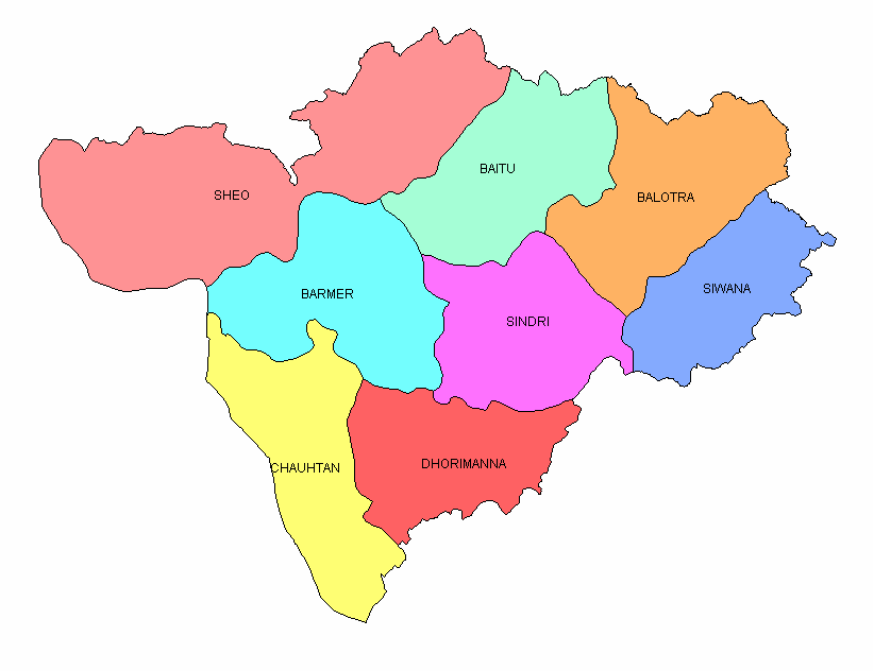
GOVERNMENT OF INDIA
MINISTRY OF WATER RESOURCES
CENTRAL GROUND WATER BOARD

GROUND WATER INFORMATION
BARMER DISTRICT
RAJASTHAN



Western Region
Jaipur
2013

DISTRICT AT A GLANCE – BARMER DISTRICT, RAJASTHAN

S No	Item	Information	
1	GENERAL INFORMATION		
	(i) Geographical area (sq km)	28,387	
	(ii) Administrative Division (As on 31.3.2011)		
	Number of Tehsils	08	
	Number of Blocks	08	
	Number of Villages	1941	
	(iii)Population (As per 2011 Census)	2,604,453	
	(iv)Average Annual Rainfall(1971-2005)	281.8 mm	
2	GEOMORPHOLOGY		
	Major Physiographic Units	Sand Dunes, Aeolian & Alluvial plains, Ridges and Hillocks.	
	Major Drainage	Luni River	
3	LAND USE (sq km) (2010-11)		
	(a) Forest Area	320.95	
	(b) Net Sown Area	17924.29	
	(c) Total Cropped Area	19794.10	
4	MAJOR SOIL TYPE	1.Desert soil 2.Sand dunes 3.Red desertic soil 4.Saline soil of depressions 5.Lithosols & Regosols of hills	
5	AREA UNDER PRINCIPAL CROPS (AS ON 2010-11)	Crops	Area in ha
		Bajra	955029
		Moth & Moong	327389
		Rape & Mustard	25982
		Wheat	16732
		Jowar	2752
		Barley	43
		Sesamum	3937
		Groundnuts	578
		Castor Seed	29510
		Gram	1072
6	IRRIGATION BY DIFFERENT SOURCES (2010-11)		
	Source	Net Irrigated Area in hectare	
	Tube wells	50127	
	Other wells	111605	
	Canals	3060	
	Net Irrigated Area (ha)	164792	
	Gross Irrigated Area (ha)	254363	
7	NUMBER OF GROUND WATER MONITORING WELLS OF CGWB (As on May 2011)		
	Number of Dug wells	62	
	Number of Piezometers	40	
8	PREDOMINANT GEOLOGICAL FORMATIONS	Aeolian Sand, Alluvium, Tertiary Sandstone, Lathi Sandstone and Barmer Sandstone (Mesozoic),	

S No	Item	Information
		Malani Rhyolite, Granite and Jalore Siwana Granite (Post Delhi)
9	HYDROGEOLOGY	
	Major Water bearing formations	Quaternary Alluvium, Tertiary Sandstone, Lathi Sandstone, Malani Rhyolite and Granite
	Depth to water level (Pre-monsoon, 2011) (mbgl)	4.90 – 70.95
	Depth to water level (Post-monsoon, 2011) (mbgl)	4.00 – 71.50
10	GROUNDWATER EXPLORATION BY CGWB (As on 31.3.2012)	
	Number of wells drilled (EW, OW, SH, PZ)	EW – 54, OW- 8, SH- 5, PZ- 22
	Depth Range (m)	18 – 457
	Discharge (liter per second)	Negligible – 23.66
	Transmissivity (m^2/day)	100 to >2000 m^2/day in Lathi sandstone
11	GROUND WATER QUALITY	
	Range of chemical constituents in the district :	EC : 747 to 27500 µS/ cm at 25^0C F : Traces to 3.08 mg/l NO_3: Traces - 892 mg/l
	Type of water	
12	DYNAMIC GROUND WATER RESOURCES (March, 2011) in mcm	
	Net Annual Ground Water Availability	257.5135
	Annual Ground Water Draft (Irrigation + Domestic)	294.1440
	Allocation for Domestic and Industrial requirement up to next 25 years/ up to 2025	61.4056
	Stage of Ground Water Development	114.22
13	GROUND WATER CONTROL AND REGULATION	
	Number of Over-exploited blocks	05
	Number of Critical Blocks	02
	No of Blocks Notified	1
14	MAJOR GROUND WATER PROBLEMS AND ISSUES	1. Water level decline 2. Quality Problem 3. Industrial pollution 4. Less recharge due to scanty and uneven rainfall

GROUND WATER INFORMATION
BARMER DISTRICT
RAJASTHAN

CONTENTS

LIST OF FIGURES

LIST OF TABLES

GROUND WATER INFORMATION
BARMER DISTRICT

1.0 Introduction

Barmer district is situated between 24^0 40' 00" & 26^0 32' 00" North latitudes and 70^0 05' 00" & 72^0 52' 00" East longitudes covering geographical area of 28,387 sq km. It is the second largest district in the State covering about 8.29% of its total area. The district as a whole forms part of the Great Indian Thar Desert. The district is divided into four sub-divisions. There are eight blocks in the district namely Baetu, Balotra, Barmer, Chohtan, Dhorimanna, Siwana, Sheo, Sindhari. The district has 2 Municipalities, and 2460 Revenue Villages. It is surrounded by Jaisalmer in the north, Jalore in the south, Pali and Jodhpur in the east and Pakistan in the west. Total population (as per 2011 census) of the district is 2,603,751 out of which 2,421,914 is rural population and 181,837 is urban population. Decadal population growth rate of the district during 2001 to 2011 has been 35.06. Population density of the district is 92 persons/sq km. The district is known for its bentonite, lignite and petroleum mineral wealth. A map showing the blocks of the district is presented as Figure-1.

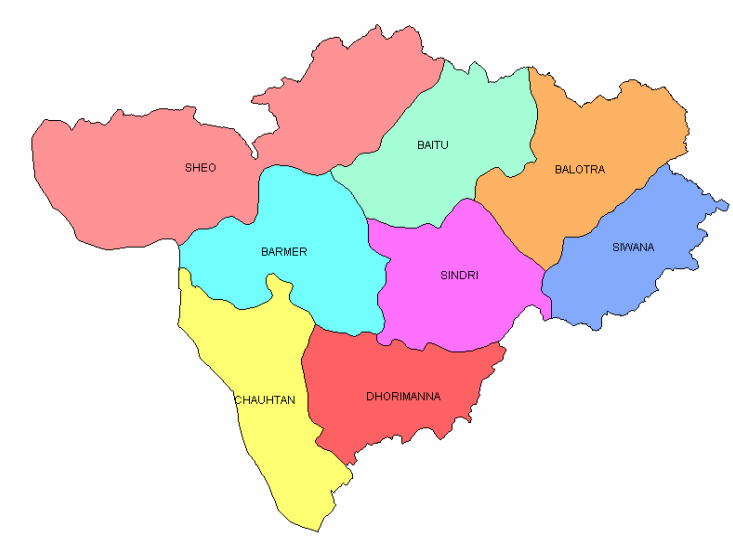


Figure 1: Administrative Map

Systematic Hydrogeological survey in the district was initially carried out by GSI during the period 1959 – 1961. Various studies including Systematic and Reappraisal Hydrogeological Surveys have been carried out in the district from time to time by Central Ground Water Board. List of such studies carried out by CGWB is given in Table 1.

Table 1: Scientific studies undertaken by Central Ground Water Board

S.No.	Officer/ Project	AAP	Type of Study
1.	R.K. Tiwari	1973-74	Systematic Hydrogeological Survey in parts of Chohtan and Barmer tehsils of Barmer district
2.	R.K. Tiwari	1974-75	Systematic Hydrogeological Survey in parts of Barmer and Jalore districts
2.	D.K. Vaid	1975-77	Systematic Hydrogeological Survey in parts of Barmer district
3.	S.K. Bansal	!976-77	Systematic Hydrogeological Survey in parts of Sheo and Chohtan tehsils of Barmer district
4.	S.K. Gupta	1982-83	Systematic Hydrogeological Survey in parts of Barmer and Jalore districts
5.	S.K. Gupta	1983-84	Systematic Hydrogeological Survey in parts of Barmer and Jaisalmer districts
6.	A.K. Bhatia & S.Datta	1978-79	Reappraisal hydrogeological survey in parts of Luni and Sukri basins, Barmer, Jalore and Sirohi districts
7.	O.P. Poonia	1997-98	Reappraisal Hydrogeological Survey in parts of Jawai sub basin of Luni river catchment (Parts of Jalore and Barmer districts),

Apart from these, micro level hydrogeological survey in the district was carried out during 2003-04. District report for Barmer district was compiled by Dr. K.R. Karanth, M.K.M. Rao and Abrar Hussain in 1981. Revised district report was compiled by M.S. Jethra in 1991. Under Ground Water Exploration Programme, a total of 54 exploratory boreholes and 5 slim holes have been drilled. Since 1973, monitoring of water level is being carried out four times a year in the district.

2.0 Climate and Rainfall

The district experiences arid type of climate. Mean annual rainfall (1971-2005) of the district is 281.8 mm whereas normal rainfall (1901-1971) is lower than average rainfall and placed at 277.5 mm. Almost 90% 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. As the district lies in the desert area, it faces extremes of heat in summer and cold in winter. Both day and night temperatures increase gradually and reach their maximum values in May and June. The temperature varies from 48 degree in summer to 2 degree in winter. Atmosphere is generally dry except during the monsoon period. Humidity is at its highest in August with mean daily relative humidity of 43%. The annual maximum potential evapotranspiration in the district is 1850 mm and it is highest (260 mm) in the month of May and lowest (77 mm) in the month of December.

3.0 Geomorphology and Soil Types

Geographically, the area as a whole forms a part of the Great Indian Desert. Apart from a small offshoot of the Aravalli hills in the east, the area is a vast sandy tract. The country west of Luni River represents sandy plain dotted with bold hills. A well defined valley is observed along Barmer-Gadra road to the east of Kharin. Pachpadra, Sanwarla and Thob are the major salt lakes in the district. A salt lake

locally called Rann is located east of Redana village. The surface elevation of the district varies from 70 above mean sea level (mamsl) at Sindhari to 457 mamsl at Ghonia village. The only major drainage course in the area is Luni River, which flows from Samdari, passing through Balotra. The river is ephemeral, flowing only in response to heavy precipitation. In the year of drought there is no run off.

Soils of the district are classified as follows:

1. **Desert soil:** Desert soil area is occupied by alluvium and wind blown sand, yellowish brown, sandy to sandy loam, loose, structure less, well drained with high permeability and lies in northern, western and central parts of the district.
2. **Sand dunes:** These are non-calcareous soil, sandy to loamy sand, loose, structure less and well drained. Sand dunes lie in northern, western and central parts of the district.
3. **Red desertic soil:** These are pale brown to reddish brown soils, structure less, loose, and well drained. Texture varies from sandy loam to sandy clay loam. These soils occupy eastern and southeastern parts of the district.
4. **Saline soil of depressions**: This type of soil is found in salt lakes. They are dark grey to pale brown, heavy soils with water table very near to the surface and are distinctly saline.
5. **Lithosols & Regosols of hills:** This type of soil is found in isolated hills as lithoslopes. These soils are shallow with gravels very near to the surface, high textured, fairly drained, reddish brown in colour and lie in southeastern part of the district.

4.0 Ground Water Scenario

4.1 Geological Framework

Geologically, the district is underlain by intrusive rocks at the basement (Post Delhi formation) consisting of Jalore and Siwana granite & Malani rhyolite and granite followed by Mesozoic and Tertiary formations consisting of sandstone, shale, conglomerate. Rocks of Mesozoic era are comprised of Lathi series of Jurassic and Abur series of Cretaceous period. Tertiaries consist of Akali and Kapurdi series of Eocene period. These formations are overlain by Pleistocene to recent alluvium consisting mainly of clay, sand and silt.

4.2 Hydrogeology

The main water bearing formations in the district are rhyolites and granites of post Delhi; Lathi sandstone, Tertiary sandstone and Quaternary alluvium. In Quaternary alluvium, ground water occurs under semi confined to unconfined conditions. In semi consolidated Tertiary and Mesozoic formations, it occurs under unconfined to confined conditions and in weathered and fractured zones in hard rocks under phreatic conditions.

Though ground water occurs in all the formations but the most productive aquifers are the Lathi sandstone, Barmer sandstone and Quaternary sediments. The Tertiary formation, which is predominantly clayey and argillaceous, is not found as productive except locally in the sandstone horizon. In general, the fractured and weathered zones in hard rocks form poor aquifers.

Consolidated formations:

Consolidated formations include intrusives of Malani rhyolite and granite and Jalore & Siwana granites of Post Delhi. They lie in northwestern part of district, south of Siwana and entire western part of Barmer upto Harsani. They form poor aquifer. Ground water occurs under water table condition in fractured and weathered residuum down to a depth of 99 m. The rhyolites are partially impervious. They are sparingly jointed and weathered into a clayey impervious residuum lessening the water bearing capacity. The rocks have secondary porosity and the water yielding capacity of rock units diminishes with depth. Yield of dug wells tapping rhyolites is the lowest and ranges from 15 to 50 m^3/day.

Two exploratory well, one piezometer and 4 production wells have been constructed in consolidated formations. The depth of drilling/ depth of wells varies from 37.94 to 171.00 m and discharge of wells is meagre indicating the poor potentiality of aquifer.

Semi consolidated formations:

Semi consolidated formations encompassing rocks of Tertiary period, which comprise of alternate layers of clay and shale associated with fuller's earth are unproductive aquifer.

Lathi sandstone forms the most potential aquifer and is constituted of medium to coarse grained sandstone with subordinate amount of gravel. It covers the total area of 7500 sq km and the extent of saturated Lathis with utilizable quality of ground water comprises about 3270 sq km. The aquifer portion of the Lathi formation ranges in thickness from less than 100 m in the east to over 800 m in the northern part, east of Jaisalmer. There are generally three aquifers in the depth ranges of 67 to 100 m, 150 to 200 m and 240 to 280 m which are in hydraulic continuity. The ground water in Lathi formation occurs under perched as well as main water table conditions and under confined condition. The eastern part of Lathis is unsaturated, except for perched saturated zone which supply water locally to villages. The depth to water level and piezometric heads ranges from 30 to over 120m. The perched water table occurs between 6 and 30 mbgl. The piezometeric surface is shallower in area north of Jaisalmer-Pokaran road due to lower topography. The piezometric surface ranges from 540 mamsl near Bhopa to about 490 mamsl north of Jaisalmer-Pokaran road and south of Jaisalmer. The piezometric gradient ranges from 0.1 m/km to 1.6 m/km.

In semi consolidated formations, 24 exploratory, 3 observation wells, 5 slim holes and 6 piezometers have been drilled. Depth of exploratory drilling varies from 82 to 347 m having depth of wells from 109 to 240 m. Discharge of wells especially in Lathi aquifer in its northern part varies from 303 to 852 lpm for drawdown ranging from 2 to 12 m, while southwards and towards southwest, the discharge of wells having saturated thickness of 15.85 (at Bhimda) to 123 m (at Bothia-II), varies from 632 to 1420 lpm indicating high potentiality of the aquifer. The transmissivity of the Lathi aquifer ranges from less than 100 to over 2000 m^2/day being comparatively higher in the northern part. Wells tapping the aquifer have high specific capacities ranging mostly from 150 to 500 lpm/ m.

Tertiary Formation: Tertiary formations consisting of alternative layers of clay and shale associated with fuller's earth are unproductive aquifers. The boreholes tapping these formations were abandoned due to very poor yield and due to salinity of formation water. The piezometric level varies from 5.95 m. in the south (Dhanau

borehole) to 111.25 m in the north (Gunga borehole). Boreholes tapping the fine grained sandstone in the Tertiaries yielded between 182 lpm (Karim Ka Par borehole) and 189 lpm (Dhanau Borehole) i.e. for drawdown of 10.6 and 12.37 m respectively.

Unconsolidated Formations:

Unconsolidated formation includes Quaternary alluvium that is most extensive, forms the potential aquifer and covers entire southern part and extreme western portion of the district. The exploration drilling data indicate that alluvium is composed of heterogeneous sequence of sand, silt, clay and kankar with occasional tongues and lenses of gravel and cobbles. The thickness of alluvium varies generally from 40 to 100 m except at a borehole at Padru in Balotra block where upto the depth of 140.20 m even bed rock was not encountered. The ground water occurs under water table condition to semiconfined condition. The perched water table condition occurs at shallow depth in clay beds and kankars which arrest the rain water of local precipitation. The piezometric surface lies between 5.51 and 49.87 mbgl. The perched water table condition prevails in central, northern and eastern parts of the district. A total of 28 exploratory, 5 observation wells, 15 piezometers and 9 production wells have been drilled in unconsolidated formation. The exploratory drilling data indicate that the depth of drilling ranges from 18 to 457 m with 18.0 m to 290 m depth of wells. Discharge of wells varies from 22 to 1409 lpm for drawdown ranging from 6.0 m to 35.0 m.

A map depicting hydrogeological features is presented as Figure-2.

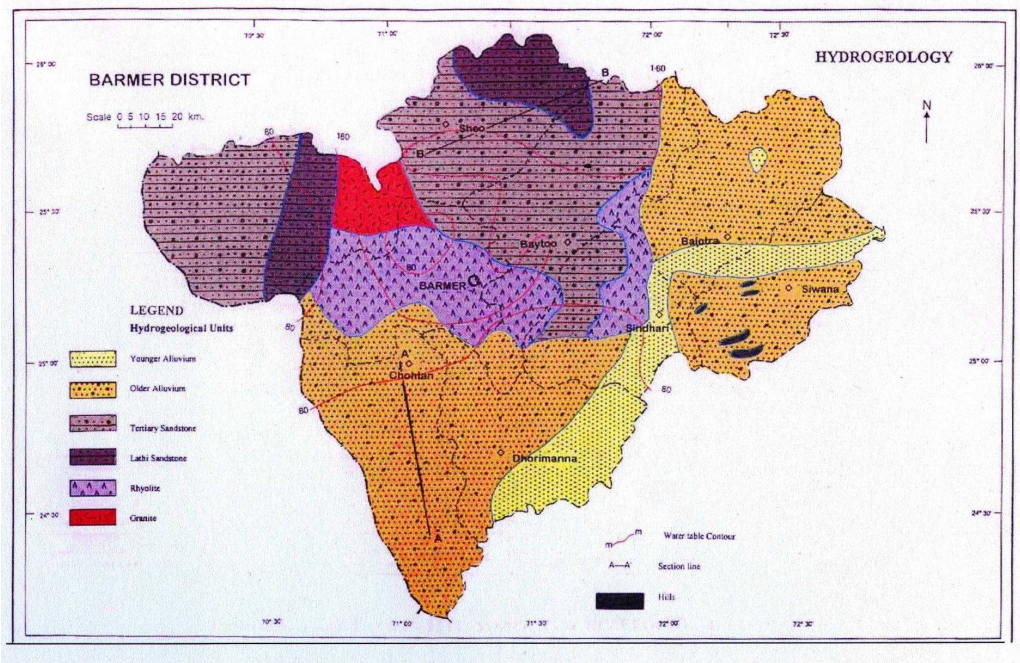


Figure 2- Hydrogeology

4.2.1 Water Level Scenario

Central Ground Water Board periodically monitors the National Hydrograph Network Stations (NHNS) stations in the Barmer district, four times a year i.e. in January, May

(Premonsoon), August and November (Postmonsoon).

4.2.2 Depth to Water Level – Premonsoon (May-2011)

Depth to water level (2011) in the district, monitored through a network of 42 hydrograph stations, ranges from 4.90 to 70.95 m bgl and 4.00 to 71.50 m bgl during pre monsoon and post monsoon, 2011, respectively. Block-wise details of depth to water level during pre-monsoon, post-monsoon and seasonal water level fluctuations are given in Table 2.

Table 2: Block wise details of depth to water level as observed during Pre-monsoon (May, 2011) and Post-monsoon (November, 2011) periods and seasonal water level fluctuation

Block	Pre-monsoon water level in m bgl		Post-monsoon water level in m bgl		Water level fluctuation in m (Pre– Post)			
					Rise		Fall	
	Min	Max	Min	Max	Min	Max	Min	Max
Baetu	22.91	36.18	19.31	35.00	0.10	3.60	-	-
Balotra	-	22.05	4.10	38.07	-	2.05	-	-
Barmer	7.73	70.95	7.31	71.50	0.20	9.76	0.25	5.20
Chohtan	4.90	64.98	4.00	65.24	0.36	4.78	0.60	4.60
Dhorimanna	5.20	59.61	5.10	59.11	0.10	0.50	-	-
Sheo	10.70	52.59	7.40	52.99	1.90	6.85	-	0.40
Sindhari	16.78	64.86	16.50	64.86	0.28	-	0.09	-
Siwana	-	28.02	-	25.05	-	3.15	-	-
District	**4.90**	**70.95**	**4.00**	**71.50**	**0.10**	**9.76**	**0.09**	**5.20**

During pre monsoon, shallow water level varying in depth from 4.90 to 36.18 mbgl existed in Baetu, Balotra and Siwana blocks. Deeper water levels from 52.59 to 70.95 mbgl were recorded in Barmer, Chohtan, Dhorimanna, Sheo and Sindhari blocks (Fig. 3)

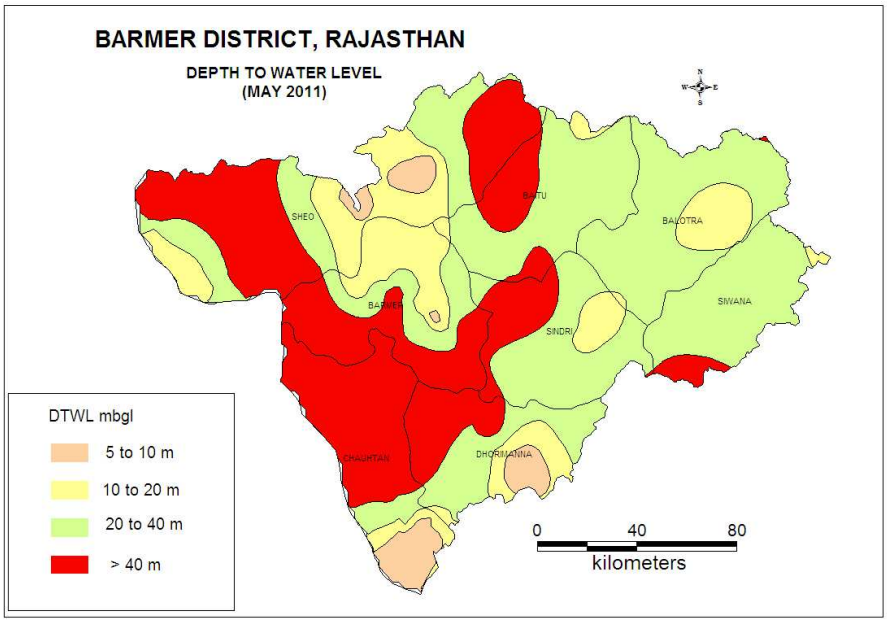


Figure 3- Depth to Water Level (Pre Monsoon - May 2011)

4.2.3 Depth to Water Level – Postmonsoon (Nov-2011)

During post monsoon, shallow water levels ranging in depth from 4.00 to 38.07 mbgl were observed in Baetu, Balotra and Siwana blocks. Deeper water levels from 52.99 to 71.50 mbgl depth were registered in Barmer, Chohtan, Dhorimanna, Sheo and Sindhari blocks (Fig. 4).

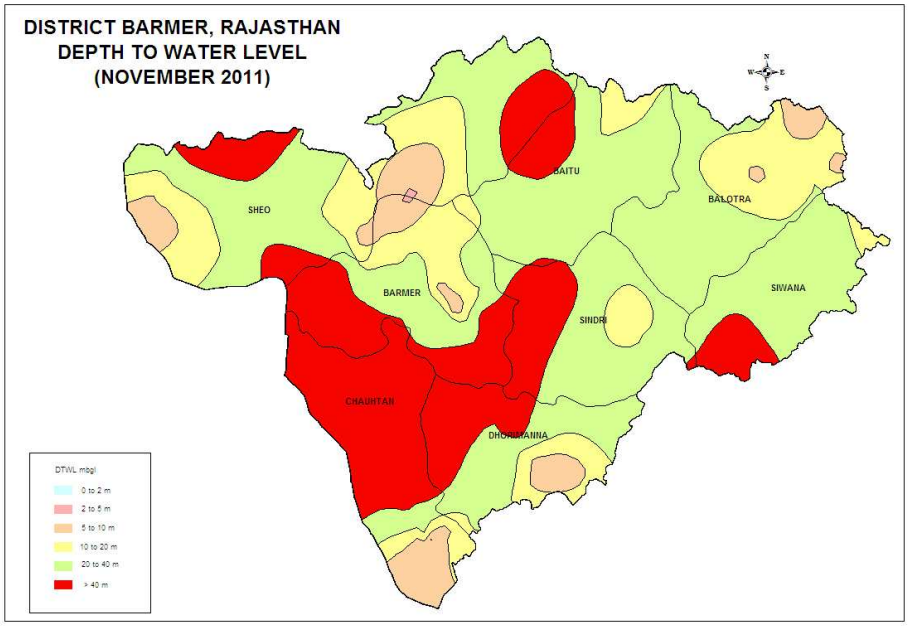


Figure 4- Depth to Water Level (Post Monsoon- Nov 2011)

4.2.4 Seasonal Water Level Fluctuation (May 2011 - Nov. 2011)

Seasonal water level fluctuation map (Fig. 5) of pre & post monsoon, 2011 indicates rise in all the blocks except central and western parts of the Chohtan block, northern part of the Barmer block and central part of Sindhari block. Major part of the district has registered rise in ground water levels in the range of 0 – 2 m.

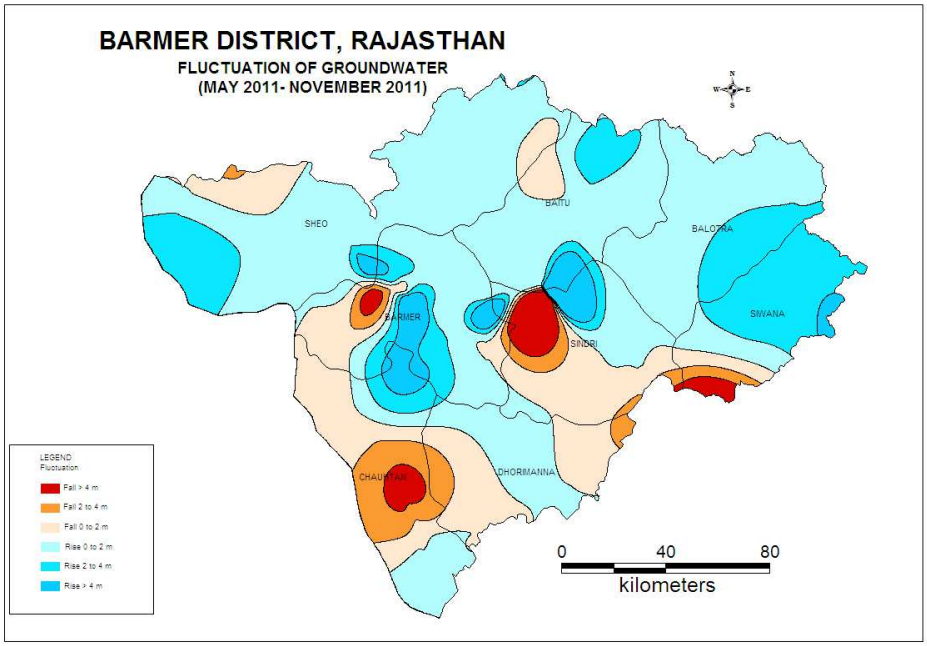


Figure 5- Seasonal water level fluctuation (Pre & Post monsoon, 2011)

4.2.5 Water Level Trend (2002-2011)

The map of pre monsoon trend of water level for the year 2002 to 2011 is presented in Figure-6. Rising trend of the order of 0 to 0.25 m/year has been noticed during the last decade in the western, northwestern, central, southwestern and northeastern parts of the district. Rising trend in the range of 0.5 to 0.75 m/year has been observed in localised pockets in Sheo block. Declining trend in the range of 0 to 0.25 m/year has been noticed mainly in the northern, eastern, southeastern and central parts of the district. Southern part of Siwana block has registered declining trend in the range of 0.25 to 0.5 m/year.

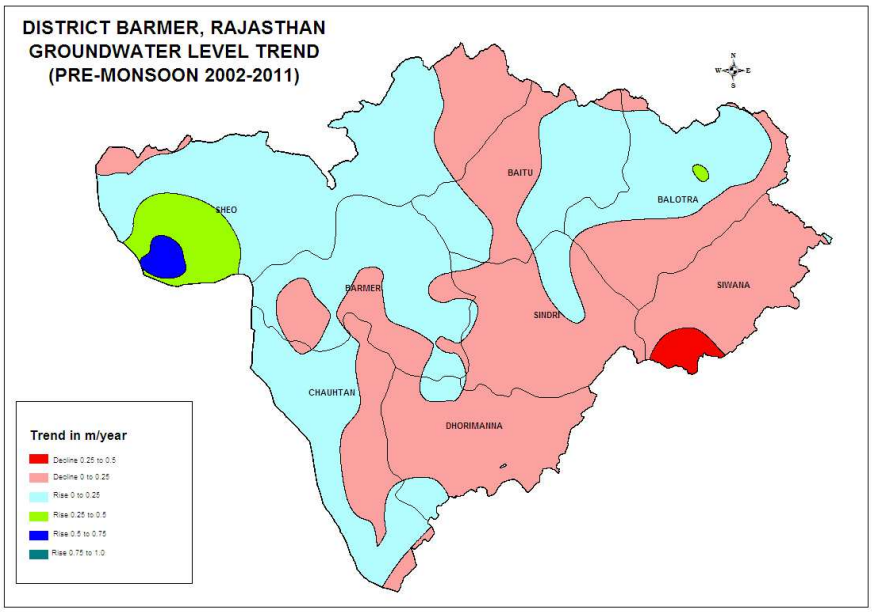


Figure 6- Water Level Trend (Pre Monsoon 2002 - 2011)

The map of post monsoon trend of water level for the year 2002 to 2011 is presented in Figure-7. Post-monsoon water levels during the last decade have registered rise in the range of 0 to 0.25 m/year in all the blocks mainly in the western, northwestern, northern, central and eastern parts of the district while declining trend in the range of 0 to 0.25 m/year has been registered in northern, southern and eastern parts of the district.

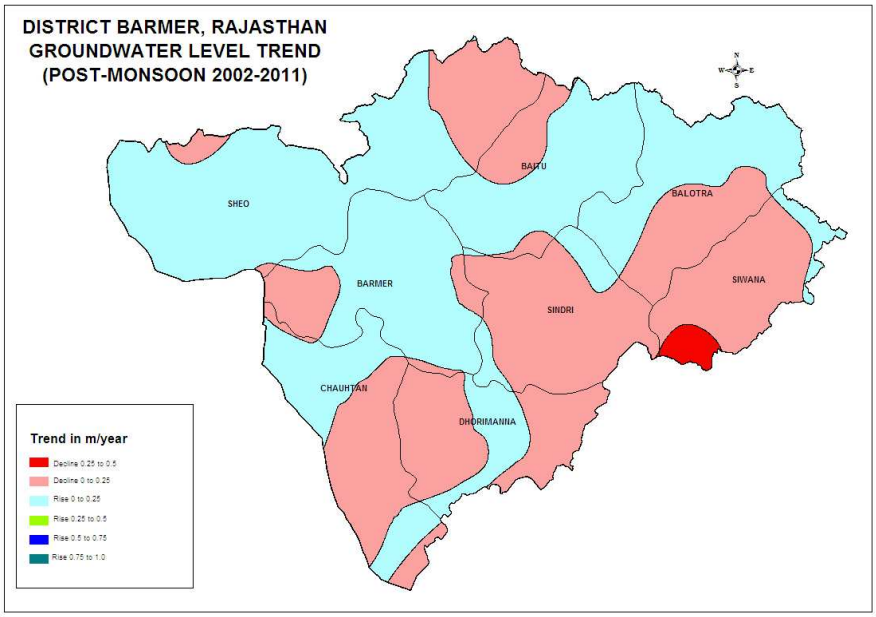


Figure 7 - Water Level Trend (Post Monsoon 2002 - 2011)

4.3 Ground Water Resources

Central Ground Water Board and Ground Water Department, Govt of Rajasthan have jointly estimated the ground water resources of Barmer district based on GEC-97 methodology. The same are presented in Table 3 and graphical representation of the resources on the map is shown in Figure-8. Ground Water Resources estimation

was carried out for 28175.74 sq. km. area out of which 12734.65 sq. km. is non-command area. Ground Water Resource estimation was also carried out for remaining 15441.09 sq. km. of saline area.

Table3: Fresh ground water resources (as on 2009)

Name of Block	Type of area	Total annual replenishable resource	Net Annual Ground Water Availability	Existing Gross Ground Water Draft for Irrigation	Existing Gross G.W. Draft for Dom. & Ind. Use	Existing Gross Ground Water Draft for all uses	Allocation for Dom. & Ind. Requirement	Net G.W. availability for future irrigation Dev.	Stage of G.W. Development	Category
		(mcm)	(mcm)	(mcm)	(mcm)	(mcm)	(mcm)	(mcm)	(%)	
BAETU (Excl. Saline)	NC	6.8421	6.4619	3.5600	10.3536	13.9136	10.3585	0.0000	215.32	OVER-EXPLOITED
BALOTRA (Excl. Saline)	NC	22.1580	20.3290	24.3504	6.9387	31.2891	7.0519	0.0742	153.91	OVER-EXPLOITED
BARMER (Excl. Saline)	NC	28.8945	26.5485	4.2160	5.6520	9.8680	5.8786	16.4539	37.17	SAFE
CHOHTAN (Excl. Saline)	NC	50.4580	45.4122	35.8680	8.2263	44.0943	8.8301	0.7141	97.10	CRITICAL
DHORIMANNA (Excl. Saline)	NC	48.1786	44.3478	55.4336	5.3700	60.8036	5.3700	0.0000	137.11	OVER - EXPLOITED
SINDHARI (Excl. Saline)	NC	44.7840	41.0919	35.3240	3.9615	39.2855	5.1583	4.1701	95.60	CRITICAL
SIWANA (Excl. Saline)	NC	58.8606	55.2854	63.4432	3.5910	67.0342	3.5910	0.0000	121.25	OVER - EXPLOITED
SHEO (Excl. Saline)	NC	19.1262	18.0368	12.6856	15.1701	27.8557	15.1672	2.4557	154.44	OVER-EXPLOITED
Total (Excl. Saline)	NC	279.3020	257.5135	234.8808	59.2632	294.1440	61.4056	23.8680	114.22	
Total (Saline)		**288.6706**	**263.0568**	**11.6008**	**5.8260**	**17.4268**	**3.8168**	**247.6392**	**6.62**	

Ground water is the only source of irrigation in the district. Ground water development is being done by dug wells and tube wells. The present stage of ground water development in the district is 114.22%, which indicates that the scope for ground water development is already exhausted. Out of 8 blocks, 5 fall under “Over-exploited” category, 2 under “Critical” category and 1 under “Safe” category.

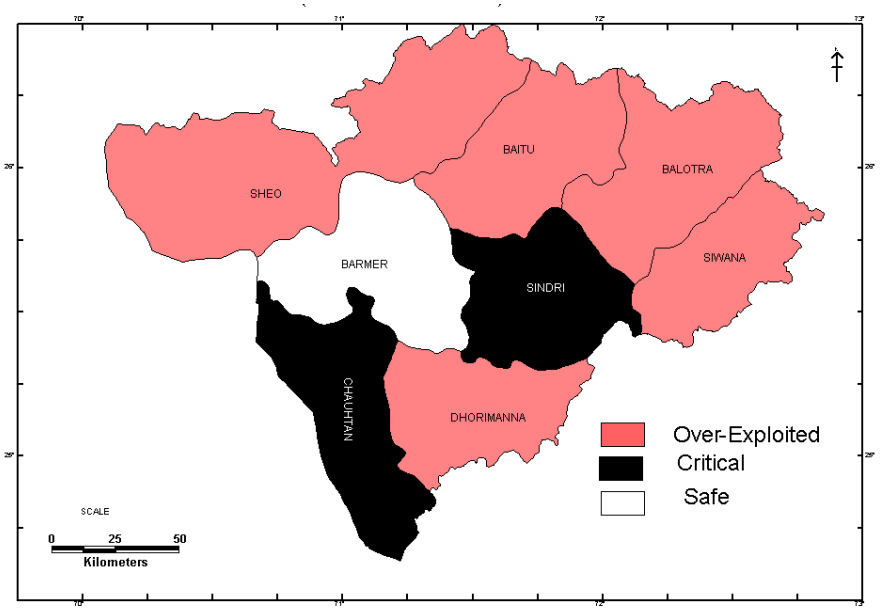


Figure 8: Category of blocks (As on 2009)

4.4 Ground Water Quality

Quality of ground water in shallow aquifer varies widely from saline in Pachpadra salt lake to fresh close to the hilly tract. Analytical results of ground water samples collected during May, 2011 indicate that specific conductance (EC) varies from 747 to 27500 µS/cm at 25°C. By and large, EC conforms broadly with chloride concentration. In greater part, EC is within 5000 µS/cm at 25°C Fig. 9). Higher values of EC have been observed in eastern part of the district around Jasol, central part around Hathi Tala and Sanwara, in northern part around Bisu kallan and in the north-western part around Napat. In general, quality of ground water deteriorates from upland and hilly tracts towards Luni River and its tributaries in the lower reaches and also in depressions in the vicinity of the saline lake.

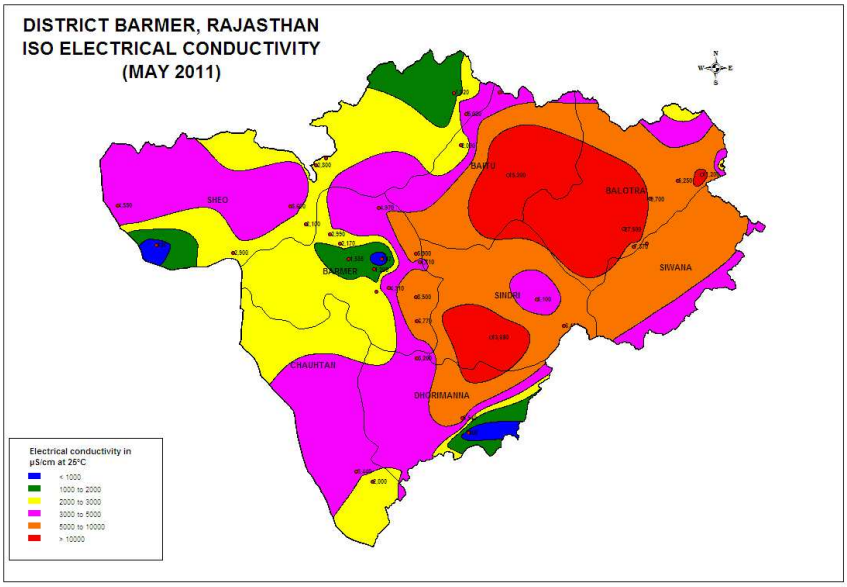


Figure-9: Distribution of Electrical Conductivity

Chloride content in ground water from shallow aquifers ranges from 50 to 5503 ppm in phreatic aquifer. The most extensive brine tract is between Thob and Chawa through Pachpadra. Vertical zonation in salinity of formation water has been observed as mentioned below:-

1. Fresh water at all levels is confined mainly to the area around Dhorimanna and the alluvial tract between Balotra and Asotra.
2. Ground water is saline at all levels in the area between Thob and Chawa and around Sanwara salt lakes.
3. Saline/ brackish water is underlain by potable water in Bhimda and Ratri areas.
4. Fresh water underlain by saline water is in Balotra-Padru area.
5. In many parts of saline tracts especially close to tanks and streams, fresh water lenses overly saline water.

Fluoride in ground water ranges between traces and 3.08 mg/l. In major part of the area, it is within the maximum permissible limit of 1.5 mg/l except in small pockets in the central part around Chawa; in northern part around Kashmir and Sau Padam Singh; in north western parts around Sandra and in the southern parts around

Shamu Ki Dhani (Fig. 10).

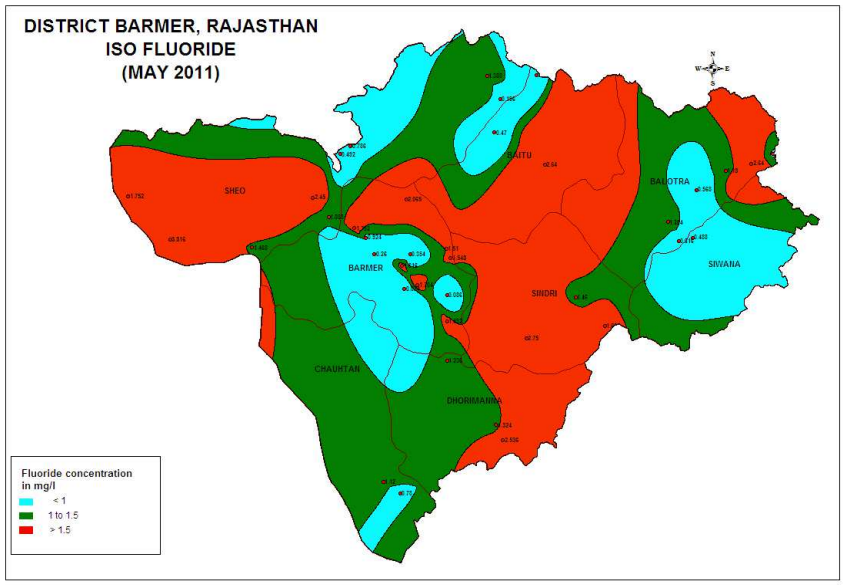


Figure-10: Distribution of Fluoride

The Nitrate concentration in ground water varies widely. Its concentration ranges from traces to as high as 892 ppm. In northeastern part of the district, the concentration of nitrate is under permissible limit Fig. 11).

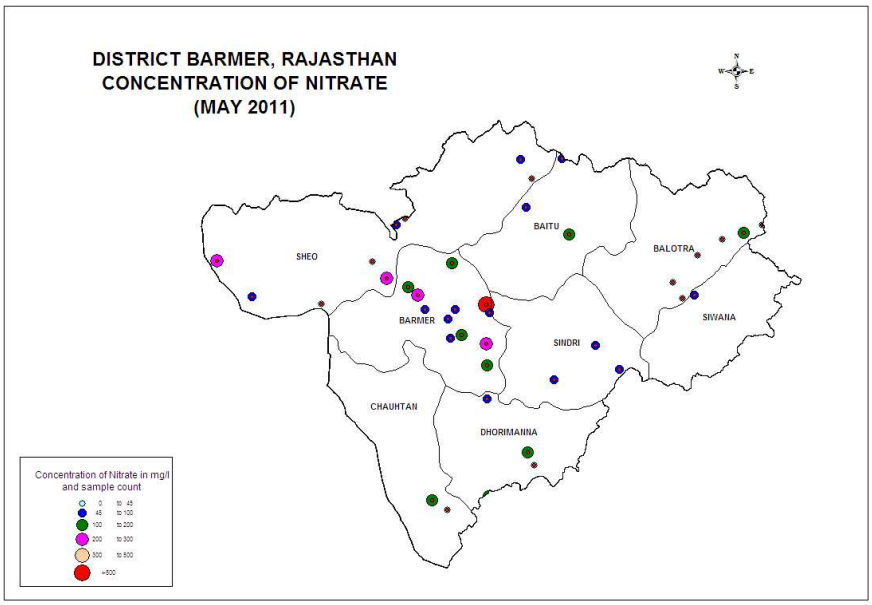


Figure-11: Distribution of Nitrate

The Iron concentration in the district ranges from nil to 4.8mg/l. Major part of the district has iron concentration within the permissible limit of 1.0 mg/l except a few localized pockets in Sheo, Balotra, Barmer and Sindhari blocks (Fig. 12).

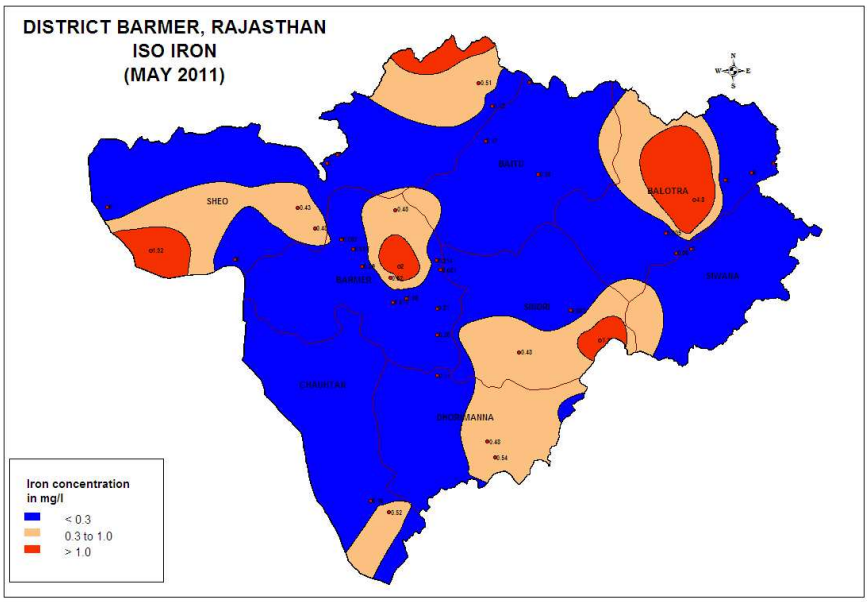


Figure-12: Distribution of Iron

4.5 Status of Ground Water Exploration

Central Ground Water Board has taken up Ground water exploration programme since 1957 in the district. The exploratory borehole data indicate that maximum depth drilled is 457.00 m. however depth of most wells is within 300 meters. The yield in hard rock is low but the quality of ground water is potable.

The status of ground water exploration as on 31.03.2011 is furnished in Table 4.

Table 4: Status of ground water exploration (as on 31.3.2011)

Type of bore hole	Formation			Total
	Unconsolidated	Semi consolidated	Consolidated	
EW/PW	28	31	6	65
SH	-	5	-	5
OW	2	3	-	5
Pz.	15	6	1	22

A total of 28 exploratory wells, 2 observation wells and 15 piezometers have been drilled in unconsolidated formation. Most of the exploratory wells drilled in alluvium have been drilled in the depth range of 18 to 457 meters with depth of well construction varying from 18 to 290m. Discharge of wells ranges from 22 lpm to 1409 lpm for drawdown ranging from 6 m to 35m. Transmissivity value varies from 50 to 156 m^2/day.

A total of 31 exploratory wells, 3 observation wells, 5 slim holes and 6 piezometers have been constructed in semi consolidated formation [Tertiary Sandstone & Lathi Sandstone]. Depth of drilling varied from 82 to 347 m and depth of construction of wells varied from 109 to 240 m. Discharge of wells specially in Lathi aquifer in its northern part varies from 303 to 852 lpm for draw down varying from 2 to 12m while in south wards and towards south west area, the discharge of wells having saturated

thickness of 15.85 (at Bhimda) to 123 m (at Bothia-II) varies from 632 to 1420 lpm indicating high potentiality of the aquifer. The transmissivity of Lathi aquifer ranges from less than 100 to over 2000 m^2/day being comparatively higher in the northern part. Wells tapping the Lathi aquifer have high specific capacity ranging mostly from 150 to 500 lpm/m.

A total of 6 exploratory wells and 1 piezometer have been drilled in consolidated formation. The depth of bore wells ranges from 25 to 180 m. Discharge of wells varies from meager to 100 lpm indicating the poor potentiality of aquifer.

5.0 Ground Water Related Issues And Problems

Major part of the district is covered by hard rock formation such as Malani rhyolite and granite and Jalore & Siwana granites of Post Delhi. These have poor water yielding capacity. Also such areas suffer from water quality problem 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 that most of the potential zones have witnessed 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 water level in the wells located in Lathi formation, Tertiary formation and Quaternary alluvium has been observed during last 15 years.

Balotra the second largest town of the district has developed as industrial centre for textile processing. The textile processing industries generate effluents, which contain toxic elements. The industrial effluent flows in river Luni, leading to ground water pollution in downstream areas.

6.0 Ground Water Management Strategy

6.1 Ground Water Development

The overall stage of ground water development of district as on 31.03.2009 is 114.22% (excluding saline) whereas that of saline ground water is 6.62%. Out of total eight blocks, 1 block (Barmer) falls in safe, 2 blocks (Chohtan, Sindhari) in critical and 5 blocks (Baetu, Balotra, Dhorimanna, Sheo, Siwana) in over-exploited categories. Nine exploratory and one observation wells in consolidated formation and 32 exploratory and 8 observation wells in unconsolidated formation are yet to be drilled in geographical gaps and unexplored areas. Deep ground water exploration especially in areas affected by salinity problem may be taken up to find out the aquifer geometry and demarcate fresh water aquifers, if any.

6.2 Water Conservation and Artificial Recharge

Precious Groundwater resources have to be conserved for sustainable availability. Artificial recharge measures need to be employed for augmenting 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 Integrated Watershed Development Project

to harvest rainwater, reduce soil erosion and check runoff velocity.

7.0 Participation In Exhibition, Mela, Fair Etc.

An Exhibition regarding activities of CGWB was made in Mela organised by Press Information Bureau at Dhorimanna.

8.0 Areas Notified By Cgwa/Sgwa

Baetu block has been notified by CGWA vide notification dated 13.08.2011 for control and regulation of ground water. The CGWA has appointed the concerned District Collector as the authorized officer for implementation of regulatory measures. In notified area, drilling/ construction of new tube wells is banned without prior permission of the Authority.

9.0 Recommendations

- 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.
- Financial assistance for ground water development in over-exploited, critical and semi-critical area should not be encouraged.
- Use of water saving devices like sprinklers, close field distribution channels etc. should be promoted.
- 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.
- Growing of water intensive crops needs 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.
- Salt resistant crops can be sown in the area having brackish to saline ground water.
- In Barmer block, which falls under safe category, further ground water development, is suggested.
- 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.
- Industrial effluent should be treated before being discharged in Luni River through an effluent treatment plant and may be recycled for reuse.
- Large-scale recharge potential exists in depleted aquifers. Implementation of artificial recharge in such areas through outside surface water sources like lift canal from IGNP system or floodwater during excess rainy years be may be promoted.
- 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.