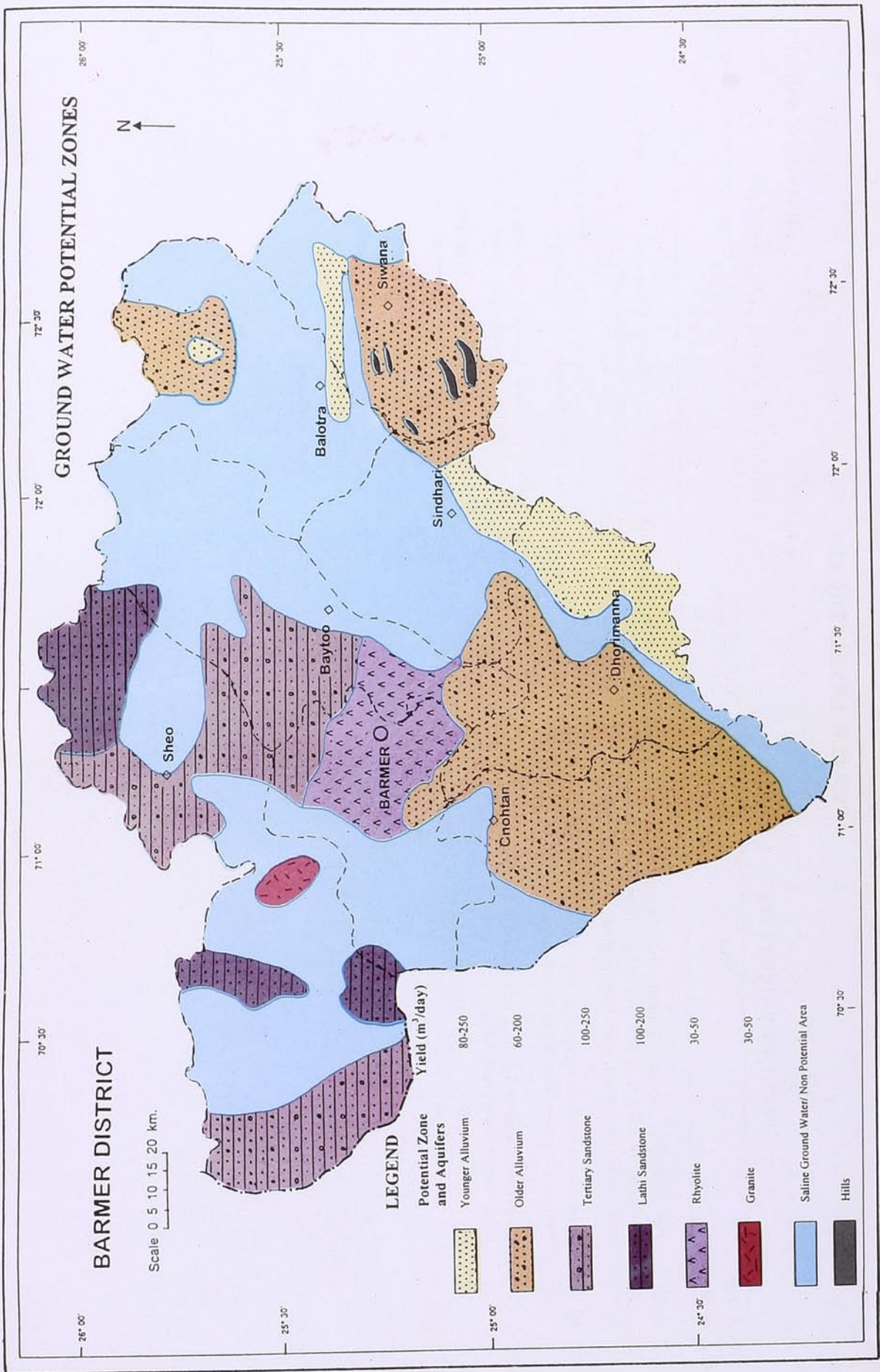


GROUND WATER POTENTIAL ZONES AND DEVELOPMENT PROSPECTS

DISTRICT - BARMER

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 ⁻⁶ siem/cm	Development Prospects
			Type	Proposed depth in m		
Younger Alluvium (1539.98)	* Balotra (100.00)	<25	TW/DCB	60-100/15-50	110-200/50-80	Over exploited
	* Dhorimanna (773.80)	<10	DCB	50-135	50-100	Critical
	* Sindhari (453.68)	<25	DCB	25-40	50-80	Critical
	* Siwana (212.50)	<20	TW/DCB	60-125/25-40	80-120/50-80	Critical
Older Alluvium (5614.49)	* Balotra (654.38)	20-45	TW/DCB	60-80/30-50	100-150/50-120	Semi Critical and white
	* Barmer (611.42)	40-70	TW/DCB	100-150/60-100	50-100/30-80	Critical
	* Chohtan (1718.75)	50-75	TW/DCB	100-200/50-90	50-120/50-90	Critical
	* Dhorimanna (887.94)	15-50	TW/DCB	100-200/50-80	60-120	Critical
	* Sindhari (529.50)	20-40	TW/DCB	100-150/40-60	60-200/50-80	Critical
	* Siwana (1212.50)	20-40	TW/DCB	75-150/15-60	100-200/50-120	Critical
	* Baytoo (645.00)	50-85	TW	150-250	100-250	White
	* Sheo (2039.21)	70-110	TW	175-250	100-250	White
Lathi Sandstone (1499.79)	* Baytoo (72.50)	30-40	TW	80-120	100-130	White
	* Sheo (1427.29)	50-105	TW	175-250	100-200	Girab-Hassani zone over exploited, Undu zone - White
Rhyolite (1306.42)	* Barmer (1306.42)	10-35	DW	20-50	30-50	White
Granite (306.25)	* Sheo (306.25)	10-30	DW	20-40	30-50	White

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



WATER LEVEL TRENDS

DISTRICT : BARMER

DEPTH TO WATER LEVEL

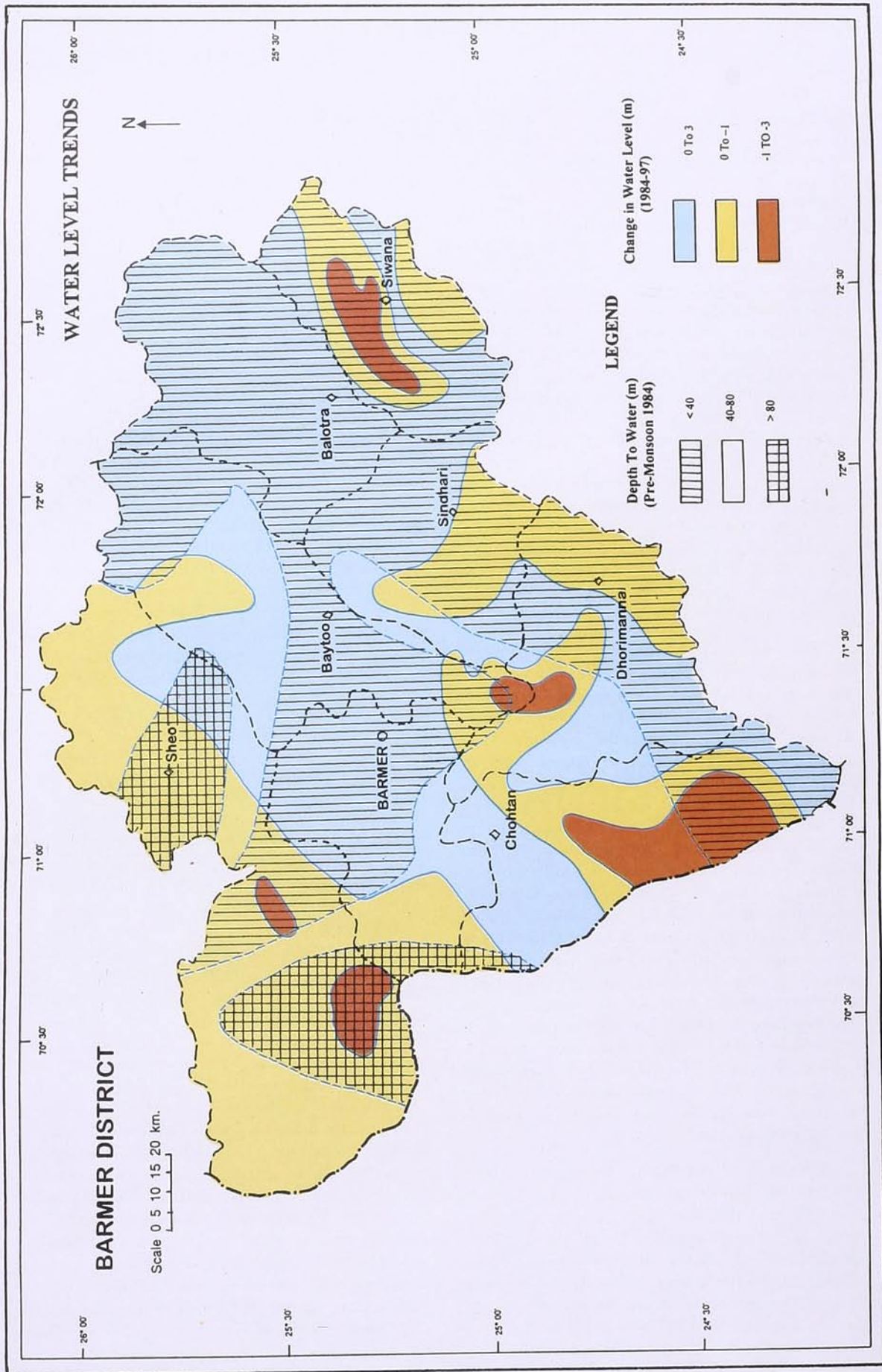
Range in m	Area
< 40	Part of Balotra, Siwana, Sindhari and Dhorimanna blocks situated in catchment of Luni river and area around Baytoo and Barmer in central part has shallow water level ranging upto 40 m.
40 to 80	Area around Chohtan and part of Sheo block located nearly northern and western periphery have depth to water level within the range.
> 80	Area around Sheo and western part located in Sheo block have deep water level ranging more than 80 m.

CHANGE IN WATER LEVEL (1984-1997)

Range in m	Area
0 to 3	Major part of district mainly demarcated as non-potential area show marginal rise in water level less than 3 m.
0 to -1	Extensive area in Sheo block and part of Chohtan, Dhorimanna, Balotra, Siwana and Sindhari blocks exhibit marginal depletion of less than 1 m.
-1 to -3	Small pockets in Sheo, Chohtan, Dhorimanna, Sindhari and Balotra blocks show depletion in water level within the range.

DETAILS OF THE SPOT

Spot code	Village (Block)	Change in water level in m (1984-97)
1.	Asotra (Barmer)	(-) 11.35
2.	Mauri (Siwana)	(-) 10.65



GROUND WATER POTABILITY

DISTRICT BARMER

The district being part of arid zone has mineralised ground water. The map of salinity clearly shows wide variation in salinity of ground water. It varies from 500 $\mu\text{S}/\text{cm}$ to as high as 17000 $\mu\text{S}/\text{cm}$. The ground water with salinity ranging between 2000-4000 $\mu\text{S}/\text{cm}$ are encountered mostly in Chohtan, Barmer & parts of Sheo, Siwana and Dhorimanna blocks. However, the ground water is practically saline ($\text{EC} > 8000 \mu\text{S}/\text{cm}$) in Baytoo, Sindhari and Dhorimanna blocks. The ground water quality is also saline in west of Sheo, south of Chohtan, south-east of Barmer and north-west of Balotra. The bar diagramme of salinity reveals that only 17.4% ground water have salinity less than 2000 $\mu\text{S}/\text{cm}$ while 38.9% & 18.8% fall in the slightly saline (2000-4000 $\mu\text{S}/\text{cm}$) and moderately saline (4000-6000 $\mu\text{S}/\text{cm}$) class of salinity respectively. The saline ground water (25%) have high electrical conductivity i.e., above 6000 $\mu\text{S}/\text{cm}$ and covers almost 50% region of the district. The prevalence of high salinity in ground water is due to the hydrogeological barriers like clay formations which covers around sixty per cent of the region. These formations restrict the circulation of water through aquifers and extreme arid climatic conditions help in salinization of ground water.

The water analysis results reveal the presence of unusually high nitrate in ground water. The maximum concentration of nitrate i.e. 730 mg/L is found in the well water of Akdara in Baytoo block. As seen from bar diagramme, the contamination of nitrate ($> 100 \text{ mg}/\text{L}$) is high in ground water of Baytoo (66.7%), Barmer (60.9%), Chohtan (58.8%), Dhorimanna (55.5%) and Sindhari (52.9%) blocks. The nitrate concentration ($< 100 \text{ mg}/\text{L}$) is relatively low in ground water of Balotra, Sheo and Siwana blocks. The distribution of nitrate is clearly shown in the map of nitrate. No significant relationship exists between nitrate and salinity. Low salinity ground water at many places near Siwana, Chohtan and Barmer are characterised with high nitrate. On the contrary, saline ground water of Sindhari, Dhorimanna and Balotra blocks have low nitrates. It is also observed from the nitrate map that the ground water of Sheo block along with few small areas in Barmer, Chohtan, Balotra & Siwana are free from nitrate contamination. Thus the high concentration of nitrate in ground water is the main problem for locating potable ground water.

Fluoride contents of ground water do not exhibit any specific relationship with salinity. The fluoride map illustrates that low salinity ground water free from fluoride contamination in the district. High concentration of fluoride are normally associated saline ground water in Baytoo, Sindhari, Dhorimanna blocks. The ground water in the east of Balotra, Siwana and south of Chohtan block have fluorides

more than 4.0 mg/L. Further the bar diagramme reveals that the ground water in Baetu (50%), Dhorimanna (78.9%), Sindhari (88.2%) and Sheo (57.1%) blocks have unpotable fluorides in comparison to rest of the blocks. The highest concentration of 18.0 mg/L of fluoride is noticed in a highly saline ground water having EC of 14800 $\mu\text{S}/\text{cm}$.

Calcium and Magnesium are the principal elements which causes hardness in water. It is evident from the water analyses that the appreciable concentrations of alkaline earths (above 300 mg CaCO_3/L) are observed in saline ground water. About 46.6% ground water have hardness of less than 300 mg CaCO_3/L . The hardness varies from 90 to 1675 mg CaCO_3/L .

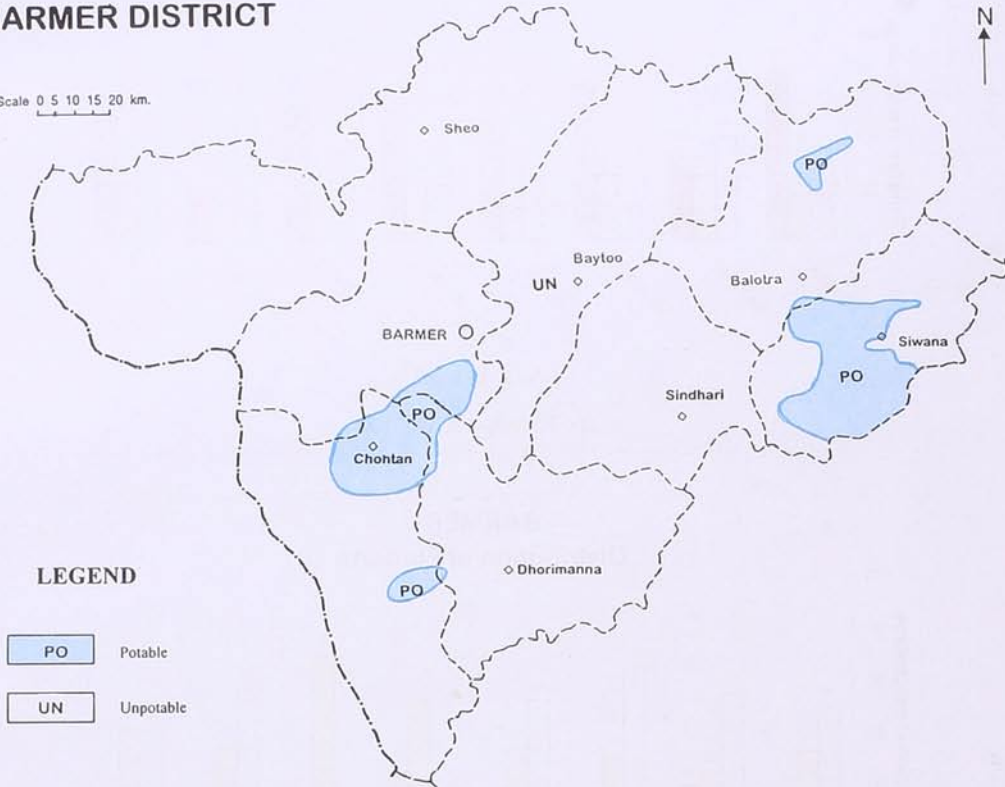
More than 75% ground water, exhibit dominance of sodium & chloride ions. Such waters yield high dissolved solids and fall in the very high class of salinity. The water analyses reveal that only 7.6% ground water occurring near foot hill zones of Siwana and isolated patches in Sheo have shown bicarbonate type character. These ground waters have dominance of sodium and characterised by low dissolved solids. Further 16.7% ground water exhibit mix type character and the most of these waters occur in north and west of the district. Such type of waters also show dominance of sodium and fall in moderately saline class of salinity.

On evaluating the water quality for drinking (ICMR), it is found that ground water from Lathi and Tertiary sand stone are suitable because of their low salinity as well as levels of health affecting constituents. The fresh water pockets conforming to water quality standards with respect to salinity, nitrate and fluoride are mainly observed in south of Barmer and southern portion of Siwana block. Besides, some tentative fresh water belts are also encountered in Undu-Bhinyar-Kanasar section in north, Nimbla-Nagurda-Bhimda section in east of Baytoo and a thin Unror-Girab section in north-west of Sheo block. Though the salinity in these sections is in potable range yet the quality with respect to nitrate & fluoride has to be ascertained prior to exploring the ground water in above sections for drinking water supplies. Due to high contents of nitrate in the low salinity ground water of south-west & east region has become unsuitable for drinking. Except for the highly saline & alkaline waters the ground water have low contents of fluoride. The suitable regions of ground water for drinking water is clearly demarcated in the map prepared on the basis of ICMR potability levels of drinking water quality. The ground water analyses and anonymous water rating criteria of irrigation water, reveal that the ground water salinity less than 8000 $\mu\text{S}/\text{cm}$ can be used for growing salt-tolerant crops on the sandy soils.

GROUND WATER POTABILITY

BARMER DISTRICT

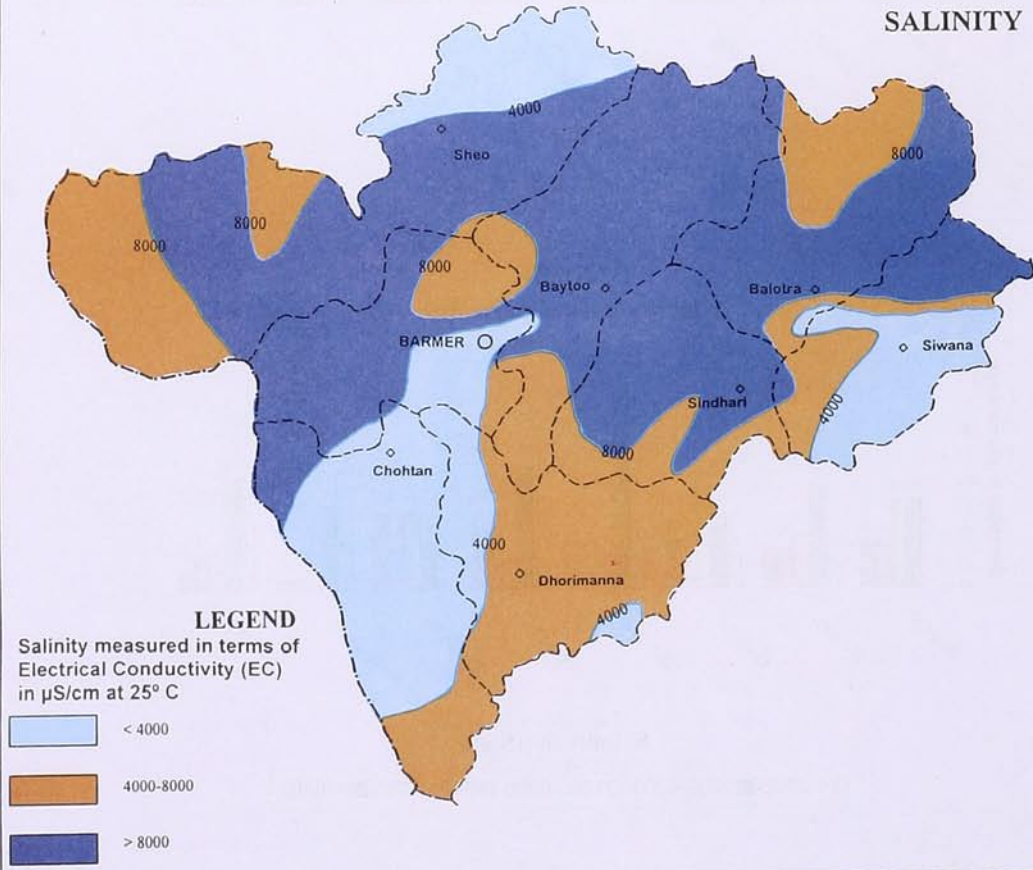
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LEGEND

- PO Potable
- UN Unpotable

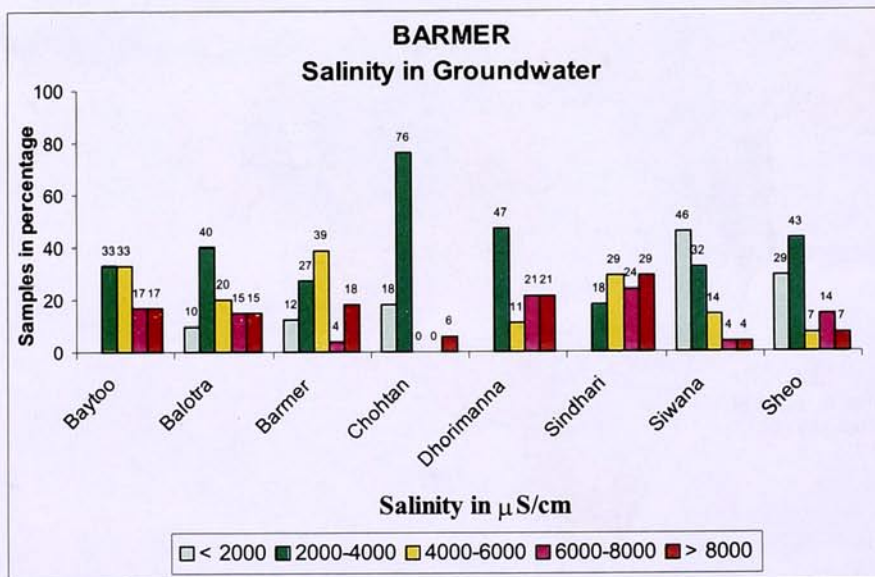
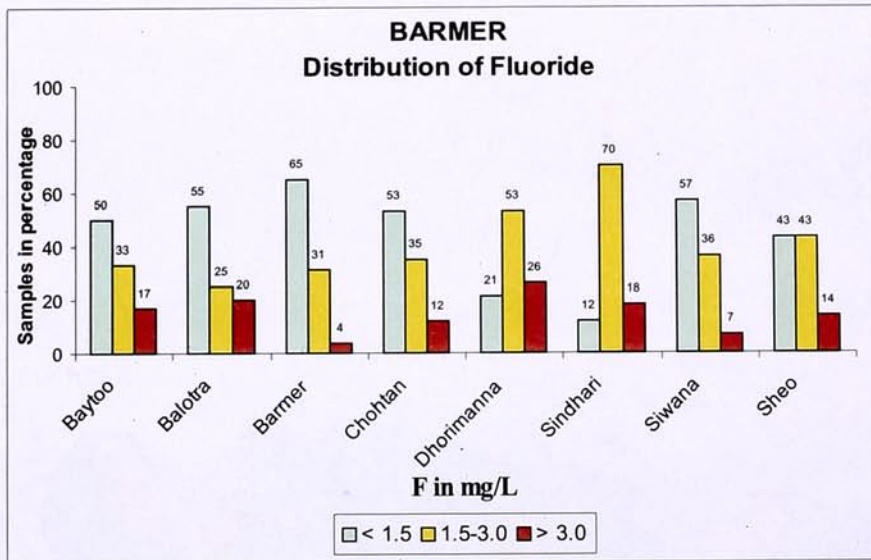
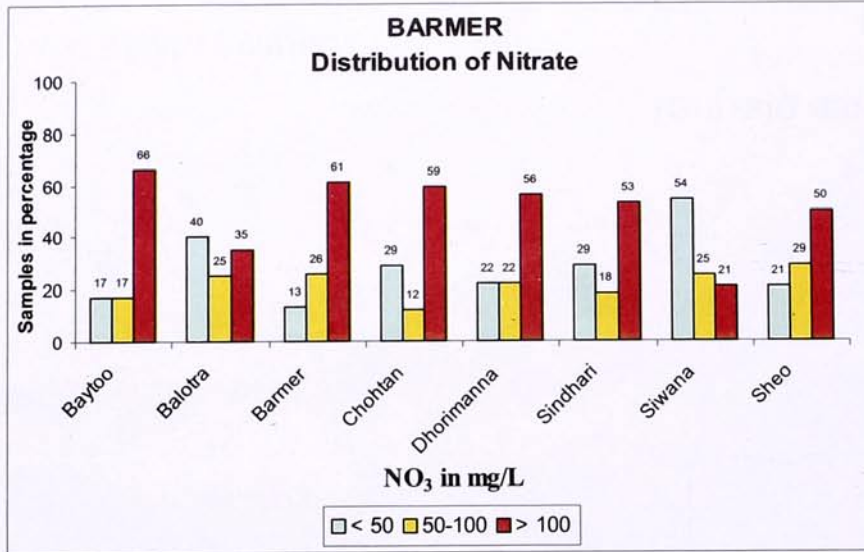
SALINITY



LEGEND

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

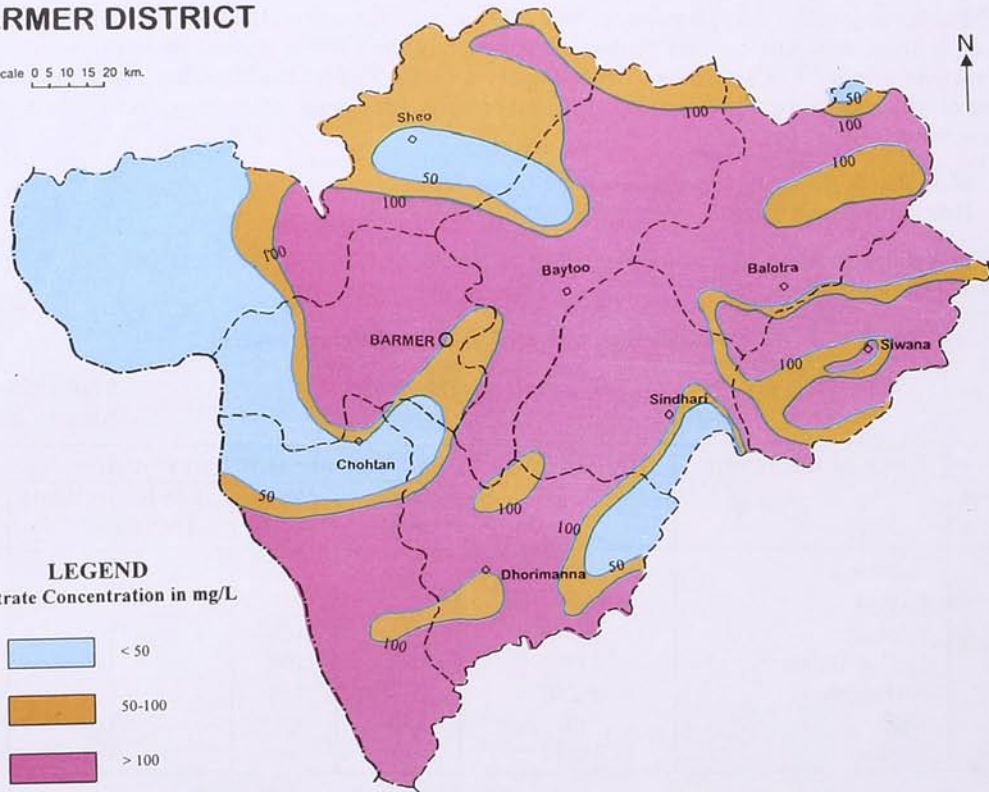
- < 4000
- 4000-8000
- > 8000



NITRATE DISTRIBUTION

BARMER DISTRICT

Scale 0 5 10 15 20 km.



FLUORIDE DISTRIBUTION

