

DISTRICT GROUNDWATER BROCHURE



स्वच्छ सुरक्षित जल – सुन्दर खुशहाल कल
CONSERVE WATER - SAVE LIFE

CENTRAL GROUND WATER BOARD
Ministry of Water Resources
Government of India



Western Region
Jaipur
July, 2008

DISTRICT AT A GLANCE – JODHPUR DISTRICT, RAJASTHAN

S No	Item	Information	
1	GENERAL INFORMATION		
	(i) Geographical area (sq km)	22,850	
	(ii) Administrative Division (As on 31.3.2007)		
	Number of Tehsils	07	
	Number of Blocks	09	
	Number of Villages	1157	
	(iii) Population (As per 2001 Census)	28,86,505	
(iv) Average Annual Rainfall (1971-2005)	326.8 mm		
2	GEOMORPHOLOGY		
	Major Physiographic Units	Sand Dunes, Alluvial plains, Ridges and Hillocks	
	Major Drainage	Luni River & Mithri River	
3	LAND USE (sq km)		
	(a) Forest Area	70.32	
	(b) Net Sown Area	12659.44	
	(c) Cultivable Area	14109.44	
4	MAJOR SOIL TYPE	Red desertic soils, Desert soils, Sand dunes, Lithosol & regosols of hills, Saline soils and Sierozem.	
5	AREA UNDER PRINCIPAL CROPS (AS ON 2005-06)	Crops	Area in hectare.
		Bajra	2,75,000
		Moth	2,00,000
		Moong	1,20,000
		Guar	20,500
		Till	45,000
		Ground nut	18,000
		Wheat	32,000
		Chilli	10,000
		Mustard	60,000
Cotton	10,000		
6	IRRIGATION BY DIFFERENT SOURCES (As on 31-03-06)		
	Source	No of structures	Gross Irrigated Area in hectare
	Dug wells	19429	8306
	Tube wells/Bore wells	13566	136948
	Tanks/Ponds		-
	Canals		17
	Other Sources		464
	Net Irrigated Area (ha)	145735	
	Gross Irrigated Area (ha)	182119	
7	NUMBER OF GROUND WATER MONITORING WELLS OF CGWB (As on May 2007)		
	Number of Dug wells	61	
	Number of Piezometers	28	
8	PREDOMINANT GEOLOGICAL FORMATIONS	Quaternary aeolian sand, Alluvium, Bap Boulder Bed, Nagaur Sandstone, Bilara Limestone and Jodhpur Sandstone of Marwar Super Group, Malani Igneous Suite, Eranpura granite & rocks of Delhi Super Group.	

9	HYDROGEOLOGY	
	Major water bearing formation	Quaternary alluvium, Nagaur Sandstone, Bilara Limestone and Jodhpur Sand - stone, Rhyolite, Granite, Schist and Phyllite.
	Depth to water level (Pre-monsoon, 2006) (mbgl)	2.10 – 77.94
	Depth to water level (Post-monsoon, 2006) (mbgl)	0.30 to 70.88
	Long term water level trend (1997-2006)	-0.17 to -0.89 m / year
10	GROUNDWATER EXPLORATION BY CGWB (As on 31.3.2007)	
	Number of wells drilled (EW, OW, PZ, SH)	EW – 37,OW- 9, SH –17 & PZ- 14
	Depth Range (m)	21 – 339.5
	Discharge (litre per second)	Negligible – 75
	Storativity	-
	Transmissivity (m ² /day)	Up to 832 m ² /day in alluvium
11	GROUND WATER QUALITY	
	Presence of chemical constituents more than permissible limit (EC>1500 m mhos/cm at 25 ⁰ C, F>1.5 mg/l, No3> 45mg/l)	EC – 4500 sq km F – 6500 sq km No3 – 3000 sq km
12	DYNAMIC GROUND WATER RESOURCES (March, 2004) in mcm	
	Annual Replenish able Ground Water Resources	375.6419
	Net Annual Ground Water Draft	741.4370
	Projected Demand for Domestic and Industrial Uses up to 2025	182.4611
	Stage of Ground Water Development	197.38%
13	GROUND WATER CONTROL AND REGULATION	
	Number of Over-exploited blocks	05
	Number of Critical Blocks	02
	No of Blocks Notified	-
14	MAJOR GROUND WATER PROBLEMS AND ISSUES	1. Water level decline. 2. Rising water level in Jodhpur city. 3. Quality Problem. 4. Industrial pollution. 5. Less groundwater recharge due to scanty & uneven rainfall.
15	MASS AWARENESS AND TRAINING PROGRAM CONDUCTED BY CGWB	A. Mass Awareness Program 1. Mathaniya 2. Bilara 3. Mandore B. Training Program 1. Jodhpur

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DISTRICT GROUND WATER BROCHURE JODHPUR DISTRICT

1.0 INTRODUCTION

Jodhpur district is situated between 25° 51' 08" & 27° 37' 09" North latitude and 71° 48' 09" & 73° 52' 06" East longitude covering geographical area of 22,850 sq km. This district comes under arid zone of the Rajasthan State. Jodhpur district is part of Jodhpur Division. The district is divided into 5 sub-divisions namely Jodhpur, Shergarh, Pipar City, Osian & Phalodi and comprises of 07 tehsils & 09 blocks. Total number of villages in the district is 1157 (2001 census). Jodhpur district is bound by Nagaur in East, Jaisalmer in west, Bikaner in North and Barmer as well as Pali in the South. Rural & Urban population of the district is 19,09,423 & 9,77,082 respectively. Decennial population growth rate of the district is 34.03% since 1991. The district is known for its Guar gum industries and mineral wealth.

Systematic Hydrogeological survey in the district was carried out by Central Ground Water Board from 1963-64 to 1978-79. Reappraisal hydrogeological survey of district was carried out from 1983-84 to 1994-95 and Micro level hydrogeological survey in the district was carried out from 2001-02 to 2006-07. Under exploratory program 37 exploratory boreholes and 17 slim holes have been drilled. Since 1973, monitoring of water level is being carried out and presently four times a year from 89 National Hydrograph Network Stations.

2.0 RAINFALL & CLIMATE

The district experiences arid to semi-arid type of climate. Mean annual rainfall (1971-2005) of the district is 326.8 mm whereas normal rainfall (1901-1970) is lower than average rainfall and placed at 296.1 mm. The rainy days are limited to maximum 15 in a year. Almost 80% of the total annual rainfall is received during the southwest monsoon, which enters the district in the first week of July and withdraws in the mid of September. Probability of annual rainfall exceeding 650 mm is only 10%. However, there is 90% probability that the annual rainfall will be more than 190 mm. The probability of occurrence of mean annual rainfall is 45%. Drought analysis based on agriculture criteria indicates that the district is prone to mild and normal type of droughts. Occurrence of severe and very severe type of drought is very rare.

As the district lies in the desert area, extreme of heat in summer and cold in winter is the characteristic of the desert. Jodhpur is no exception. Both day and night temperatures increase gradually and reaches their maximum values in May and June respectively. The temperature varies from 49 degree in summer to 1 degree in winter.

Atmosphere is generally dry except during the monsoon period. The humidity is highest in August with mean daily relative humidity is 81%. The annual maximum potential evapotranspiration in the district is quite high and it is highest (264.7 mm) in the month of May and lowest (76.5 mm) in the month of December.

3.0 GEOMORPHOLOGY & DRAINAGE

Jodhpur district forms part of Great Thar Desert of Rajasthan. In this arid region, there are sand dunes, alluvial areas dotted with few hillocks and hill chains scattered in the area. In the eastern part of the district, the area between Bilara and Jodhpur is covered by alluvium deposited due to fluvial action of Luni river system. The eastern part of the district area exhibits gentle undulating topography interrupted by small ridges of hard rocks. The general elevation of plains varies from 300 m amsl in north to 150 m amsl in south. Regional slope is from north-east towards south-west direction. Orientation of alluvial plain area follows the Luni river and its tributaries. Sand dunes occupy a major part of the district north of Vindhyan escarpment in northern and northwestern part of the district. The sand dunes are transverse and longitudinal types formed due to aeolian action and overlie the denuded consolidated formations. Ridges and hillocks are common features in Bilara and Osian tehsils. A chain of escarpments and ridges composed of comparatively resistive rocks like granite, rhyolite and Jodhpur sandstone are found extending from Shergarh in the west to Bilara in the east. The alluvial and sand filled valleys are separated by the ridges whose crest elevation ranges from 325 to 460 m amsl. In the northern part of the district, highest peak of the hill is 284 m amsl. Presence of boulder beds exhibit striking plain topography around Bap and similarly the low lying out-crops of limestone, shale and sandstone layers are also observed in northern part of the district near Phalodi.

Geomorphologically the district is divided into following units:

Origin	Landform Unit	Occurrence
Aeolian	Sand dunes	North and northwestern part of the district.
	Sandy Plains	North and northwestern part of the district.
Fluvial	Alluvial Plains	Eastern part of the district along rivers- Luni, Mithri etc.
	Inter-dunal Plains	Scattered in entire district, mainly in north and western part of the district.
Denudational	Pediments	Scattered in district, mainly in east & west.
Hills	Linear Ridges	In Bilara and Osian Blocks. It extends from Shergarh in the west to Bilara in the east.
	Structural Hills	In northwest & eastern part of the district and Jodhpur town.

Jodhpur district falls in the Luni & Barmer Basins. Major River of the district is Luni, which flows in ENE to WSW direction. It enters in Jodhpur district near village Jhak in Bilara tehsil and leaves the district near village Dhundhara. Total length of the Luni River is 125 km in Jodhpur district. Channel pattern of Luni is dendritic to sub-parallel. However in major part of the district, the drainage is essentially ephemeral and internal. Important tributaries to the Luni river are Mithri and Bandi. Other streams in the district are Jojri, Golasmi, Guniamata and Bastua, which are all ephemeral.

4.0 SOIL, LAND USE & IRRIGATION PRACTICES

Soils of the district are classified as follows:

Red desertic soils: These types of soils are most predominant soils in central, eastern and southern parts of the district. These are pale brown to reddish brown soils, loose and well drained and texture varies from sandy loam to sandy clay loam.

Desert soils: Desert soils occupy a considerable area of the district forming its northern and western part of the district. These are mainly wind blown sand and soils of interdunal depressions.

Sand dunes: Sand dunes occupy a small part in northern and north-western margin of the district. These are sandy to loamy sand, loose, structure less and well drained.

Lithosol and regosols of hills: These types of soils are found in hills and hill slopes of central and western part of the district. These are shallow, light textured, fairly drained, reddish brown to grayish brown in colour.

LAND-USE PATTERN

Total reported area as per village record is 22,56,405 hectares and about 62.53% of the total area are being cultivated. The district is very poor in forest covering only 7032 hectares, which forms only 0.31% of the total area of the district. Agriculture is the main occupation of the rural population. Net cultivable area of the district is 1265944 hectares whereas non agriculture land area including fallow land is 636069 hectares. Maximum cultivated area lies in Osian tehsil followed by Bhopalgarh tehsil.

LAND USE PATTERN (2005-2006)		
Classification	Area (Hectares)	Percentage
Total Geographical Area	22,56,405	100.00
Areas under forest	7,032	0.311
Area under non agriculture use	2,24,713	9.95
Permanent Pastures and other grazing lands	1,22,713	5.43
Miscellaneous trees crops and Groves not included in the net area Sown.	80	0.003
Non Agricultural Land including Fallows	6,36,069	28.18
Net area Sown	12,65,944	56.10
Area Sown more than One time	1,45,000	6.42
Total area Sown	14,10,944	62.53

CROPS- The district comes under arid zone of the State and on account of non-availability of adequate water, cropping pattern is, by and large, single only. Only 2.91% of the net cultivated area are being utilised for double / multiple cropping. The total area under *Kharif* crop is 561200 hectare. During kharif, Bajra, Jawar, Moong, Moth, Guawar and til are the main crops cultivated and during Rabi, wheat, Barley and Mustard are the main crops in the district.

Area under Kharif crops in last three Years [Area in Hectares]

Name of Crops	Year-2004	Year- 2005	Year-2006
Millet	4,13,500	2,75,000	1,50,000
Jowar	15,000	25,000	27,000
Moong	87,000	1,20,000	1,00,000
Moth	1,51,500	2,00,000	1,00,000
Groundnut	17,050	18,000	22,000
Till	44,650	45,000	38,000
Castor	11,340	4,450	20,000
Cotton	13,990,	0	12,000
Guar	1,57,000	2,05,000	70,000
Fodder	15,170	15,873	5,000
Total	9,26,200	9,08,323	5,61,200

IRRIGATION- Ground water is only source of irrigation in the district. Gross area of irrigated land by wells works out to 136948 hectares. There are about 13566 tube wells for irrigation in the district. Also, a large area is being irrigated with the help of dug wells numbering 19429. Maximum irrigated area (43180 hectare) is in Osian tehsil followed by 32323 and 23813 hectares in Bhopalgarh and Bilara tehsils respectively. Minimum area under irrigation is in Luni tehsil due to poor ground water potential.

Source	No of structure	Gross Irrigated Area in hectare
Dug wells	19429	8306
Tube wells/Bore wells	13566	136948
Canals	-	17
Other Sources	-	464

5.0 GROUND WATER SCENARIO

5.1 Geological Framework

The geological set-up of the district is represented by various igneous, metamorphic and sedimentary rocks. Delhi Super Group litho units are very limited and in the form of isolated pockets. Erinpura granites and Malani igneous rocks cover large area in the southern part of the district. Marwar Super Group of rocks occupies maximum geographical area of the district lying in the central, western, and eastern parts of the district. The rock units of various formations belonging to Cenozoic epoch/era represented in very small area and lies in the north-western parts of the district. In the entire district, the hard rocks are overlain by thin blanket of alluvium and wind blown sand.

5.2 Hydrogeology

Ground water occurs under unconfined to semi-confined conditions in rocks of Delhi Super Group, Jodhpur sandstone, Bilara limestone, Nagaur sandstone, Lathi sandstone and unconsolidated sediments (valley fills and alluvium). These form the chief source of ground water in the district. Confined condition is also met sometimes at deeper levels in the northwestern part of the district.

Delhi Super Group: Rocks comprising of schists, phyllites, slates and quartzites form aquifer in isolated patches in small area in south-eastern part of the district. These patches occur within the granitic terrain. These generally form poor aquifer. Ground water occurs under unconfined condition in weathered mantle and fractured zone. Yield of existing open wells generally varies from 30 to 90 m³ /day and discharge of bore wells is also very poor below 160lpm.

Granites and Rhyolites: Granites and rhyolites although cover a vast area in southern part of the district, but are indeed poor aquifers. Ground water occurs under unconfined conditions in secondary spaces in weathered and fractured zones. The fractures tend to die out with depth. Yield of open wells in these formations varies from 10 to 50 m³/day. Yield of wells tapping good weathered zone in granites is up to 80 m³/day. Dug-cum bore wells and bore wells in favourable selective locations can yield up to 120 m³/day.

Jodhpur and Nagaur Sandstone: Jodhpur and Nagaur sandstones are forming aquifer over a large area in central and northern parts of the district. These cover maximum area among all aquifers. These are generally hard and compact layered rocks with intermittent shale and clay layers but softer and friable sandstone layers and patches do occur in these formations making it a good yielding aquifer tapped by open wells and bore wells. Sandstone is fine to medium grained, sometimes coarse to gritty and friable. In such formations, the friable and soft nature often leads to formation of small cavities in saturated zones. This makes it a very good aquifer forming chief source of ground water in the area. A large number of light to medium duty bore wells have been constructed in such areas for irrigation and water supply purposes. In the central part of the district, ground water in this formation is generally free from salinity problem. Ground water in sandstone occurs under unconfined to semi-confined conditions. Open wells tapping sandstone generally yield low to moderate quantity of water with yield varying from 30 to 180 m³/day. Bore wells tapping saturated zones down to depth of 200 m yield 7 to 55 m³/hr water with 5m to 8m draw down.

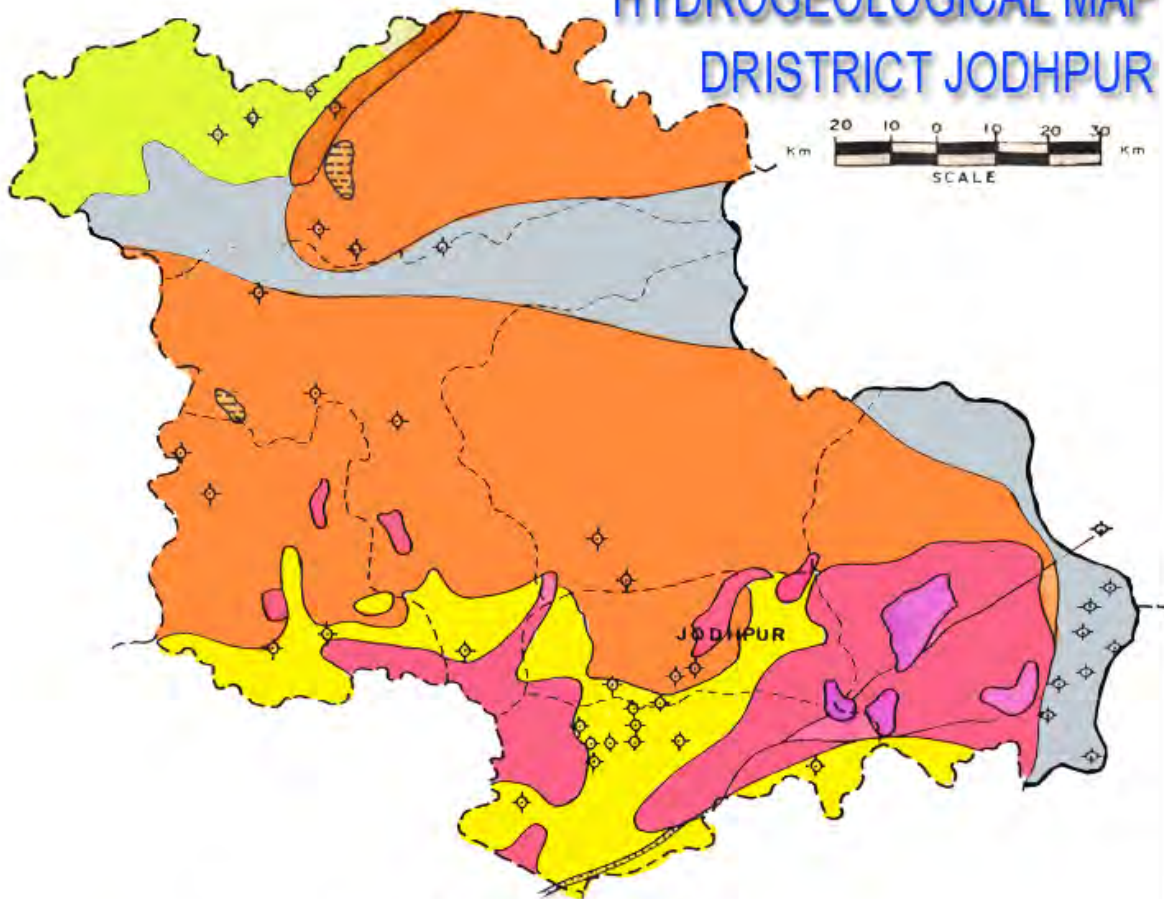
Bilara limestone: Bilara limestone is the most potential aquifer in the district. The limestone exposures are found between Khawaspura & Bilara in eastern part of the district and between Phalodi & Chadi in northern part. Siliceous and cherty limestone and dolomites with association of shale beds is quite common. In Borunda - Bilara area, limestone is mostly dolomitic, grey to dark at places, inter bedded with thin cherty layers. In Chadi - Phalodi area, limestone are predominantly cherty or siliceous. Further north-west of Phalodi, limestone is with thick cover of shale. In Borunda - Ransigaon - Bilara area, limestone shows steep dips and pitching folds. These beds are highly crumpled and show development of caverns formed due to solution activities. In Phalodi - Chadi area, limestone are not so much disturbed having low angle of dip towards north and show development of caverns to lesser extent. Thickness of limestone varies from a few meters to more than 100 m. The yield of wells in both the areas varies largely because of considerable variation in limestone characters. In Phalodi area, yield of wells generally lies between 10 & 40 m³/hr for 2 to 9 m draw down. In Borunda - Bilara area, discharge of the wells varies from 12 to 272 m³/hr with a draw down in range of 3 to 16 m.

Bap boulder bed: Bap boulder bed occurs in narrow stretch in northern part of the district having NE-SW extension. It consists of ill-sorted boulders, pebbles, cobbles embedded in silty matrix. Ground water occurs under unconfined condition. Wells in this formation yield meager quantity of water, which is saline.

Paleocene and associated formation: Semi-consolidated formations comprising of soft, friable sandstone, grit conglomerates ranging from Permian to Paleocene age form aquifer in extreme north- western part of the district. There is association of varying amount of shales and clays with the above sediments, which causes great variation in the yield of the wells. Among semi-consolidated formations, Lathi sandstone does not form prominent aquifer in the district. Yield of wells varies largely but generally lies in range of 15 to 60 m³/hr. There is also quality zonation due to intermittent shale/clay layers.

Unconsolidated sediments: The unconsolidated Quaternary sediments comprising of alluvium, valley fill and aeolian sands form important aquifers in some parts of the district mainly in Shergarh, Luni and Bilara blocks. In major part of the area, these sediments occur as thin blanket over the older sediments but in certain area the thickness up to 70 m and as such form aquifers. In a narrow strip extending east-west ward between Shergarh- Balesar- Agolai-Doli- Jodhpur, alluvium forms aquifer. Thickness of alluvium varies from 47 to 69 m in this area. Yield of open wells varies from 20 to 100 m³/day in alluvium. Yield of exploratory tube wells constructed in alluvium ranges from 22 to 55 m³/hr. In Shergarh and Balesar, yield of tube wells tapping valley fills varies from 20 to 36 m³/hr. Thickness of alluvium in southern part of the district along the course of Luni river and its tributaries is comparatively less and water is generally brackish.


HYDROGEOLOGICAL MAP DISTRICT JODHPUR




EXPLANATION


LITHOLOGY

UNCONSOLIDATED


 Alluvium : Sand, Gravels, Pebbles, Silts, Clay

SEMI CONSOLIDATED


 KAPURDI/PALANA/LATHI FORMATION : Soft friable sandstone with variagated shales


 BAP BOULDER BED : Ill sorted boulders, pebbles, cobbles cemented with silty matrix


CONSOLIDATED


 NAGPUR & JODHPUR GROUP : Sand Stone

 BILARA GROUP : Lime Stone

 MALANI RHYOLITE & GRANITES

 DELHI SUPER GROUP : Slate, Schist, Phyllites

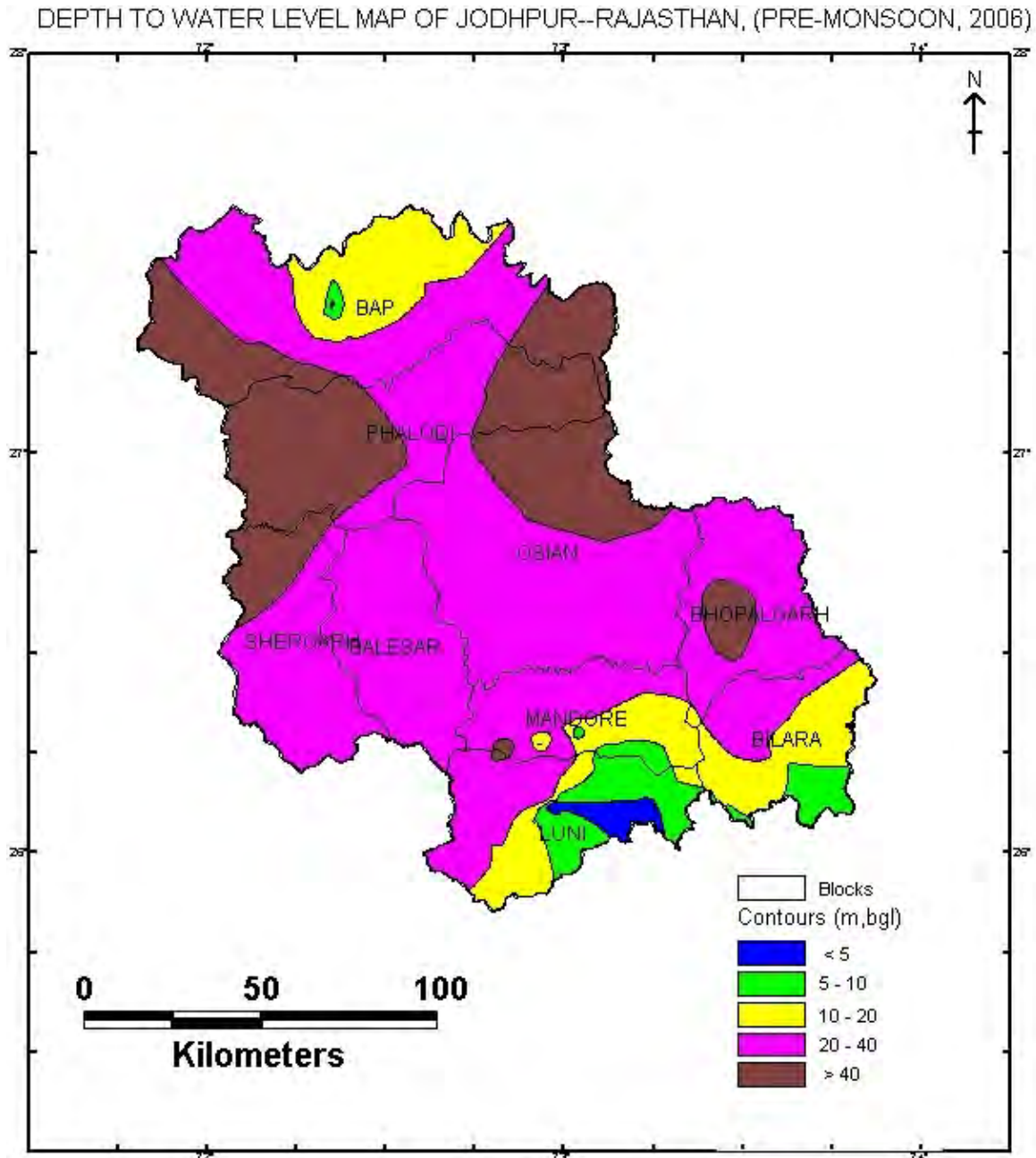
 Exploratory bore hole

 Block boundary

 River

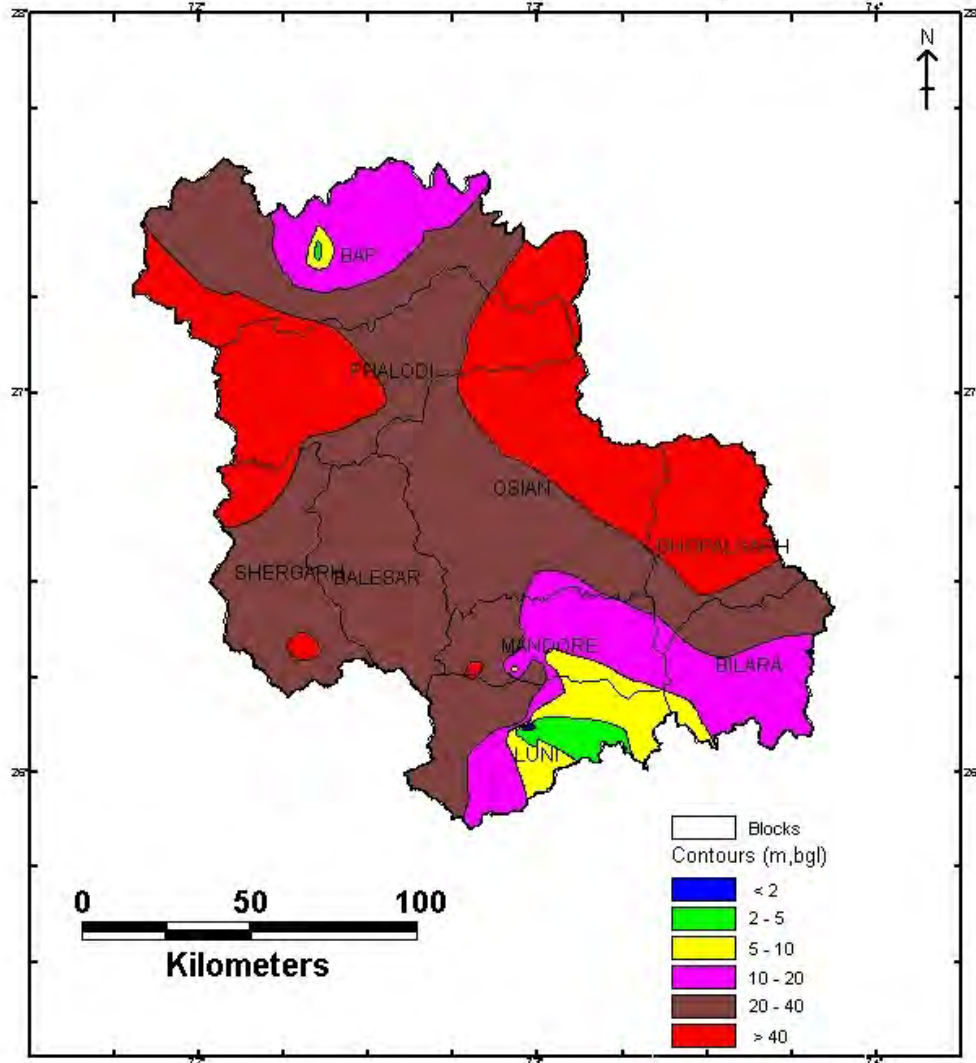
Depth to Water Level

Depth to water level (2006) in the district, monitored on 74 stations, ranges from 2.10 to 77.94 meters below ground level (mbgl) and 0.30 to 70.88 m during pre monsoon and post monsoon, 2006, respectively. During pre monsoon, shallow (2.10 to 34.54 m) water level exists in Balesar, Bap, Bilara, Luni and Shergarh blocks. In Bhopalgarh, Mandore, Osian, and Phalodi blocks water level is from 3.78 to 77.94 m.



During post monsoon, shallow (0.30 to 37.60 m) water level exists in Balesar, Bap, Bilara and Luni blocks. In the Bhopalgarh, Mandore, Osian, Phalodi and Shergarh blocks water level is from 3.48 to 70.88 m.

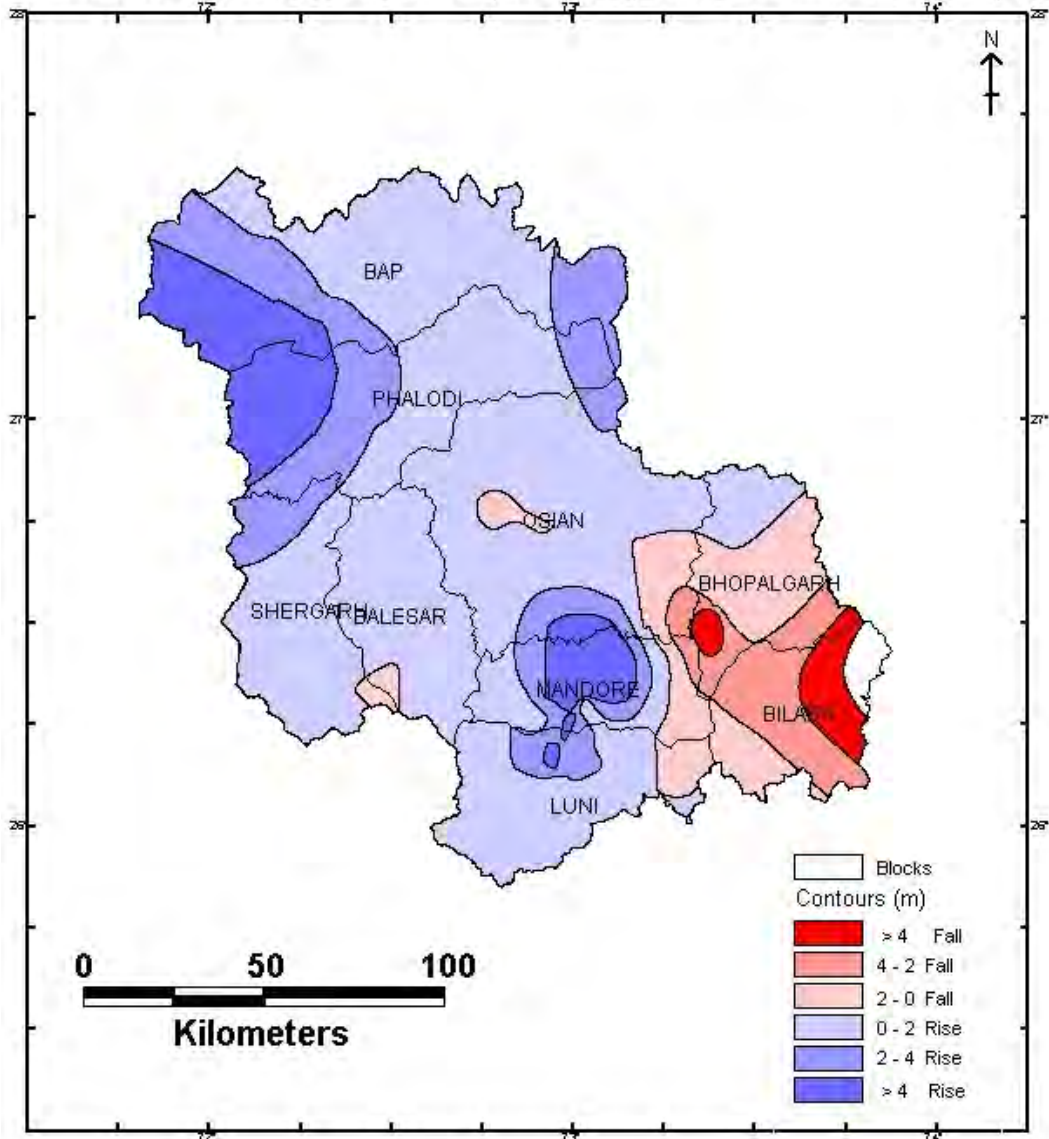
DEPTH TO WATER LEVEL MAP OF JODHPUR--RAJASTHAN, (POST-MONSOON, 2006)



Seasonal fluctuation of pre & post monsoon, 2006 indicates rise in all the blocks except Bhopalgarh and Bilara due to widespread and good rainfall. Rise in water level more than 10 m was observed in Mandore and Phalodi blocks.

Block	Pre Monsoon water level in m		Post Monsoon water level in m		Water level fluctuation in m (Pre- Post)			
	Min	Max	Min	Max	Rise		Fall	
					Min	Max	Min	Max
Balesar	25.18	25.18	25.21	25.21	-	-	0.03	0.03
Bap	4.24	13.63	2.77	13.08	0.55	1.59	-	-
Bhopalgarh	23.80	46.48	29.28	46.88	-	-	0.40	5.48
Bilara	9.84	23.73	13.19	13.19	-	-	3.35	3.35
Luni	2.10	38.80	0.30	37.60	0.05	4.33	0.13	0.13
Mandore	3.78	44.95	3.48	42.95	0.30	10.70	0.06	0.48
Osian	24.56	72.82	24.63	70.88	1.94	1.94	0.07	0.12
Phalodi	43.03	77.94	40.60	67.75	2.43	10.19	-	-
Shergarh	34.54	34.54	34.47	43.10	0.07	0.07	-	-
District	2.10	77.94	0.30	70.88	0.05	10.70	0.03	5.48

WATER LEVEL FLUCTUATION MAP (PRE-POST) OF JODHPUR--RAJASTHAN, (2006)



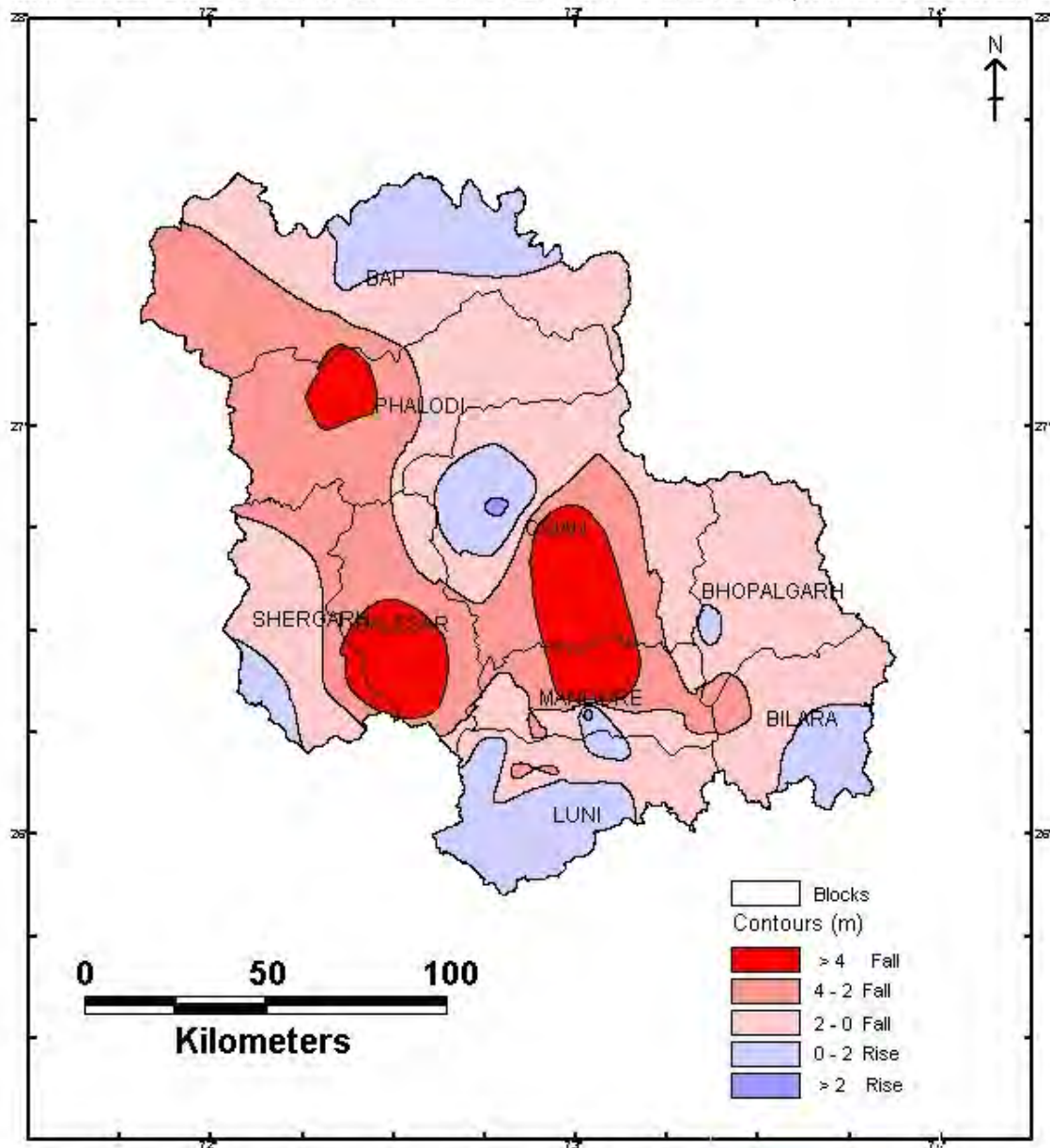
Long term pre monsoon (1997-2006) water level data of Hydrograph Stations show rising trend of 0.02 to 0.15 m/year and fall of 0.01 to 0.08m/yr. During post monsoon decadal trend shows minimum rise & maximum decline of 0.01 and 0.09 m/year respectively. Block-wise pre & post monsoon decadal trend is as follows:

Block	Pre Monsoon Trend (m/yr)		Post Monsoon Trend (m/yr)	
	Rise	Fall	Rise	Fall
Balesar	-	0.04	-	0.05
Bap	-	0.02	0.01	-
Bhopalgarh	-	0.08	-	0.09
Bilara	-	0.05	-	0.04
Luni	0.02	0.02	0.02	0.04
Mandore	0.05	0.04	0.06	0.03
Osian	0.15	0.01	0.01	0.09
Phalodi	0.02	0.04	0.03	0.03
Shergarh	-	-	0.01	0.07

In view of long term change in ground water regime, it is observed that over a major part of lying in central and eastern parts of the district shows maximum decline. This significant decline is observed due to increased ground water draft. In some areas of Osian, Bhopalgarh and Bilara, water level decline of more than 25m has been noticed during last 10 years.

The significant rise in water level from 1997 to 2006 has been observed in Jodhpur city. A rise of 1.30 to as high as 15.73m was observed in various part of the city between 1995 to 2001. It was due to change in water balance by non utilization of local ground water structures located in the vicinity of city, increase of Kaylana water supply by three times, leakage through old city sewerage system and local hydrogeological set up. In the Jodhpur city area, water level has come up to 2 to 3 m bgl and seeped into the basements of the houses of the city which can cause significant damage to the civil structures.

WATER LEVEL FLUCTUATION MAP OF JODHPUR--RAJASTHAN, (MAY-2006- DECADAL MEAN)



Long term pre monsoon (1984-2006) water level data show minimum declining trend 0.17 m/year in Bap block whereas maximum declining trend 0.89 m/year in Bilara block of the district. Block-wise Long term pre monsoon (1984-2006) and pre & post monsoon 2006 water level trend as observed in the Ground Water Department key wells is as below.

S. No.	Block	Change in Water level in m. pre monsoon 1984-2006		Change in Water level in m. pre & post monsoon 2006	
		(+ rise)	(- fall)	(+ rise)	(- fall)
1	Balesar		-9.63		+0.72
2	Bap		-3.88		+1.20
3	Bhopalgarh		-15.61		+0.51
4	Bilara		-19.63		+1.77
5	Luni		-6.53		+1.74
6	Mandore		-9.02		+1.12
7	Osian		-13.73		+0.54
8	Phalodi		-7.29		+0.15
9	Shergarh		-7.73		+0.37
Total			-9.28		+0.88

5.3 Ground Water Quality

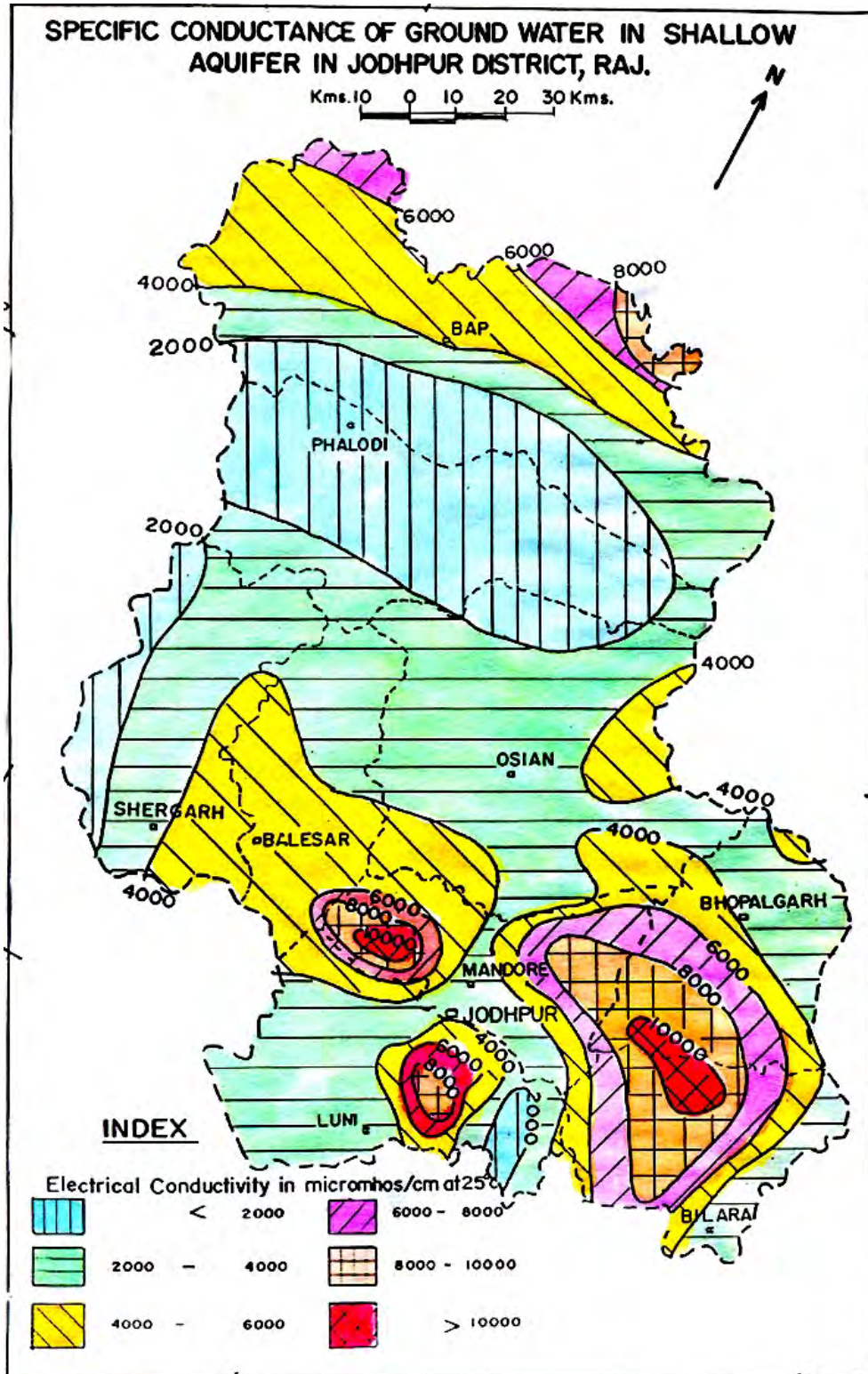
There is a large variation in chemical quality of ground water in the district depending on the characteristics of water bearing formation, movement of ground water, depth to water levels etc. It is seen that in shallow ground water zone, the electrical conductance varies generally from 510 to 9460 ms/cm at 25⁰C. Highly mineralized ground water occurs in Rann area. The ground water in southern, southeastern parts of the district, south and south west of district is saline. In northern part around Bap and extreme north, ground water quality is brackish to saline with electrical conductance generally ranging from 4000 to 10000 ms/cm at 25⁰ C. The electrical conductance is less than 3000ms/cm at 25⁰ C in small parts of area viz. Doli Pal, Mathania area, northwest of Osian, around Balesar, Borunda-Ransigaon area. In the central part of the district where sandstone forms the aquifer, electrical conductance generally varies from 2000 to 5000 ms/cm at 25⁰ C

Chemical quality of deeper ground water as revealed by the exploratory drilling indicates large variation having electrical conductance from 587 ms/cm at 25⁰ C (Ranja Ki Dhani) to 31370 ms/cm at 25⁰ C (Ghataur). High salinity of more than 10000 ms/cm at 25⁰ C electrical conductance has been noticed at Sangaria Ki Dhani, Narnadi, Agolai, Lunawas Charnan, Sajjara and Jhanwar. The ground water quality in deeper zones in the area north of Phalodi is better due to encountering of Bilara Limestone below Nagaur sandstone.

Textile and steel rolling mills are most polluting industries in Jodhpur city. The effluent mainly contains alkalies residual dyes, starch and cellulose, soluble sodium salts, silicates, sulphates and nitrate chemicals. In discharge area of effluents, the ground water quality is brackish to saline. Due to pollution, there is an increase in concentration of sodium, sulphate, chloride and nitrate in ground water which further deteriorates already existing poor quality of ground water and making it unfit even for cattle in the nearby areas of discharging point of waste water.

Higher concentration of nitrate more than 100 ppm is reported in northern, eastern and western part of the district. This includes the areas of Bap, Shergarh, Balesar, Mandore, Osian and Bhopalgarh blocks.

Fluoride concentration in groundwater exceeding permissible limit (1.5 mg/l) has been reported from all the blocks. Higher values i.e. more than 3mg/l of fluoride are observed in Bap, Balesar, Shergarh, Mandore, Bilara and Luni blocks.



JODHPUR DISTRICT

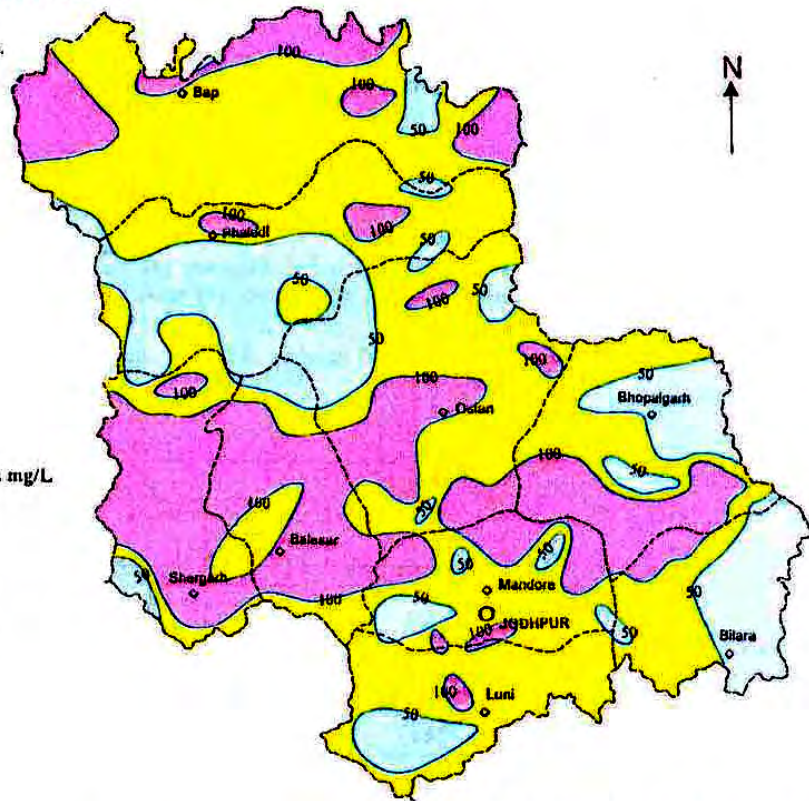
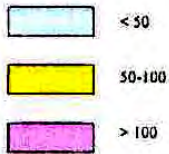
NITRATE DISTRIBUTION

Scale 0 5 10 15 20 km.



LEGEND

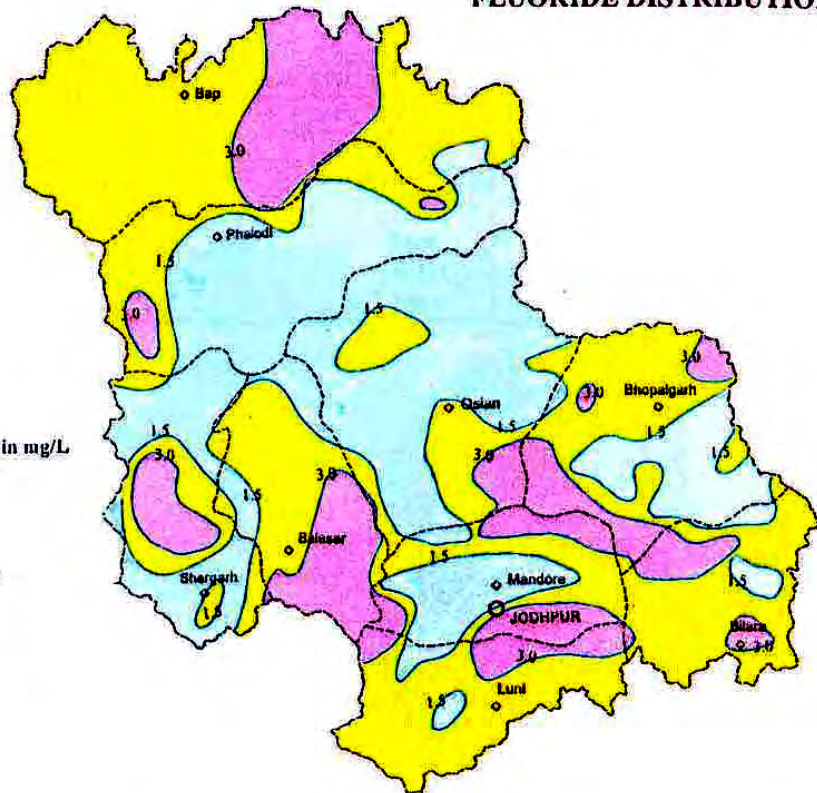
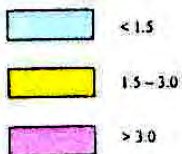
Nitrate Concentration in mg/L



FLUORIDE DISTRIBUTION

LEGEND

Fluoride Concentration in mg/L



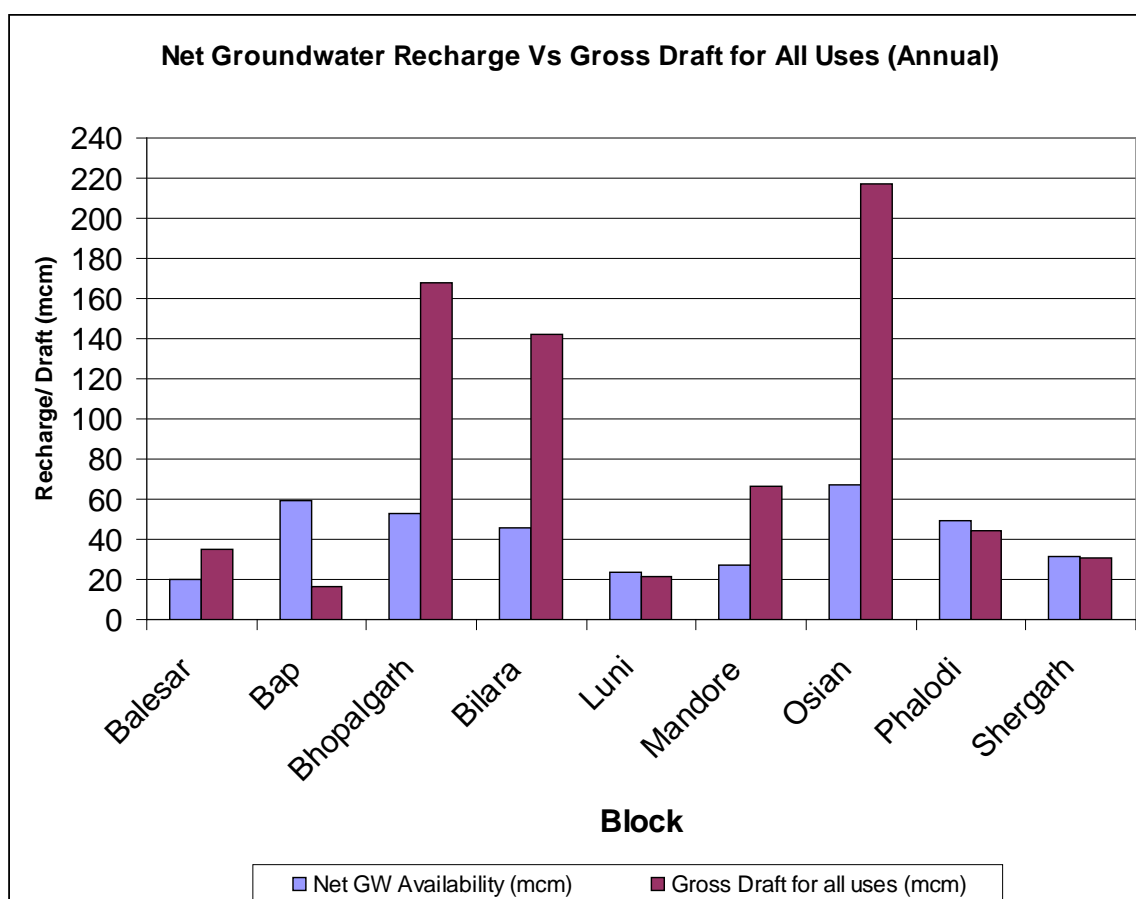
5.4 Ground Water Resources

Ground water resources have been reassessed as on 31.3.2004 based on Ground Water Estimation Committee (1997) are given below:

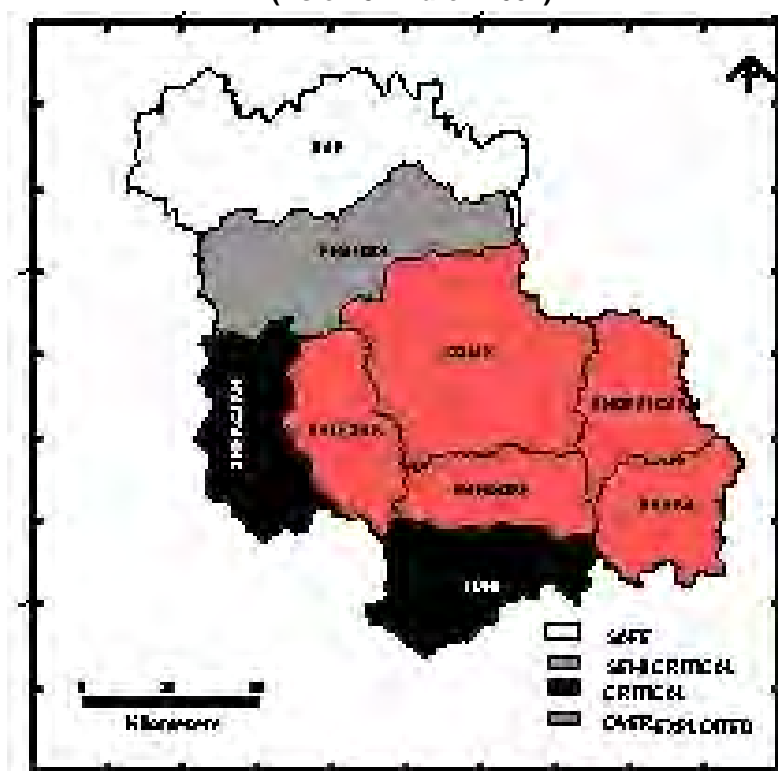
Table 7: Ground Water Potential of JODHPUR District (As on 31.3.2004)

Block	Area (Sq.Km)	Type of Area	Potential Zone Area (Sq.Km.)	Net Annual GW availability (mcm)	Agriculture Draft (mcm)	Dom. & Ind Draft (mcm)	Annual Gross Draft for All Uses (mcm)	Stage of GW Dev (%)	Category
BALESAR	1878.25	NC	1503.03	20.0363	28.5378	6.6720	35.2098	175.73	O.E.
BAP	4380.03	NC	3586.92	59.2212	9.8221	6.4480	16.2701	27.47	Safe
BHOPALGARH	1755.69	NC	1718.69	52.9338	157.2750	10.3656	167.6406	316.70	O.E.
BILARA	1494.33	NC	1234.20	45.4563	124.9324	17.0474	141.9798	312.34	O.E.
LUNI	1978.95	NC	758.78	23.3991	17.2192	4.4340	21.6532	92.54	Critical
MANDORE	1255.96	NC	1165.19	27.1327	51.2092	15.3948	66.6040	245.47	O.E.
OSIAN	4248.40	NC	4248.40	66.8960	185.3426	32.0100	217.3526	324.91	O.E.
PHALODI	3118.13	NC	3118.13	49.0096	24.2824	19.7744	44.0568	89.89	Semi Critical
SHERGARH	2079.98	NC	1534.58	31.5568	23.0034	7.6668	30.6702	97.19	Critical
TOTAL OF DISTRICT (Excl. Saline)			18867.92	375.6419	621.6240	119.8130	741.4370	197.38	
TOTAL OF SALINE			3321.80	89.1820	10.4864	2.0142	12.5006	14.02	

O. E. – Over-exploited NC – Non Command



CATEGORY OF BLOCKS, JODHPUR DISTRICT
(As on 31 March 2004)



5.5 Ground Water Development

Ground water is only source of irrigation in the district. The ground water development in the district is being done by dug wells and tube wells. The present stage of ground water development in the district is 197.38%, which indicates that the scope of ground water development is already exhausted. Out of 9 blocks, 5 falls under “Over-exploited” category, 2 blocks under “Critical” category, 1 block under semi-critical category and 1 block under safe category. General depth of dug wells and bore wells ranges from 20 to 80 m and up to 200 m respectively. A detail of groundwater structures is as follows:

Formation	Yield of Dug well (m ³ /day)	Discharge of Bore well (lpm)	Depth (m)		Diameter		Type of pump/Water lifting devices
			Dug well	Bore well	Dug well (m)	Bore well (mm)	
Alluvium	20-100	300-900	40-50	100	2-3	200	Submersible/ Centrifugal pump
Semi-consoli. Sandstone	15-60	200-400	40-60	150	2-3	200	
Limestone	10-272	200-4000	40-60	200	4-5	200	
Sandstone	30-180	150-1000	40-80	250	3-4	200	
Granite Rhyolites	10-50	60-150	20-40	80	4-5	200	
Phyllite/Schist	30-90	60-150	20-40	100	4-5	200	

6.0 GROUND WATER DEVELOPMENT STRATEGY

6.1 Ground Water Development

Stage of ground water development in the district is 197.38%, which indicates that the scope of ground water development is already exhausted in 5 blocks where groundwater development has already exceeded 100% and categorized as “Over-exploited”. 2 blocks falls under “Critical” category and 1 block falls under semi-critical category where ground water development is approaching 100%. Only one block (Bap) fall under safe category. Stage of groundwater development is even above 300% in some limestone and sandstone potential zones of Bhopalgarh, Bilara, Mandore and Osian blocks. There is no scope for further groundwater development in the district except in Bap block. However, exploratory drilling can be taken up in unexplored area for estimation of aquifer parameters.

6.2 Water Conservation and Artificial Recharge

Precious Groundwater resources have to be conserved for sustainable availability. Artificial recharge measure to be employed for augment ground water resources by roof top rain water harvesting, construction of sub surface barriers and anicuts at suitable locations. Inferior quality water can be blended with fresh water for irrigation use. Watershed Development & Soil Conservation Department has constructed permanent (masonry) check dams under Irrigated Watershed Development Project to harvest rain water, reduce soil erosion and check runoff velocity.

7.0 GROUND WATER RELATED ISSUES & PROBLEMS

- Major part of the district is covered by hard formation such as Jodhpur sandstone, Malani rhyolites, granites, and Delhi Super Group metamorphics. These have poor water yielding capacity. Also such areas suffer from water quality problems and in some of the areas ground water is highly saline. Villages located in such areas have the basic problem of drinking water requirement and the situation becomes very critical in summers and in drought years.
- Another problem of concern in the district is the that most of the potential zones have registered heavy ground water development causing lowering of water table and drying up of large number of shallow wells or reduction in their yields. Heavy decline of more than 15 m observed in Tinwari- Mathania, Bilara, Ransigaon-Borunda area, part of Bhopalgarh area during last 10 years.
- Jodhpur is the second largest urban agglomerate of the State and has a developed industrial center. The textile processing and stainless steel re-rolling industries generate industrial waste effluent, which contains toxic elements. These industries are located in Basni industrial area of Jodhpur city. The combined industrial effluents are carried through drainage & is left in river Jojri having its course south of city. Industrial effluents have caused ground water pollution in down stream of the river in villages viz. Salawas, Nandwan, Bhandu Kallan etc. which is harmful for irrigation also.

- Measures are required to be adopted to tackle the rising water level problem observed in the Jodhpur city during last few years.

8.0 Recommendations

1. Heavy ground water withdrawal from potential zones of Bhopalgarh, Bilara, Osian and Mandore for agriculture use, where stage of ground water development has reached more than 300%, it has to be controlled by preventing further development through notifying of over exploited blocks.
2. Awareness program to educate about conservation of precious ground water resources and training on rainwater harvesting will be beneficial to check decline in water level and justified use.
3. Financial assistance/loaning for ground water exploitation in over-exploited, critical and semi-critical area should not be encouraged.
4. Use of water saving devices like sprinklers, close field distribution channels etc. should be promoted.
5. Modern agricultural management techniques have to be adopted for effective and optimum utilization of the water resources. This can be achieved by maintaining irrigation through minimum pumping hours as per minimum requirement of water by the crop and also selecting most suitable cost effective crop pattern.
6. High water requirement crops to be discouraged. Proper agriculture extension services should be provided to the farmers so that they can go for alternate low water requirement economical crops.
7. Salt resistant crops can be sown in the area having brackish to saline ground water.
8. Bap block, which falls under safe category further ground water development, is suggested in this area through financial institutions.
9. A close network of piezometers should be established in over exploited and areas of heavy ground water development to precisely watch changes in ground water level for further planning.
10. In the limestone and sandstone areas of the district, deep ground water exploration is suggested by suitable combination rigs.
11. Over a large part of the district, ground water quality is saline. Systematic ground water exploration is needed in such areas to locate fresh water pockets and yielding zones to meet water supply demand.
12. Traditional rainwater harvesting structures like Tankas, roof top rain water storage should be encouraged for day to day requirements which will reduce ground water draft.

13. Industrial effluents should be treated before being discharged in Jodhpur river through a Combined Effluent Treatment Plant.
14. To combat rising water table problem in Jodhpur city area, measures are required to be adopted to avoid damage to civil structures. This includes pumping of water from unutilized surface water bodies and reuse existing ground water structure of city area.
15. Large-scale recharge potentials exist in depleted aquifers. Mega ground water recharge to such areas through outside surface water sources like lift canal from IGNP system or floodwater during excess rainy years be implemented.
16. Small check dams or earthen dams, at suitable sites, may be constructed to store rainwater. This will increase recharge to ground water which ultimately result in increase of yield of wells.
17. Ground water legislation should be implemented for regulation and control of ground water in over-exploited areas with immediate effect.
