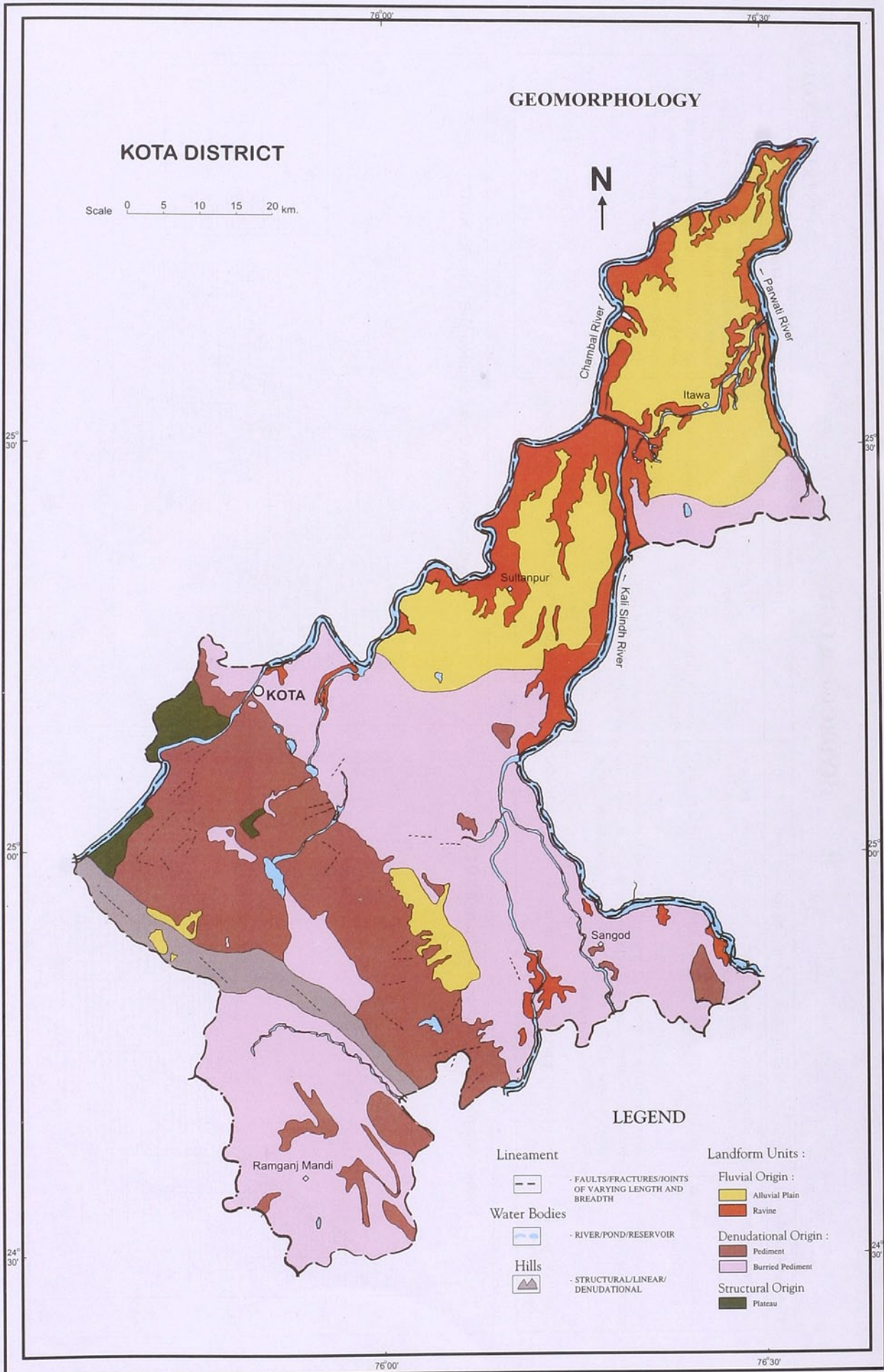


GEOMORPHOLOGY

DISTRICT—KOTA

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.	In between rivers Kalisindh, Chambal and Parvati.	Double crop, single crop (Rabi), fallow.
Ravine	RV	Small, narrow, deep, depression, smaller than gorges, larger than gully, usually carved by running water.	Along rivers Kalisindh, Chambal and Parvati, mainly concentrate in north.	Single crop (Kharif), 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.	Main concentration in central and western part. Scattered in south, east and north.	Marginal double crop, single crop (Kharif), open scrub, fallow land.
Burricd Pediment	BP	Pediment covered essentially with relatively thicker alluvial, colluvial or weathered materials.	Mainly concentrated in northern, central, western and south west.	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.	South east and north west of district.	Land with or without scrub.
Hill Structural Hill	SH	Linear to arcuate hills showing definite trend-lines with varying lithology associated with folding, faulting etc.	Run in between west to south east & south small patches in north.	Forest, open scrub.

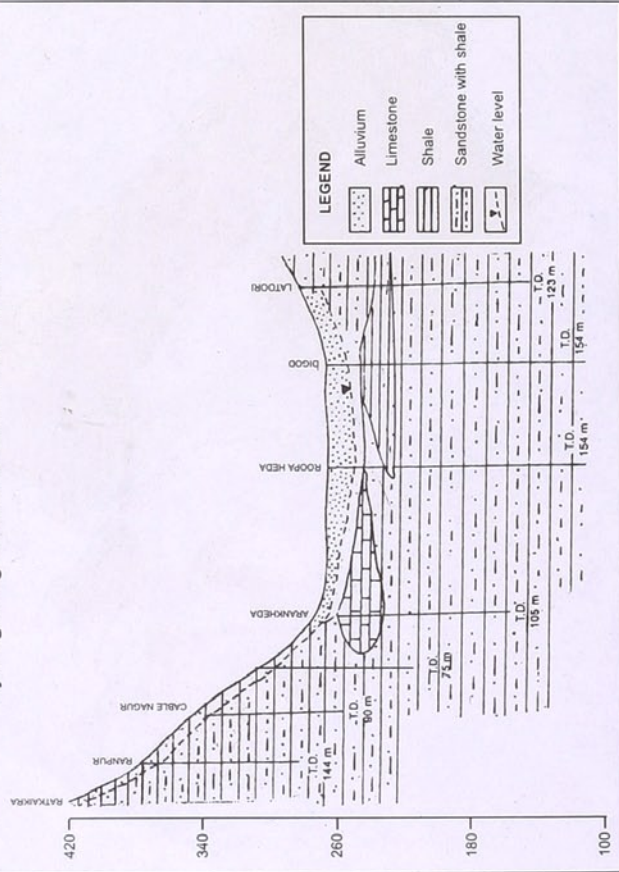


HYDROGEOLOGY

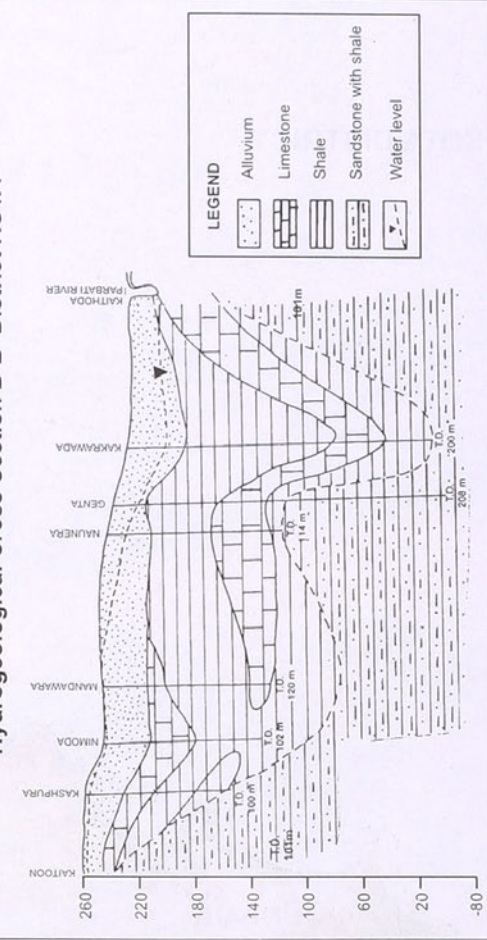
DISTRICT—KOTA

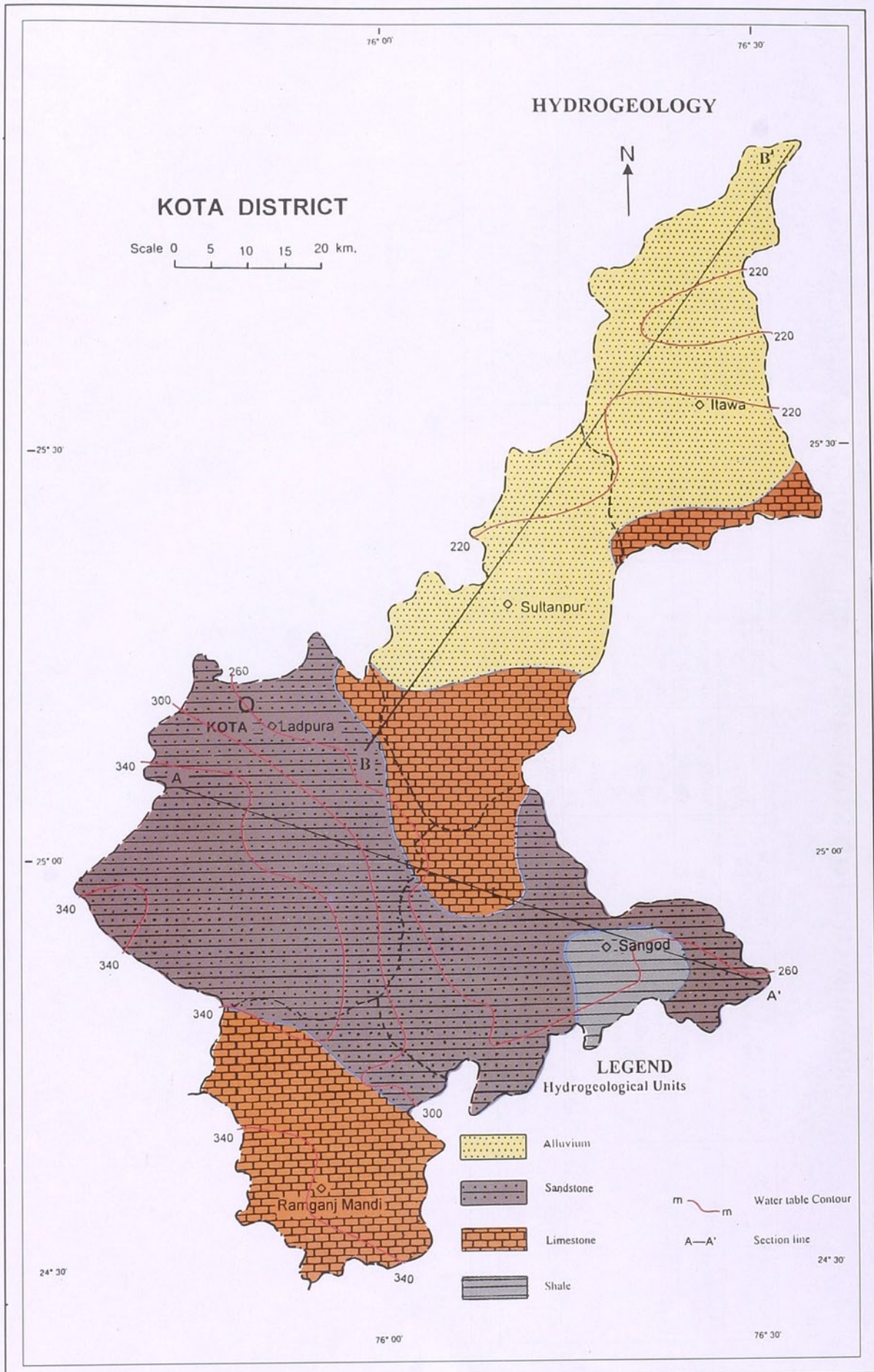
Hydrogeological units	Description of the unit/Geological section	Occurrence	Ground Water flow
Alluvium (Quaternary)	It comprises unconsolidated to semi consolidated sand, silt and clays. Thickness of alluvium varies from few metres to about 40m.	The litho unit occupies northern part of the area in parts of Itawa and Sultanpur blocks.	General direction of ground water flow corresponds to the surface drainage pattern. In major part of the area, it has been inferred, SW to NE. However in eastern part around Sangod the flow direction is from S to N. Hydraulic gradient in the central part has been computed as 4.0 m/km.
Sandstone (Vindhyan Super Group)	Sandstone is buff to red coloured, hard compact and quartzitic.	It occurs in Central part of the area in Latpura and Sangod blocks.	
Limestone (Vindhyan Super Group)	Limestone is fine to medium grained grey, yellowish buff, red and chocolate coloured. Grey and yellowish limestone at places are siliceous, hard and less susceptible to weathering. Limestone is often interbedded with shales.	Limestone of Vindhyan Super Group encompasses Ramganj Mandi and localised pockets in other blocks.	
Shale (Vindhyan Super Group)	The litho unit represents Rewa group and occurs as interbedded with sandstone and limestone.	Shale of Vindhyan Super Group covers area around Sangod.	

Hydrogeological Cross Section A-A' District KOTA



Hydrogeological Cross Section B-B' District KOTA



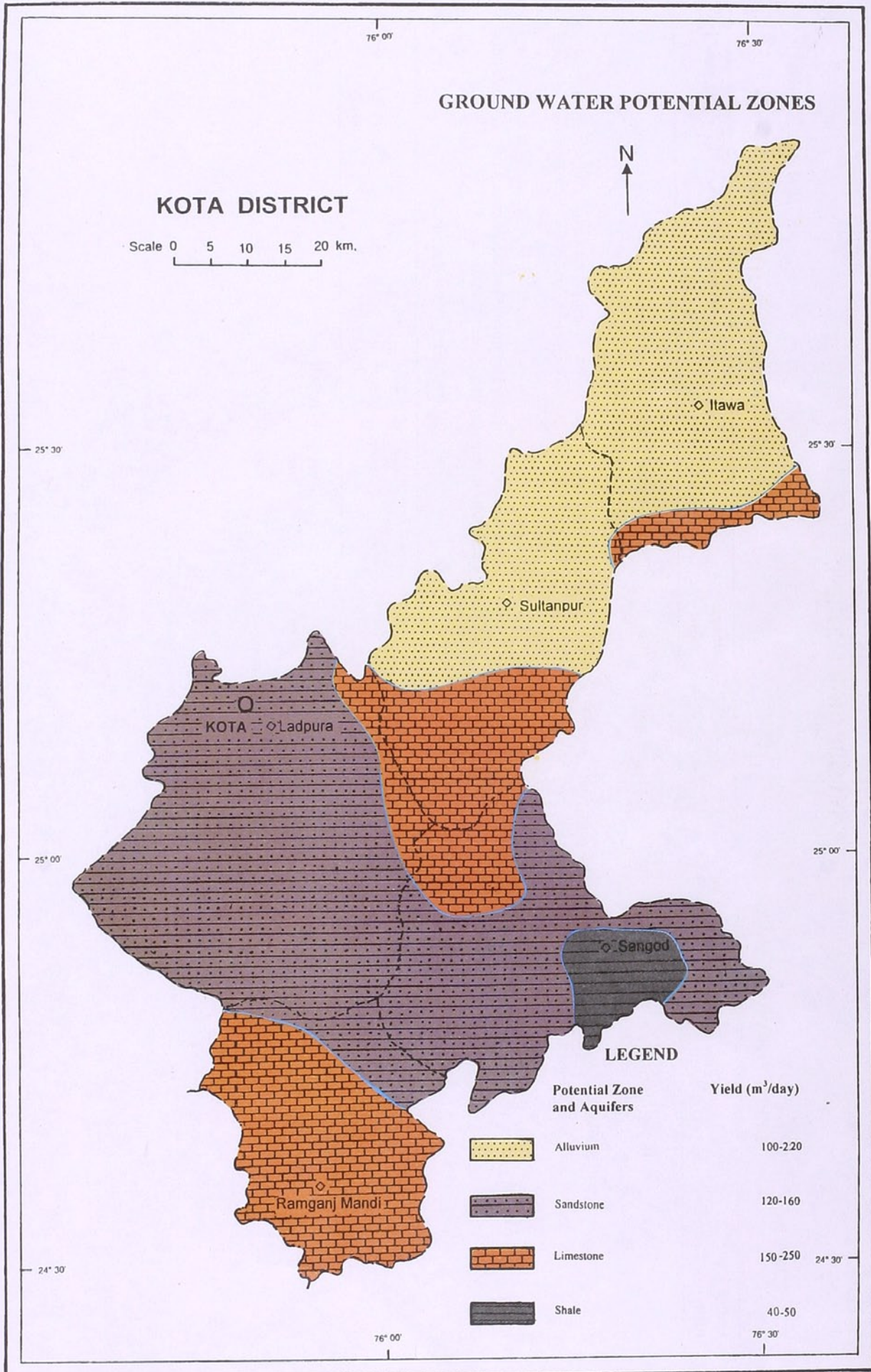


GROUND WATER POTENTIAL ZONES AND DEVELOPMENT PROSPECTS

DISTRICT - KOTA

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		
Alluvium (1410.25)	* Itawa (787.30)	<20	TW/DW	80-100/25-40	200/60-70	Safe
	* Sultanpur (622.95)	<25	TW/DW	80-100/25-40	200/60-70	Safe
Limestone (1180.53)	* Itawa (110.21)	<15	TW/DW	80-100/25-40	270/65-85	Safe
	* Ramganjmandi (556.85)	<20	TW/DW	80-100/25-30	270/65-85	Over exploited
	* Ladpura (64.95)	<20	TW/DW	80-100/25-30	270/65-85	Safe
	* Sangod (161.90)	<20	TW/DW	80-100/25-30	270/65-85	Safe
	* Sultanpur (286.62)	<30	TW/DW	80-100/25-40	270/65-85	Over exploited
Sandstone (2380.89)	* Ramganjmandi (193.75)	<15	TW/DW	80-100/25-40	270/65-85	Over exploited
	* Ladpura (1456.40)	<20	TW/DW	80-100/25-40	270/65-85	Safe
	* Sangod (730.74)	<15	TW/DW	80-100/25-40	270/65-85	Safe
Shale (151.50)	* Sangod (151.50)	<20	TW/DW	80-100/25-30	150/25-35	Safe

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 : KOTA

DEPTH TO WATER LEVEL

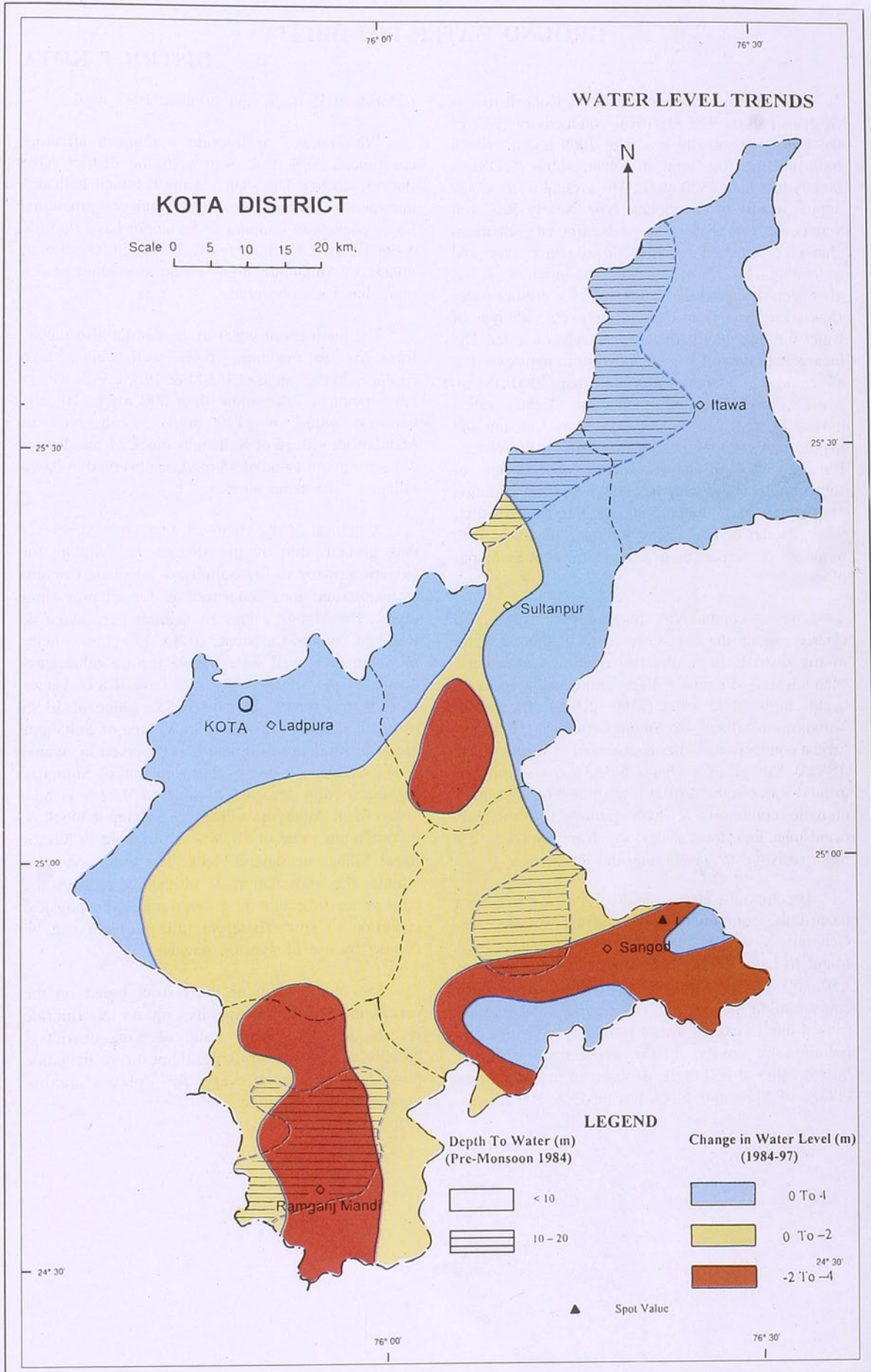
Range in m	Area
< 10	Major part of the district, leaving aside pockets in Itawa, Sangod and Ramganjmandi block, has shallow water level less than 10 m.
10 to 20	Part of Itawa block along Chambal river and small area around Ramganjmandi and west of Sangod have depth to water level between the range.

CHANGE IN WATER LEVEL (1984-1997)

Range in m	Area
0 to 4	Itawa, Sultanpur and part of Ladpura block along Chambal river and pockets in Sangod block exhibit rise in water level within the range.
0 to -2	Southern part of the district comprising part of Ladpura, Sangod and Ramganjmandi blocks show marginal depletion in water level less than 2 m.
-2 to -4	Area around Sangod, Ramganjmandi and a pocket east of Ladpura exhibit depletion in water level between the range.

DETAILS OF THE SPOT

Spot code	Village (Block)	Change in water level in m (1984-97)
1.	Sangod (Sangod)	(-) 9.60



GROUND WATER POTABILITY

DISTRICT KOTA

The quality of ground water in Kota district is fresh in nature. The electrical conductivity (EC) of the water is generally less than 2000 $\mu\text{S}/\text{cm}$, which indicates that the total dissolved solids (TDS) is mostly less than 1500 mg/L. The ground water of the area is mostly of bicarbonate type. Nearly 76% well waters of the district have bicarbonate chemical character followed by 13% mixed anion type and remaining 11% are of chloride type in nature. It has also been observed that salinity of the ground water slowly increases from bicarbonate to chloride type of water through intermediate mixed type of water. The bicarbonate type of waters are fresh in nature having electrical conductivity value less than 2000 $\mu\text{S}/\text{cm}$, while chloride type of waters are slightly saline having EC range of 2000-4000 $\mu\text{S}/\text{cm}$. Calcium and magnesium are dominating cations in low EC Waters. But generally in saline waters concentration of sodium is enhanced with the inhibition of concentration of alkaline earth metal ions. In the Kota district, ground water of Ladpura & Ramganj mandi is fresh in nature in comparison to Sangod, Itawa & Sultanpur block.

The iso-conductivity map of the district also clearly reveals the occurrence of fresh ground water in the district. In north-east covering Gumanpura, Mandawara, Mingana village some saline pockets occurs high saline water (7500 $\mu\text{S}/\text{cm}$) observed in Mandawara village of Sultanpur block. However, lowest conductivity water is observed in Jogpura (300 $\mu\text{S}/\text{cm}$) Village of Ladpura block. Low salinity of ground water in the district is attributed to sub-humid climatic conditions & hydrogeological formations (sandstone, limestone, shales) which are comparatively more resistive to weathering and dissolution.

The ground water in the district is also free from hazardous components like nitrate & fluoride. Generally 83.4%, 11% & 57% well waters have been found to have nitrate concentration in the range of <50, 50-10 & >100 mg/L respectively. High concentration of nitrate in the ground water may be caused due to excess use of nitrogenous fertiliser or pollution by sewage. In the whole district highest nitrate value of 650 mg/L is observed in Mandawara village of Sultanpur block having EC 7500 $\mu\text{S}/\text{cm}$,

Chloride-1035 mg/L and sulphate 1033 mg/L.

With regards to fluoride - a health affecting constituent, 88% well waters in the district have fluoride content less than 1.5 mg/L which indicates that the area is free from fluoride induced problems. Some pockets in Ladpura & Sultanpur have fluoride content between 1.5-3.0 mg/L & only in Kherlitoran village of Sultanpur, highest fluoride, value of 3.6 mg/L has been observed.

The hardness of water in the district also ranges from low to medium. 76.4% well waters have hardness in the range of 0-300 & 19.7% well waters have hardness value more than 600 mg/L. Highest hardness value of 1170 mg/L is observed in Mandawara village of Sultanpur block of the district & its minimum value of 45 mg/L is observed in Itawa village of the same block.

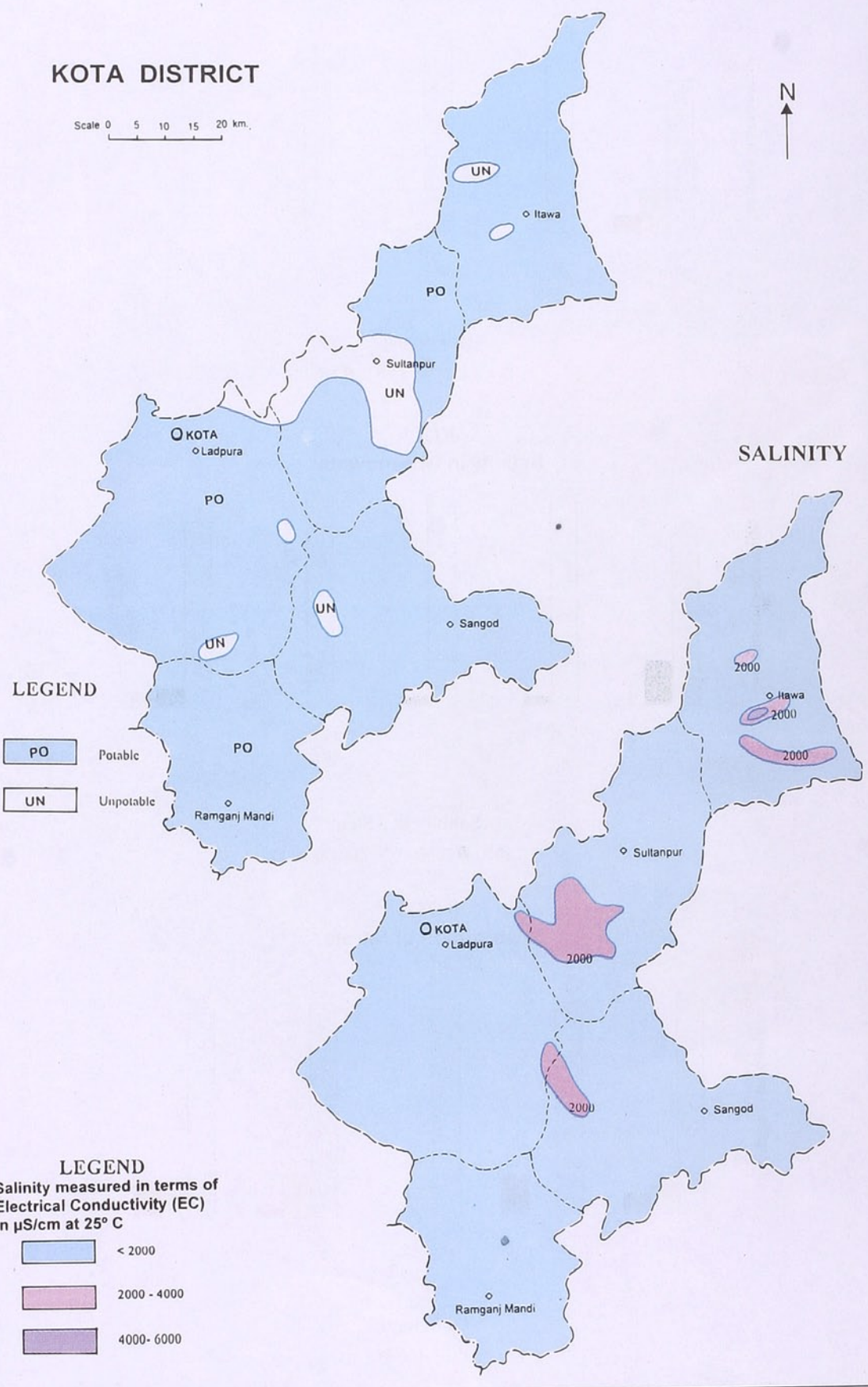
A perusal of the chemical analysis data reveals that groundwater of the district is suitable for irrigation owing to low salinity & adequate calcium & magnesium ions concentration for all prevailing crops. The higher values of sodium percentage & Residual Sodium Carbonate (R.S.C.) imparts sodicity in water. 68% well waters have R.S.C. values less than 2 meq/L whereas only 32% have R.S.C. values more than 2 meq/L. Highest R.S.C. value of 13.95 meq/L is observed in Amarpura village of Sultanpur block & minimum of 0 meq/L is observed in Ayana, Ayani, Mingana & many other well waters. Similarly highest sodium percentage value of 92.2% is also observed in Amarpura village of Sultanpur block & its minimum value of 10.98% is observed in Kishor Sagar Village of Sangod block. The sodic condition inhibits the germination & ultimately reduces the crop yield. In addition, it deteriorates the physical condition of soil. Therefore, this problem can be combat by use of gypsum powder.

The quality map of the district based on the permissible limits of salinity, nitrate & fluoride reveals that the ground water of Kota district is broadly suitable for drinking, domestic & irrigation purposes, except at very few places quality management is required.

GROUND WATER POTABILITY

KOTA DISTRICT

Scale 0 5 10 15 20 km.



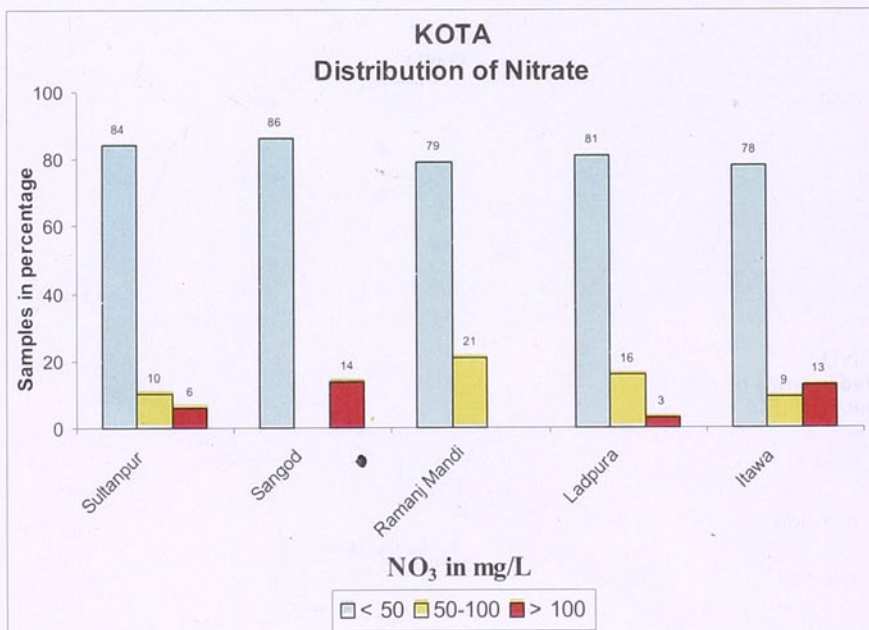
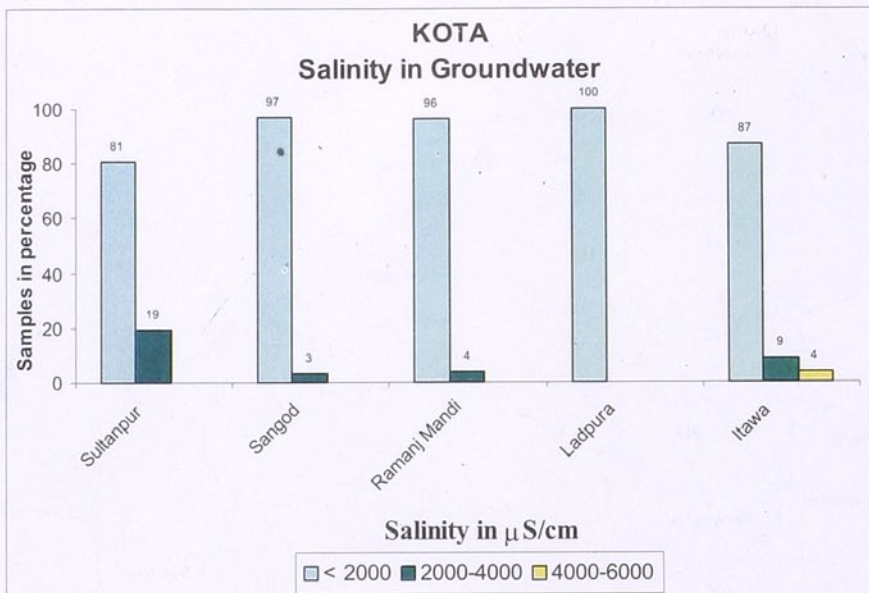
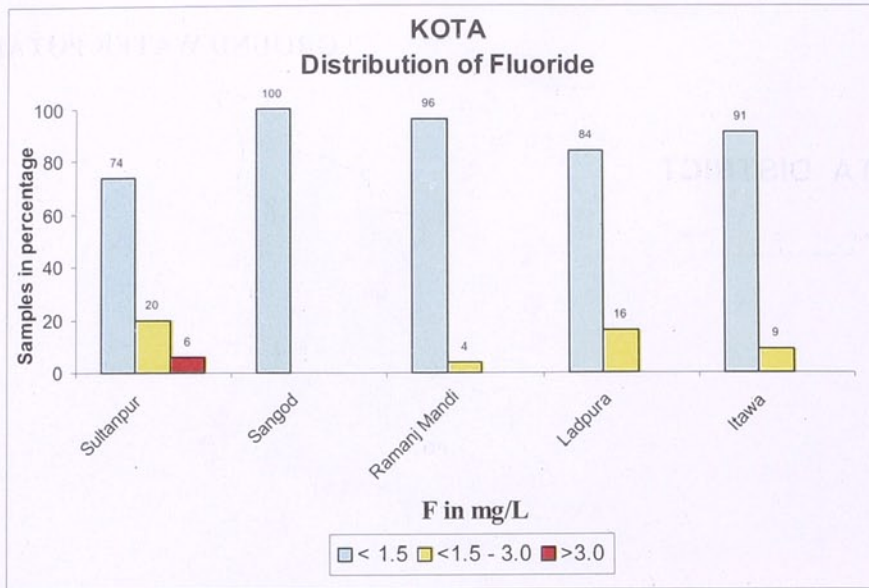
LEGEND

- PO Potable
- UN Unpotable

LEGEND

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

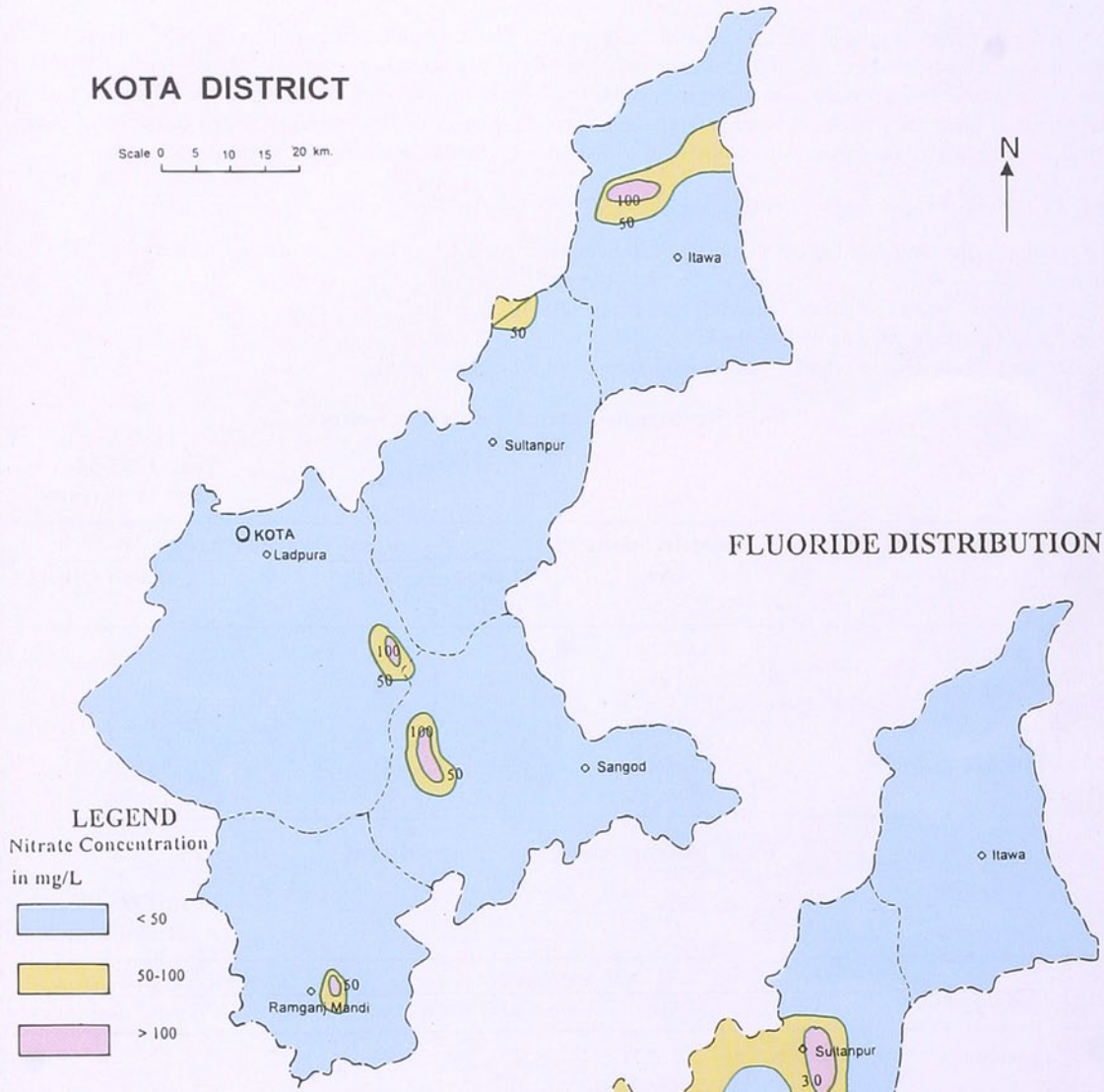
- < 2000
- 2000 - 4000
- 4000 - 6000



NITRATE DISTRIBUTION

KOTA DISTRICT

Scale 0 5 10 15 20 km.



FLUORIDE DISTRIBUTION

LEGEND

Fluoride Concentration in mg/L

