GOVERNMENT OF INDIA

MINISTRY OF WATER RESOURCES

CENTRAL GROUND WATER BOARD

GROUND WATER INFORMATION
RAJSAMAND DISTRICT
RAJASTHAN

WESTERN REGION

JAIPUR

2013

RAJSAMAND DISTRICT AT A GLANCE

Latitude (North)	24°46'32" : 26°01'36"
Longitude (East)	73°28'30":74°18'55"
Geographical area (sq. km)	4522.26 sq km
Per cent area of the State	1.33
Altitude	532.50 m above mean sea Level
No. of Tehsils & Name	(7) Amet, Bhim, Deogarh, Khamnor, Kumbhalgarh, Railmagra, Rajsamand
No. of Blocks & Name	(7) Amet, Bhim, Deogarh, Khamnor, Kumbhalgarh, Railmagra, Rajsamand
No. of Villages	1037
Population (as per 2011 census)	Rural : 972777 Urban : 183820
Average annual rainfall (mm) (2001-2011)	524.37 mm
Major physiographical Units	Rolling topography intersected by shallow valleys. Aravalli hills in the western part, central and eastern parts occupied by relatively plain area forming foothills of Aravallis. Alluvium more conspicuous and relatively thick.
Major Drainage	Banas river and its tributaries viz. Khari, Candrabhaga, Gomati, Kothari, Ahar etc.
Land Use (ha) (As on 2010-11) (Source: Dte. Of Economics & Statistics, Ministry of Agriculture, GOI)	
Forest area	25952
Other uncultivable land excluding current fallows	174425
Fallow land	31087
Land not available for cultivation	126565
Net sown area	94697
Total cropped area	145629
Area sown more than once	50932
Principal crops (Source: Dte. Of Economics & Statistics, Ministry of Agriculture, GOI) (As on 2010-11)	
Crop	Area (ha)
Maize	63620
Wheat	31898
Jowar	8310
Barley	8472
Pulses	3508
Condiments & spices	1476
Oil seeds	13787
Fruits & vegetables	689
Fibre	2888

Irrigation by different sources (As on 2010-11) (Source: Dte. Of Economics & Statistics, Ministry of Agriculture, GOI)		
Source	Net area irrigated	Gross area irrigated
Canals	-	-
Tanks	4606	4666
Tubewells	895	1243
Other wells	38549	43156
Other sources	3	3
Total	44053	49068
No. of observation wells Monitored	30	
Geological formations	Rocks of Aravalli Bhilwara Super group, Aravalli super group and Delhi Super group and alluvial deposits along the channels of river Banas, Khari and other rivers in the form of valley fills.	
Principal water bearing Formations	Quartzite, Phyllite, Gneisses, Schist, Dolomitic marble	
Pre-monsoon depth to water level during 2011 (mbgl)	2.25 - 18.04	
Post-monsoon depth to water level during 2011 (mbgl)	0.7 - 15.95	
Ground Water Quality		
Electrical Conductivity	1120 - 5920 µS/cm at 25°C	
Fluoride	0.5 - 3.8 mg/l	
Nitrate	2.8 - 500 mg/l	
Iron	0 - 4.89 mg/l	
Type of water	Alkaline	
Ground Water Exploration		
Type of wells	Total	
EW	48	
OW	2	
SH	7	
Depth of wells (m)	8 to 203	
Discharge (lpm)	Meagre to 1110	
Electric Conductivity	300 to 3440 µS/cm at 25°C	
Total annually replenishable ground water resource	103.6106 MCM	
Net annual GW availability	93.2495 MCM	
Gross GW draft for all uses	118.1736 MCM	
Stage of GW development	126.73 %	
Major ground water problems and issues	Over-exploitation of ground water, declining ground water levels	

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RAJSAMAND DISTRICT

1.0 Introduction

Rajsamand district is located in the southern part of Rajasthan State and extends between north latitudes 24°46’32” and 26°1’36” and east longitudes 73° 28’30” and 74°18’55”. Covering an area of 4522.26 sq km, it occupies 1.39% of the total area of the state. It is bounded in the south and southwest by Udaipur district, in the east and southeast by Bhilwara and Chittorgarh district, in the north by Ajmer district and in the west by Pali district. The district is divided into 7 Tehsils and 7 blocks. As per 2011 Census data the population of the district is 1156597. The rural and urban population is 972777 and 183820 respectively with a density of 248 persons per sq km. Administrative map of the district is presented in Figure 1.

Figure 1: Map showing Administrative Divisions

Systematic hydrogeological survey and other investigations were carried out in the district by the Geological Survey of India till 1972 and later by Central Ground Water Board during 1972 to 1985. Reappraisal hydrogeological surveys have been carried out in the district by Central Ground Water Board between F.S.P. 1986-87 and 1987-88. Monitoring of water level is being carried out four times a year from 30 National Hydrograph Network Stations. Under ground water exploration programme, 48 exploratory boreholes and 2 observation wells and 7 piezometers have been drilled in the district in order to delineate potential aquifer zones and ascertain aquifer characteristics. Salient features of ground water exploration in the district are given in Table 1.

Table 1: Salient features of ground water exploration

Type of well	No.	Depth drilled (m)	SWL (m)	Transmissivity (m^2/day)	Discharge (lpm)	EC (micromhos/cm) at 25°C
EW	48	8 - 203	1 - 39.3	985 – 7944	10 – 1110	300 – 3440
OW	2	160 – 194.6	5.22 - 15			1485
PZ	7	87 - 199	2.3 – 21			580 - 1450

2.0 Rainfall & Climate

The district experiences arid to semi-arid type of climate. Normal rainfall (1951-2000) of the district is 554.5 mm whereas average annual rainfall (2001-2011) has been lower than average annual rainfall and placed at 524.37 mm. Almost 93% of the total annual rainfall is received during the southwest monsoon which enters the district in the third or fourth week of June and withdraws in the mid of September. Rainfall data of the district during the period 2001 - 2011 is presented in Table 2. The highest average annual rainfall has been 836.09 mm at Kumbhalgarh, which lies near the southwestern boundary of the district. The lowest average annual rainfall 439.67 mm has been received at Rajsamand, which lies in the central part of the district. 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.

Table 2: Annual Rainfall Data (2001-2011)

Station	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Average
Nathdwara	815.0	339.0	403.0	441.0	1004.0	774.0	591.0	345.0	595.0	955.0	783.0	640.45
Railmagra	533.0	249.0	519.0	603.0	889.0	915.0	636.0	478.0	471.0	703.0	872.0	624.36
Amet	691.0	264.0	423.0	436.0	564.0	789.0	700.0	492.0	336.0	650.0	669.0	546.73
Bharai	492.0	212.0	387.0	495.0	495.0	889.0	629.0	269.0	470.0	485.0	665.0	498.91
Bhim	774.0	286.0	416.0	463.0	656.0	623.0	452.0	378.0	377.0	702.0	746.	533.91
Chikalwas			461.0	415.0	452.0	608.0	438.0	324.0	392.0	712.0	699.0	500.11
Deogarh	280.0	259.0	485.0	530.0	680.0	788.0	509.0	493.0	321.0	752.0	765.0	532.91
Kumbhalgarh	1266.0	669.0	1464.0	373.0	822.0	926.0	788.0	502.0	401.0	1077.0	909.0	836.09
Nand samand	639.0	283.0	376.0	326.0	673.0	703.0	460.0	227.0	451.0	538.0	521.0	472.45
Rajsamand	636.0	364.0	483.0	462.0	805.0	730.0	637.0	423.0	447.0	1039.0	522.0	595.27
Rajsammand			345.0	307.0	640.5	636.0	526.0	177.5	296.0	477.0	552.0	439.67

The winter season sets in after about the middle of November, when both day and night temperatures begin to drop steadily up to the month of January. January is the coldest month with mean daily minimum temperature of 7.8ºC. The day and night temperatures rise rapidly from February to May. May is the hottest month of the year with mean daily maximum temperature of 38.6ºC.

When the southwest monsoon arrives in the district both day and night temperatures start decreasing appreciably. After the withdrawal of southwest monsoon there is a slight increase in day temperatures and a secondary maximum is obtained in the month of October. The night temperature, however, continues to fall gradually. The day temperature also starts falling in November.

The relative humidity is generally low except during southwest monsoon season. The highest relative humidity (81%) is recorded in the month of April. The summer season is the driest part of the year. Winds are generally light with some strengthening in the later half of summer and southwest monsoon season. During the period from May to September, winds blow from directions between south and west. In the post monsoon season, the winds are predominantly from direction between northwest and northeast. The potential evapotranspiration is highest in the month of May and lowest in December. Evapotranspiration is more than rainfall in all the months except in July and August.

3.0 Geomorphology & Drainage

Rajsamand district consists of monotonously rolling topography intersected by shallow valleys. Towards the western part of the district, Aravalli hills, a series of ridges run diagonally in the direction of NE and SW. The highest portion of Aravallis occurs south of Kailwara near Kumbhalgarh fort with an altitude of 1293 m amsl. A typical gneissic plain bearing irregularly carved off gneisses and granites without any alluvial cover is observed to the highest altitude of above 600 m amsl. The central and eastern parts of the district are relatively plain forming the foot hill part of Aravalli ranges. This plain gently slopes towards the east and northeast. In the higher and more rugged part towards the western side, alluvium is scanty whereas in the eastern flank, the alluvium is more continuous and reasonably thick.

Geomorpholgically, there are Intermontane plateaus, structural hills, pediment, buried pediment, aggradational plains, denudational plains, valley fills, flood plains etc. Geomorphological units show linearity specially the structural hills which are aligned in the direction of Arravallis (NE-SW).

Rajsamand district is drained by Banas river and its tributaries i.e. Khari, Chandrabhaga, Gomati, Kothari, Ahar etc. The river as well as tributaries are ephemeral and flow only in response to heavy precipitation. The predominant drainage pattern in the western hill ranges is rectangular to sub-rectangular and it is dendritic to sub-dendritic in rest of the area. Drainage pattern in the western hill region is controlled by fractures and joints and in the rest of the area by subsurface lineaments. The area has some lakes and tanks also. The famous Rajsamand lake is situated near the district head quarters Rajsamand and is the main source of supply of drinking water to Rajsamand city. There are small check dams and tanks constructed on the rivers and streams of the district which augument the natural recharge of ground water in the area.

4.0 Soil, Land Use & Irrigation Practices

The soils of the district are mainly lithosols in the western part on slope and some inceptisols as per topography. Texturally it varies from sandy loam in Bhim, Deogarh & Amet blocks to heavy clay in Kumbhalgerh block. The types of soil occurring in the district are classified as follows:

Type of Soil	Name of block
Sandy loam	Bhim, Deogarh, Amet
Clay loam	Rajsamand, Railmagra, Khamnor
Heavy clay	Kumbhalgarh.

4.1 Land-use pattern

The socio cultural and economic factors have significant influence over land use, both in rural and urban areas. Land forms, relief of land forms, slope, nature of soils and natural resources are some of the important factors which control the land use pattern of the district. Out of the total area of 452726 hectares, approximately 145629 hectares land is cultivable land and there was 94697 (20.9% of total geographical area) actual cultivated land during 2010-11. The land use pattern of the district as on 2010-11 is given in Table 3. The most of the farmers have small and marginal land holdings.

Table 3: Land Use Pattern (2010-11)

Geographical Area	452726 Hectors
Forest	25952 Hectors (5.73% of total geographic area.)
Non Agriculture Land	183276 Hectors (40.48%)
Fallow Land	100285 Hectors(22.15%)
Dupaj Land	50932 Hectors(11.25 %)
Actual Cultivated Area	94697 Hectors (20.91%)
Total Cultivated Area	145629 Hectors (32.16%)
Total Irrigated Area	49068 Hectors (10.83%)

4.2 Irrigation

The principal means of irrigation in the district are wells though the small area is irrigated by tanks also. Ground water plays an important role for irrigation and is utilized through dug wells, dug cum bored wells and tube wells. The details of the net and gross irrigated area by different sources are given in Table 4.

Table 4: Area irrigated by different sources (2010-11)

Source	Net area irrigated (ha)	Gross area irrigated (ha)
Tanks	4606	4666
Tubewells	895	1243
Other wells	38549	43156
Other sources	3	3
Total	44053	49068

5.0 Geological Framework

The oldest formations exposed in the area belongs to Bhilwara super group of Archaean age. The northern, central and western parts of the district are occupied by the younger formations of Aravalli super group and Delhi super group of Proterozoic age. Quaternary and recent alluvium overlies most of the formations in isolated pockets, along river courses and in shallow depressions.

6.0 Ground Water Scenario

6.1 Hydrogeology

Occurrence of ground water in the district is mainly controlled by the topographic and structural features present in geological formations. Ground water occurs mainly under water table conditions in all formations. Important water bearing formations besides alluvium are gneisses, granites, schists, phyllites and limestone. In hard rock formations, occurrence and movement of ground water is governed by foliation/bedding planes, fractures, joints solution cavities and other structurally weak planes. Weathered mantle of hard rocks yields good discharge of water. In alluvium, ground water occurs in interstices of unconsolidated sand and gravel. Locally semi confined conditions are encountered in both hard rock and alluvium. Hydrogeological map of the district is presented in Figure 2. Water bearing properties of different aquifers in the district are described below.

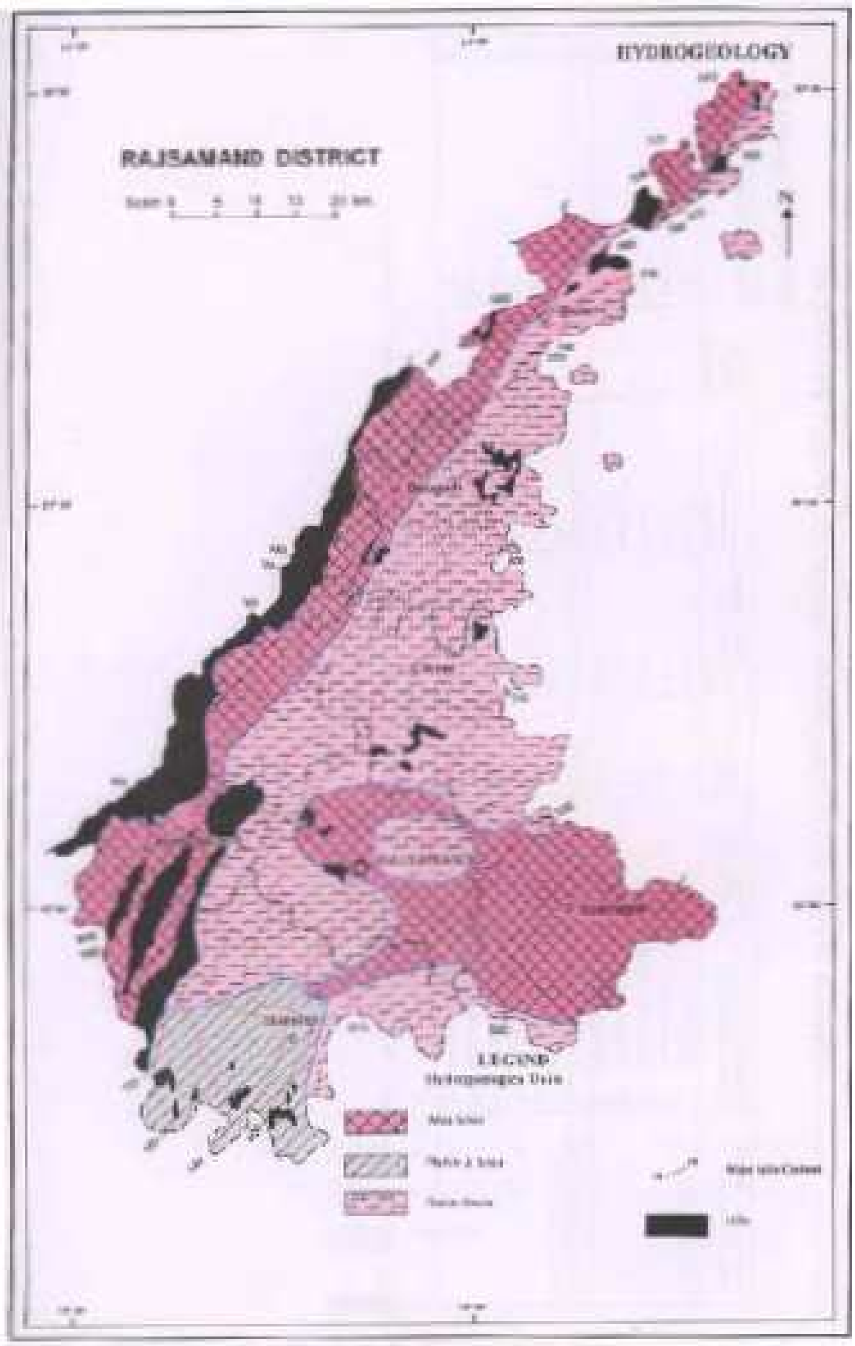

Figure 2: Hydrogeological Map

6.1.1 Ground water in Bhilwara Super Group

The eastern part of the district is underlain by the rocks of Bhilwara super group comprised of schists, gneisses and migmatites with intrusive granites. Ground water in these rocks occurs under water table conditions in weathered and fractured zones and along joints and foliation planes. Schists intermixed with gneisses form better aquifer. At places, granites and gneisses form fairly good aquifer. Intrusive contacts are found to be good channels for ground water circulation. Yield of wells varies from 10000 to 150000 litres per day (lpd). The rate of recuperation in wells is slow in gneisses and schists as compared to that in granites.

6.1.2 Ground water in Aravalli Super Group

Rocks belonging to Aravalli super group are located in south central part of the district and comprise mainly of phyllite, schist, quartzite, conglomerate, dolomite, marble etc. Phyllite, quartzite and dolomite form important aquifer. Quartzite generally occurs intercalated with phyllite and slate and is well jointed. Yield of wells in these rocks varies from 15000 to 150000 lpd. However, average yield is around 40000 lpd. In dolomite and limestone, yield of wells varies from 20000 to 200000 lpd with an average yield of 92000 lpd.

6.1.3 Ground water in Delhi Super Group

The formations belonging to Gogunda and Kumbhalgarh groups of Delhi super group are exposed in the western part of the district along a NW- SE trending belt. Lower Gogunda group constitutes mainly quartzite and schist and the upper Kumbhalgarh group consists mainly of schist, gneiss, marble and quartzite. Yield of wells in quartzite varies from 16000 and 96000 lpd. Yield of wells tapping biotite schist and hornblende schist varies from 12000 to 250000 lpd. In calc schist and calc gneiss, yield of wells varies between 10000 and 100 lpd.

6.1.4 Ground water in alluvial valley fills

Alluvial deposits of Recent origin occur in narrow discontinuous bands along the channels of Banas, Khari and other rivers in the form of valley fills. They are composed of stream laid sand and gravel and occasionally silt, clay and kankar. Besides these, blown sand occurs in localized patches. Thickness of alluvium has been found to vary from thin veneer near outcrops to 19m in the south of Bamania Kalan. The bed rock is overlain by a boulder gravel bed varying in thickness from 2 to 6 m. Ground water in boulder and gravel beds occurs under confined conditions. Saturated thickness of alluvium has been found to vary between 3 and 12 m.

6.2 Ground water levels

6.2.1 Depth to water levels

During pre-monsoon period (May, 2011), the depth to water level was recorded between 2.25 mbgl in Railmagra block and 18.04 mbgl in Kumbhalgarh block. More than 55 % of the wells monitored have registered depth to water level between 10 and 20 mbgl. Shallow water levels in the range of 2 to 5 m have been observed in isolated pockets in Kumbhalgarh, Rajsamand and Railmagra blocks (Figure 3). During post-monsoon period (November, 2011), the depth to water level varied from 0.7 mbgl in Railmagra block to 15.95 mbgl in Kumbhalgarh block. About 83% of the wells monitored have registered water levels in the range of 0 to 10 mbgl. Depth to water level in the range of 10 to 20 mbgl has been recorded in parts of Rajsamand, Kumbhalgarh, Khamnor and Railmagra blocks (Figure 4). Tehsil wise minimum and maximum depth to water levels during pre- and post-monsoon periods are given in Table 4.

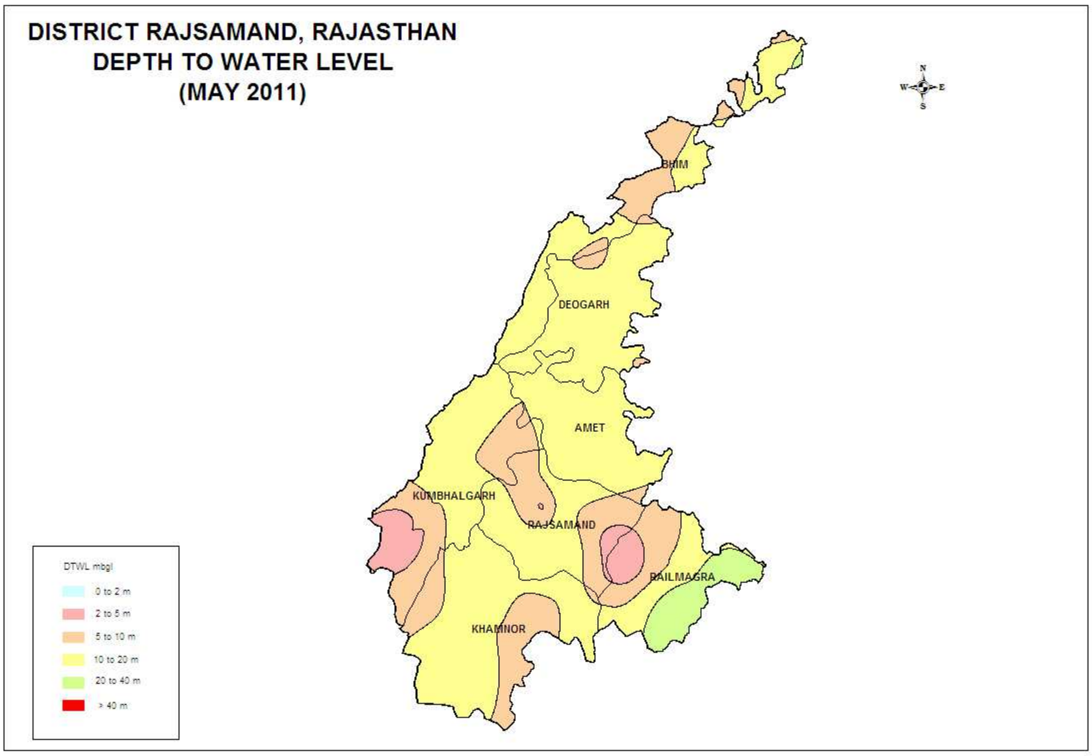

Figure 3: Depth to water level map (May, 2011)

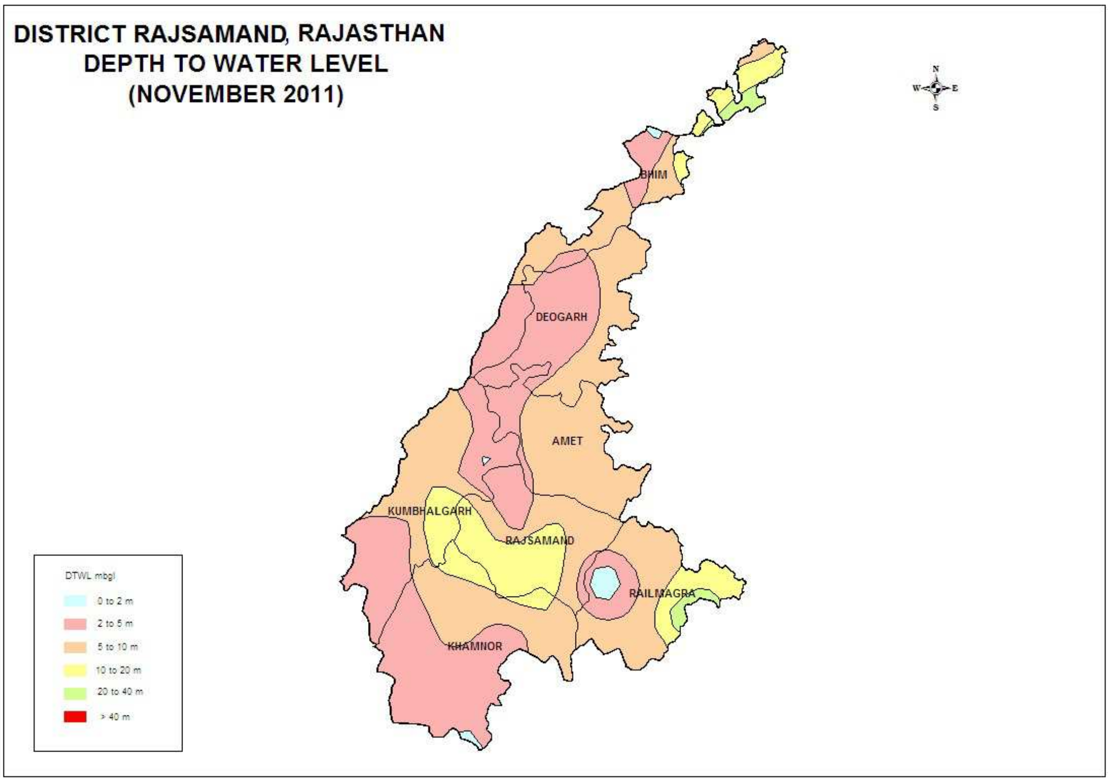

Figure 4: Depth to water level map (November, 2011)

Table 4: Tehsil wise range of depth to water levels (2011)

Tehsil	Pre-monsoon depth to water level (mbgl)		Post-monsoon depth to water level (mbgl)	
	Minimum	Maximum	Minimum	Maximum
Amet	10.08	26.15	3.15	9.75
Bhim	5.90	14.65	2.02	6.89
Kumbhalgarh	3.24	18.04	1.81	15.95
Khamnor	-	-	2.39	6.30
Railmagra	2.25	13.49	0.7	9.95
Rajsamand	4.91	13.73	3.44	15.02

6.2.2 Seasonal fluctuation

Analysis of depth to water level data of Pre- and Post-monsoon periods (may and November, 2011) indicates that out of 26 wells analysed, only 1 well in Rajsamand block has registered decline of 1.29 m. All the remaining wells have registered rise in water levels with extent of rise varying from 1.27 to 12.56 m. More than 50 % of the wells analysed have registered rise of more than 4 m in water levels (Figure 5).

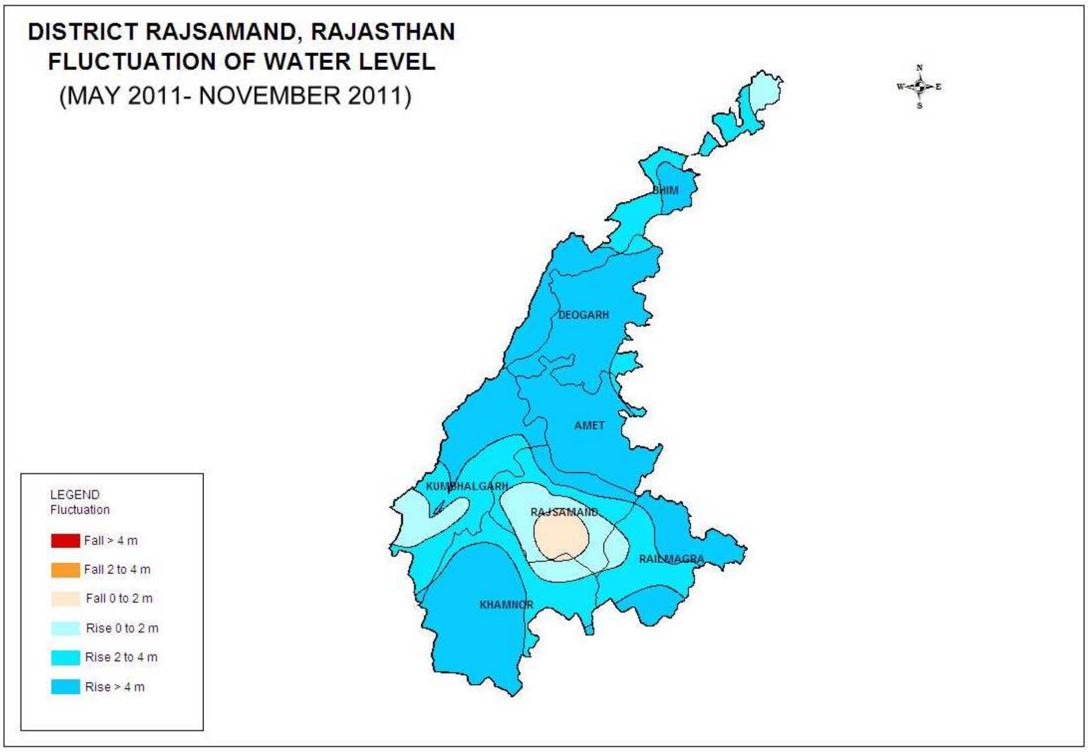

Figure 5: Seasonal water level fluctuation map (May-November, 2011)

6.2.3 Long term trend of water levels

Analysis of decadal pre-monsoon water level data indicates that major part of the district has witnessed rising trend in water levels of upto 25 cm/year. Declining trend of upto 25 cm/year has been recorded in the northern part of the district in Bhim and Deogarh blocks and isolated pockets in Kumbhalgarh, Khamnor, Rajsamand and Railmagra blocks (Figure 6).

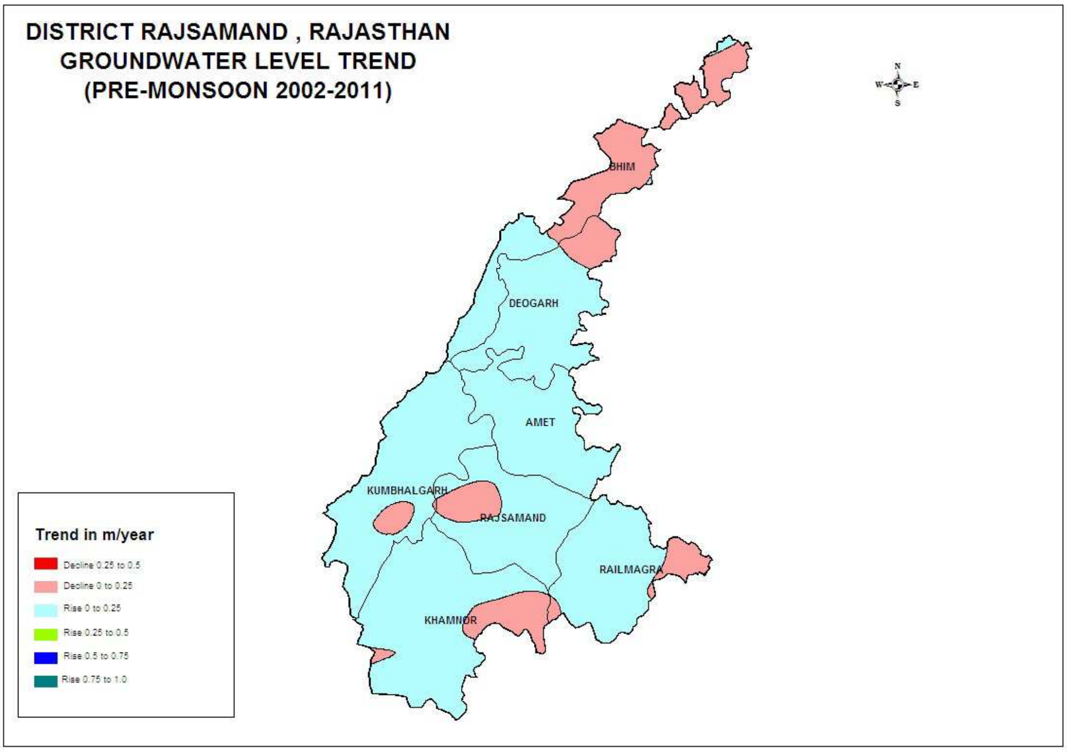

Figure 6: Decadal pre-monsoon water level trend map (May 2002 – 2011)

6.3 Chemical quality of ground water

The quality of ground water is potable in major part of the district. However, presence of excess fluoride, nitrate, iron and electrical conductivity in ground water has been reported from some pockets in the district.

The electrical conductivity (EC) in ground water varies from 1120 µS/cm at 25°C at Barar, Bhim block to 5920 µS/cm at 25°C at Nadiawala, Rajsamand block. In most parts of the district, EC has been found to be within 3000 µS/cm at 25°C. However, in Rajsamand and Amet blocks, EC above 3000 µS/cm at 25°C has been reported (Figure 7).

Fluoride content in ground water varies from 0.5 mg/l at Baghana to 3.8 mg/l at Ghata in Bhim block. Fluoride content in ground water is within the maximum permissible limit of 1.5 mg/l (as prescribed by BIS) in major part of the district. Excess fluoride in ground water has been reported from parts of Rajsamand, Railmagra, Kumbhalgarh and Bhim blocks (Figure 8).

Iron content in ground water is generally within the maximum permissible limit of 1 mg/l. Excess iron content has been reported from Railmagra and Bhim blocks (Figure 9). Maximum concentration of 4.89 mg/l has been reported from Ghata in Bhim block.

Nitrate concentration in ground water varies widely from 2.8 mg/l at Baghana, Bhim block to 500 mg/l at Nadiawala, Rajsamand block. Nitrate content in excess of maximum permissible limit of 45 mg.l has been observed in parts of Amet, Kumbhalgarh and Rajsamand blocks (Figure 10).

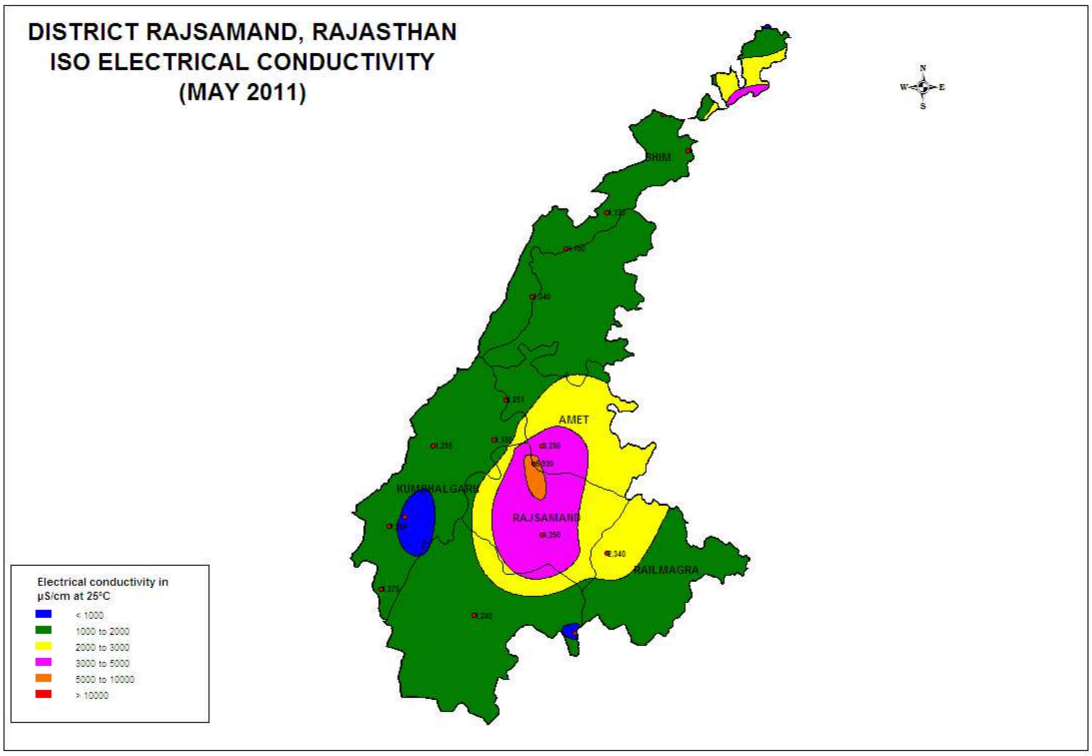

Figure 7: Iso electrical conductivity map (May, 2011)

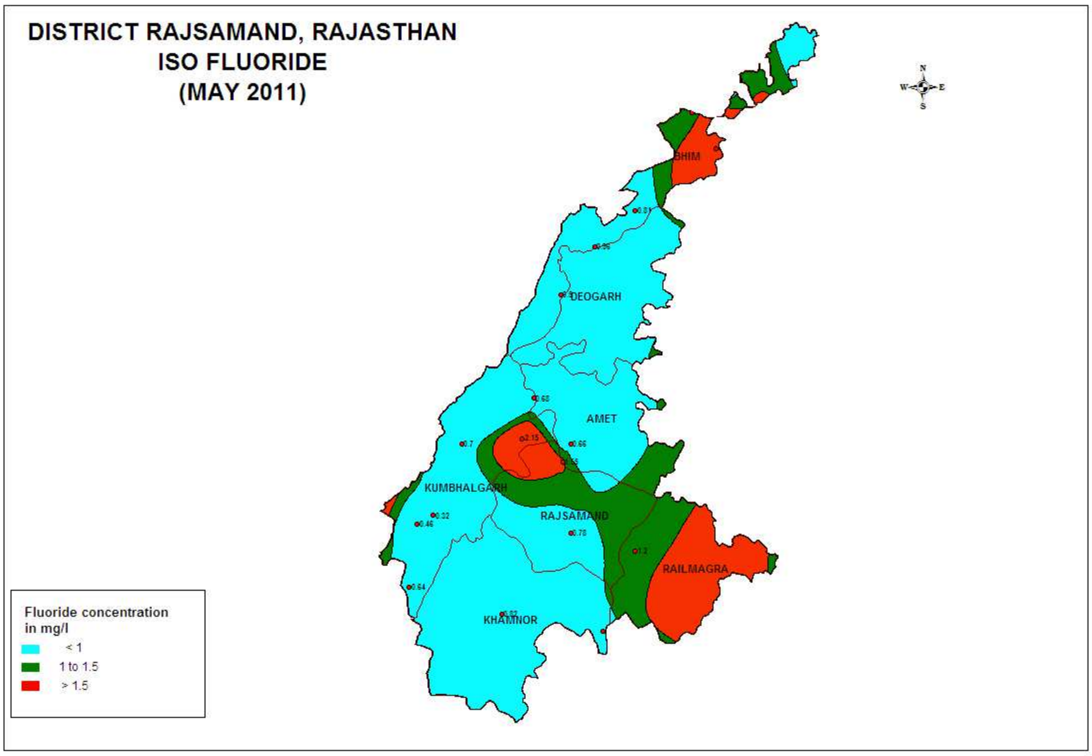

Figure 8: Iso fluoride map (May, 2011)

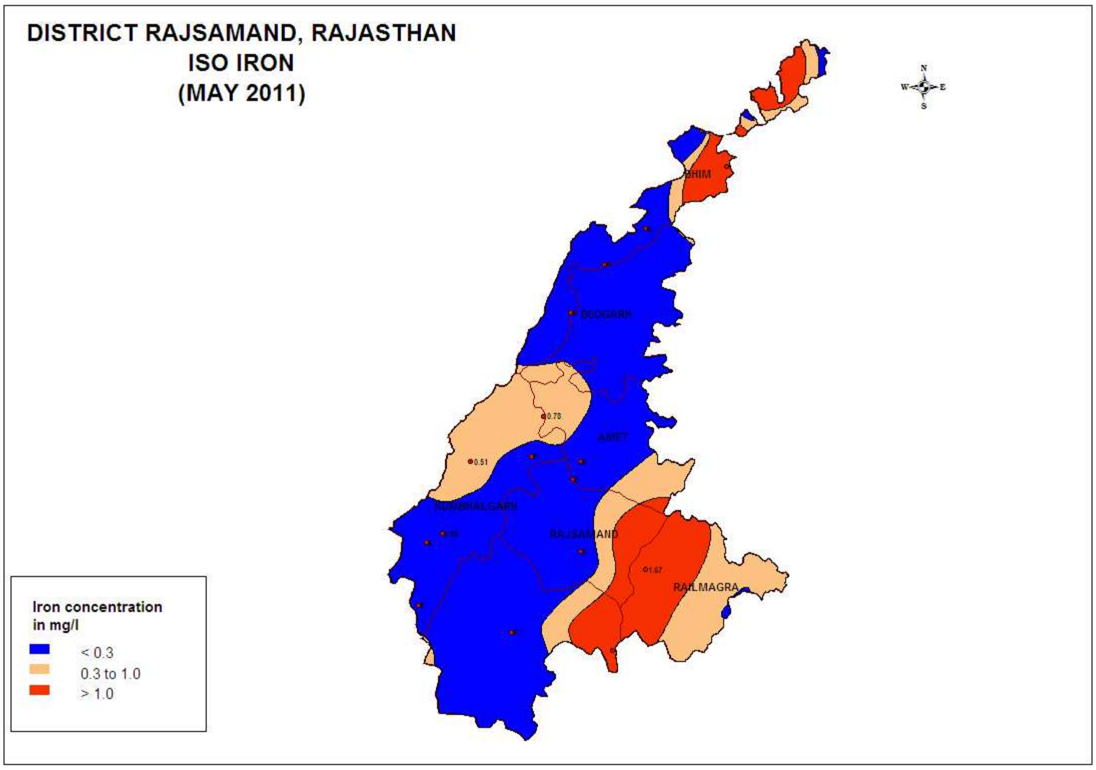

Figure 9: Iso iron map (May, 2011)

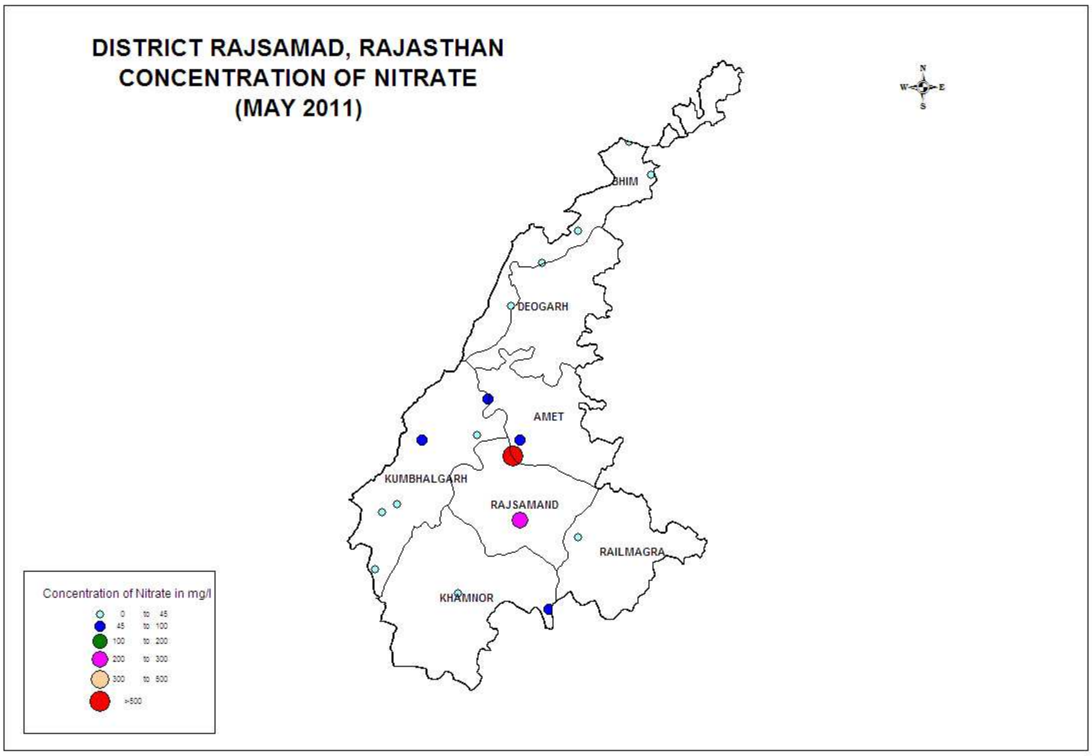

Figure 10: Map showing distribution of Nitrate (May, 2011)

7.0 Ground Water Resources

Ground water resources of the district have been estimated jointly by CGWB and State Ground Water Department as per the norms recommended by GEC' 97. While assessing the ground water resources, saline and hilly areas have not been considered. Annually replenishable ground water resources of the district have been estimated to be 103.6106 MCM. Net annual ground water availability in the district is estimated as 93.2495 MCM. Annual ground water withdrawal for all uses is 118.1735 MCM and overall stage of ground water development is 126.734%. Summarised block wise estimate of dynamic ground water resources is given in Table 6.

The dynamic ground water resource estimation (2009) indicates 126.73% percentage of ground water development and all the 7 blocks are under over exploited category. But during this period due to the extensive measures taken for increasing the natural recharge of ground water a no. of hydrograph stations show rising trend but still some area has shown declining trend of ground water levels in the district due to increase in the pace of ground water development. There is increase in the net irrigated areas in the district by different sources that is also reflected in the trend of water level of the district.

Table 6: Block wise replenishable ground water resources (As on 2009)

Block	Annually replenishable ground water resource (MCM)	Net annual ground water availability (MCM)	Annual ground water draft for irrigation (MCM)	Annual ground water draft for domestic & industrial use (MCM)	Gross annual ground water draft (MCM)	Stage of ground water develop-ment (%)	Category
Amet	13.0539	11.7485	13.1022	1.9728	15.0750	128.31	OE
Bhim	12.1457	10.9311	13.9956	1.0862	15.0818	137.97	OE
Deogarh	12.3505	11.1154	11.7042	0.6986	12.4028	111.58	OE
Khamnor	19.0327	17.1294	18.7005	2.8616	21.5621	125.88	OE
Kumbhalgarh	22.3782	20.1404	19.3428	1.3585	20.7013	102.79	OE
Railmagra	14.5402	13.0862	17.5206	1.3414	18.8620	144.14	OE
Rajsamand	10.1094	9.0985	11.6868	2.8017	14.4885	159.24	OE
District	**103.6106**	**93.2495**	**106.0527**	**12.1208**	**118.1735**	**126.73**	

7.1 Status of ground water development

Rainfall in the district is the main source of ground water recharge. Due to less rainfall and increased ground water withdrawals, ground water levels are declining in some parts of the district particularly in the northern part. Increasing urbanization and change in lifestyle have led to increased demand of water. Increasing urbanization also leads to reduced recharge. Further ground water is also an important source for irrigation in the district. The stage of ground water development for the district as a whole has reached around 127% as on 31.03.2009. All the blocks in the district are over-exploited. There is practically no scope left for further ground water development in the district.

8.0 Ground Water Related Issues & Problems

All the blocks in the district are over-exploited, where stage of ground water development has exceeded 100 % leaving no further scope for ground water development. These blocks require judicious development of ground water. Quality of ground water is generally potable, except for a few pockets, where high Electrical Conductivity, Fluoride, Nitrate and Iron have been reported.

9.0 Ground Water Management Strategy

Due to pressure of population and improvement in the standard of living, the demand of fresh water for both agriculture and domestic use has substantially increased. This has led to a sharp increase in ground water withdrawal. The top layer of fresh ground water is also reducing every year. Artificial recharge serves as a means for restoring the depleted ground water storage, slow down the quality deterioration and put back into operation many ground water abstraction structures.

9.1 Ground water development

Stage of ground water development in all the blocks in the district has exceeded 100%, which indicates that the scope of ground water development is already exhausted and the blocks have been categorized as “Over-exploited”. There is no scope for further development of ground water for irrigation or industrial use. However, exploratory drilling can be taken up in unexplored area for estimation of aquifer parameters. There is need to control and regulate ground water development in the entire district.

9.2 Water conservation and artificial recharge

Precious ground water resources have to be conserved for sustainable availability. There is need to reduce/ avoid wastage of water in various uses. Ground water should be used judiciously taking into account modern agriculture water management techniques by cultivating crops needing less watering and use of sprinkler system & drip irrigation should be encouraged.

It is recommended that increasing number of ground water structures should not be encouraged and artificial ground water recharge schemes like check dams, bunds, anicuts etc., should be constructed at appropriate hydrogeological locations. Surface water reservoirs like ponds/ tanks etc. should be constructed, which would serve dual purpose of supply of water during lean period and recharge to the ground water body. Also watershed development projects and soil conservation projects should be encouraged.

10.0 Recommendations

- Large diameter (5-8 m) dug wells should be constructed in hard rock area with sufficient depth 30-40 mbgl so as to have good storage during pumping and also during the lean period. Horizontal drilling can be done to tap the lateral fractures for enhancing the yield of the wells in hard rock areas.
- Ground water should be used judiciously taking into account modern agriculture water management techniques by cultivating crops that need less watering.
- Use of sprinkler system & drip irrigation should be encouraged.

- Small farmers in the area should be encouraged to use common ground water structures for optimum use of ground water resources for irrigation purposes.
- Cultivators should also be made aware and encouraged to adopt suitable cropping pattern using modern techniques by extension services for getting maximum agriculture production through minimum withdrawal.
- Suitable artificial recharge structures like subsurface barriers across the river beds should be constructed so that the ground water runoff can be arrested and impounded in the subsurface reservoir for meeting various sectoral demands.
- There is need for regulation of ground water development in overexploited areas.
- Awareness about the consequences in the near future of the over-exploitation of ground water resources and need and ways of judicious use of water and rain water harvesting and artificial recharge needs to be created among the users.
- The quality of ground water in most part of the district is good for irrigation and domestic/ drinking purpose except at few places where nitrate and iron problems need to be tackled by the concerned state agencies by tapping alternate sources of water supply.