GOVERNMENT OF INDIA
MINISTRY OF WATER RESOURCES
CENTRAL GROUND WATER BOARD

GROUND WATER SCENARIO
BARAN DISTRICT

WESTERN REGION
JAIPUR
2013

GROUND WATER SCENARIO
BARAN DISTRICT

S. No.	Item	Information	
1.	**GENERAL INFORMATION**		
	Geographical area (sq. km)	6955.31	
	Administrative Divisions		
a.	No. of tehsils / blocks	08/07	
b.	No. of villages	1114 inhabited 126 non habited	
c.	No. of towns	4	
d.	No. of municipalities	4	
	Population (as per 2011 census)	1222755	
	Average annual rainfall (mm) (2001-2011)	707	
2.	**GEOMORPHOLOGY**		
	Major physiographical Units	Hill ranges of Vindhyans in the northeast and low rounded hills of Malwa plateau in the south bound the region. Sedimentary rocks of Vindhyan Supergroup occupy northwestern part.	
	Major Drainage	The drainage system is well developed and represented by Chambal, which is perennial in nature.	
3.	**LAND USE (ha) (2010-11)**		
	Forest area	216494	
	Net sown area	338497	
	Cultivable area (net sown area + fallow land)	366348	
4.	**MAJOR SOIL TYPES**	1. Deep black clayey soil 2. Deep brown loamy soil 3. Red gravelly loam hilly soil	
5.	**AREA UNDER PRINCIPAL CROPS (ha) (2010-11)**		
	Food grains	Bajra : 3472 Jowar : 2006 Wheat : 147930 Barley : 559 Rice : 8231 Maize : 16913	
	Total Pulses	10872	
	Total Oil seeds	311473	
	Total Condiments & Spices	67818	
6.	**IRRIGATION BY DIFFERENT SOURCES (ha)**	Net Area irrigated	Gross area irrigated
	Canal	54485	57488

S. No.	Item	Information	
	Tank	2376	3137
	Tubewells	191558	200258
	Other wells	28252	28293
	Other sources	16052	16820
	Total	292723	306626
7.	**NUMBER OF GROUND WATER MONITORING WELLS OF CGWB**		
		No. of dug wells	20
		No. of piezometers	1
8.	**PREDOMINENT GEOLOGICAL FORMATIONS**	Upper Vindhyan, Bhander Group, Ganurgarh shales, Bhander limestone and Bhander sandstone overlain by Deccan traps and alluvium of Quaternary age.	
9.	**HYDROGEOLOGY**	The main water bearing formations are alluvium of Quaternary age and limestone/ sandstone of Vindhyan Super Group.	
	Depth to water level (Pre-monsoon, 2011) (mbgl)	3.2 to 11.55	
	Depth to water level (Post-monsoon, 2011) (mbgl)	1.75 to 17.32	
	Long term water level during 2002-2011	33.3% wells monitored recorded rise from 0-2m,11.1% from 2-5 m &11.1% from 5-10 m and remaining 33.3 % wells recorded fall of the order of 0-2 m	
10.	**GROUND WATER EXPLORATION**		
	No. of wells drilled	EW – 7, OW -2, PZ – 3, Total - 12	
	Depth range (mbgl)	25.5 – 175	
	Discharge (litres per minute)	72 - 550	
	Transmissivity (m^2/day)	78 - 403	
11.	**GROUND WATER QUALITY**		
	Presence of chemical constituents (EC in µS/cm at 25°C, F, Fe and NO_3 in mg/l)	EC : 630 - 3550 F : 0 – 0.5 Fe : 0.04 – 0.12 NO_3 : 2 - 280	
	Type of water	Alkaline in nature	
12.	**DYNAMIC GROUND WATER RESOURCES (March, 2009) in MCM**		
	Annual replenishable ground water resource		
	Net annual ground water availability		
	Net annual ground water draft		
	Stage of ground water development		
13.	**AWARENESS AND TRAINING ACTIVITIES**		
	Mass awareness programmes	NIL	
	Water management training programmes	NIL	

S. No.	Item	Information
14.	**EFFORTS OF ARTIFICIAL RECHARGE AND RAIN WATER HARVESTING**	
	Projects completed by CGWB (number and amount spent)	NIL
15.	**GROUND W ATER CONTROL AND REGULATION**	
	Number of OE blocks	5
	Number of critical block	1
	Number of safe block	1
	Number of notified blocks	None
16.	**MAJOR GROUND W ATER PROBLEMS AND ISSUES**	
	Declining water levels and increasing draft due to increase in irrigation and domestic draft as well.	

DISTRICT GROUND WATER BROCHURE
BARAN DISTRICT

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DISTRICT GROUND W ATER BROCHURE
BARAN DISTRICT

1.0 Introduction

Baran district with an area of 6992 sq km is located between latitude 24°25'00" and 25°27'00" east and longitude 76°12'00" and 77°25'00" north. The district forms a part of Kota Division. It is bounded by Kota district in the west and Madhya Pradesh in the northeast and in south by Jhalawar district. It falls on Survey of India toposheet numbers 54C, 54D, 54G & 54H (on 1:2,50,000 scale).

Administratively, the district is divided into eight tehsils and six development blocks. Total number of inhabited villages in the district are 1114 with 4 urban towns and 6 sub urban townships. The population of the district as per 2011 census is 1222755 persons including 633945 males and 588810 females. Rural and urban population of the district is 968541 and 254214 souls respectively (as per 2011 census). A map showing administrative divisions is given inFig.1 and administrative set up of the district is given in Table 1.

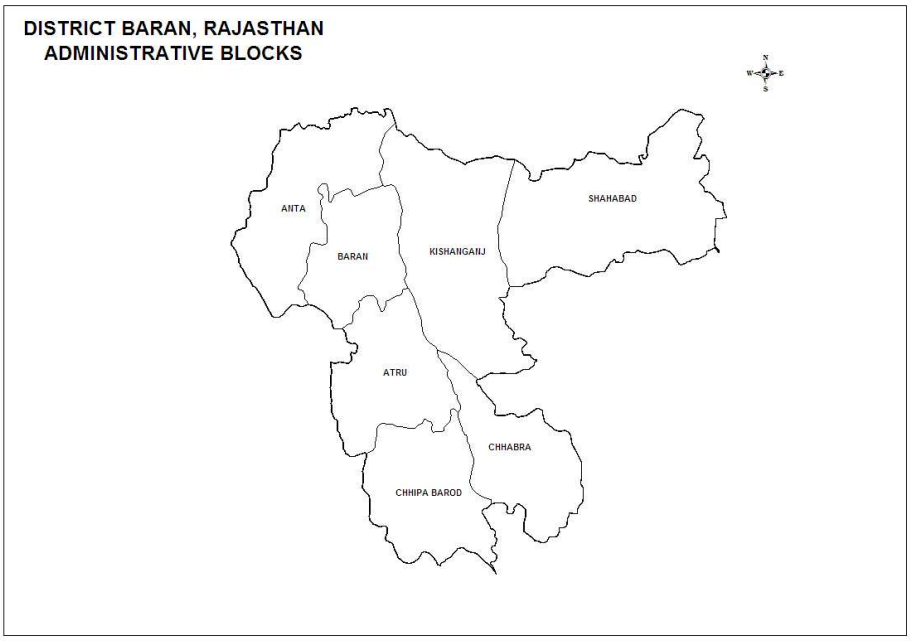

Fig. 1: Administrative map of Baran district

Table 1: Administrative set up of Baran district

S. No.	Name of block	Geographical area (sq km)	Name of Tehsil it covers	Name of Sub division
1	Anta	949.01	Mangrol/Anta	Baran
2	Atru	860.30	Baran& Mangrol	Chhabra
3	Baran	626.21	Baran & Anta	Baran
4	Chhabra	790.79	Chhabra	Chhabra
5	Chhipabarod	828.76	Chhipabarod	Chhabra
6	Kishanganj	1430.98	Kishanganj	Chhabra
7	Shahbad	1469.26	Shahbad	Shahbad

The ground water investigations were carried out by GSI in 1969-70 and systematic hydrogeological Survey has been carried out by CGWB, WR, Jaipur in 1980-81. Ground water exploration has also been undertaken in the year 1983-85. Later other hydrogeological activities have been undertaken by CGWB, WR, Jaipur for ground water evaluation and resources estimation in association with ground water department of Rajasthan State. Monitoring of National hydrograph stations four times in a year is done by Central Ground Water Board, Western Region, Jaipur.

A total of 7 exploratory wells have been drilled in Baran district. The depth of exploratory wells varies from 25.5 to 175 m and static water level varies from 2.88 to 32.2 m. The transmissivity of the aquifers varies from 78 to 403 m^2/day and discharge of the wells varies from 72 to 550 litres per minute (lpm).

2.0 Rainfall & Climate

Baran district falls under the arid to semi-arid type of climatic zone according to the meteorological classification given by India Meteorological Department. The normal annual rainfall for the district for the period 1951 - 2000 is 852.7 mm. However the annual average rainfall recorded during the period 2000 – 2011 has been 707 mm (Table 2).

Table 2: Annual rain fall data (2000-2011)

Station	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Average
Antah	977.0	365.0	776.0	932.0	1029.2	1278.2	560.8	960.0	848.0	498.0	1412.0	876.02
Atru	1029.0	237.5	768.0	881.0	610.0	752.0	837.0	808.0	686.0	615.0	1627.4	804.63
Baran	868.0	254.0	571.0	715.0	923.5	925.4	600.0	665.0	650.0	564.0	1507.0	749.35
Chhabra	751.0	440.5	994.0	994.0	863.0	887.0	750.0	950.0	730.0	529.0	1499.0	853.41
Chhipabarod	767.0	314.0	785.8	922.0	893.0	749.0	803.0	1042.0	928.0	650.0	1940.0	890.35
Gopalpura*				554.0	509.0	545.0	599.0	884.0	523.0	345.0	1033.0	624.00
Kishanganj	1047.4	283.6	590.0	570.0	794.0	589.0	697.0	854.0	634.0	549.0	1447.0	732.27
Mangrol	879.0	350.0	502.0	817.0	760.0	732.0	481.0	1051.0	502.0	569.0	1418.0	732.82
Shahbad	809.0	333.0	731.0	530.0	795.0	620.0	607.0	944.0	549.0	535.0	1357.0	710.00
Ummedsagar*				602.3	526.0	394.0	601.0	1091.0	496.0	377.0	1031.0	639.79

Summers are very hot and dry and winters are very cold. The maximum temperature during summer rises as high as 48°C while minimum during winter reaches as low as 5°C. The summer season prevails from March to mid of June after which the rainy season starts with the onset of monsoon rains lasting till the end of September. During the May/ June months, the mean daily temperature is about 40°C. The potential evapotranspiration is 1780.0 mm annually.

3.0 Geomorphology & Drainage

The district is a part of “Hadoti Region”, which is a distinct geomorphic region of Rajasthan state. The hill ranges of the Vindhyan in the northeast and low rounded hills of Malwa plateau in the south bound the region, while sedimentary rocks belonging to the Vindhyan super group occupy northwestern part. The rivers and the streams of the district belong to the Chambal river system. The rivers drain through undulating plain that slopes from SSE to NNW. It attains a maximum height of 500 m at village Rajpur and a minimum of 220 m above mean sea level at village Ulthi.

Geomorphologically, the district can be divided into the rocky uplands, pedeplains and alluvial plains.

4.0 Soils, Land use and Irrigation Practices

The soils of the district are alluvial in nature and are generally non-calcareous. Its colour varies from dark brown to black. This type of soil generally occurs in plains. Mainly black kachari soils are found in Baran and Mangrol tehsils, which is highly fertile. Red gravelly loam hilly soils are found in the southern and eastern parts of the district.

4.1 Land use pattern

The land use statistics of the district is furnished in Table 3. The total sown area is 338497 ha and area sown more than once is 235908 making the total cropped area as 574405 ha.

Table 3: Land use pattern (2010-11)

S. No.	Particulars	Area (ha)
1	Reporting area for land utilization statistics	699461
2	Forests	216494
3	Not available for cultivation	66299
4	Permanent pastures & other grazing lands	34946
5	Land under miscellaneous tree crops and groves	134
6	Culturable waste land	15240
7	Fallow land	27851
8	Net sown area	338497
9	Total cropped area	574405
10	Area sown more than once	235908

4.2 Irrigation

The principal means of irrigation in the district are well/tube wells, though some areas are also irrigated by canals, tanks etc. Ground water is the main source of irrigation and is utilized through dug wells, dug cum bore wells and tube wells. Canal irrigates only a small area. Details of net and gross irrigated area by different sources are given in Table 4.

Table 4: Details of net irrigated area and gross irrigated area by different sources

(Area in Ha)

Source / Area	Canal	Tanks	Tubewells	Other wells	Other sources	Total
Net irrigated	54485	2376	191558	28252	16052	292723
Gross irrigated	57488	3137	200258	28923	16820	306626

Agricultural activity is spread over both Kharif and Rabi cultivation. Kharif cultivation is rain fed and Rabi cultivation is mostly based on ground water. Out of 306626 ha of gross irrigated area, 229281ha area is irrigated by wells and tubewells. The main Kharif crops grown in the area are Bajra, Jowar and Maize etc., whereas principal Rabi crops are wheat, gram and mustard.

5.0 Geology

Geology of an area plays an important role in occurrence and movement of ground water in it. The ground water potential depends upon these aquifers present in the area. Therefore, it is necessary to consider the nature of the geological formations present in Baran district. The sandstone, limestone and shale of Bhander group of Vindhyan Super Group constitute the basement overlain by Deccan Trap basalt. At places a thin Alluvial cover is also found. The general stratigraphic succession of the district is given in Table 5.

Table 5: General stratigraphic succession

Era	Group	Sub-group	Lithology
Recent	---	---	Alluvium and soil
Upper Cretaceous to Palaeocene	---	Deccan traps	Basaltic flows with inter-trappean beds
Upper Vindhyan	Bhander group	Lower Bhander sandstone	Sandstone with shale intercalation
		Bhander limestone	Impure argillaceous stromatolitic limestone
		Ganurgarh shale	Variegated shale

Southern part of Baran district is occupied by basaltic flows and constitutes about 16% area of the district covering parts of Chhabra & Chhipabarod blocks. Sandstone, limestone & shale of lower Bhander group occupy 84% of the area in north and northeastern parts of Anta, Atru, Baran, Kishanganj & Shahbad blocks. The rock formations exposed in Baran district are the meta-sedimentaries belonging to Vindhyan Super Group, overlain by Deccan basalt and Quaternary alluvium.

6.0 Ground Water Scenario

6.1 Hydrogeology

The availability, occurrence and movement of ground water depends upon the rock formations present in the area. In Baran district, alluvium, limestone, sandstone, shale and inter trappeans are the main hydrolith units. Among these formations, alluvium is the most potential among different hydrogeological formations. The ground water in these formations occurs under water table conditions. At places, semi-confined conditions also exist.

Ground water in hard rocks viz. Vindhyan limestone, sandstone, shale and Deccan basalt occurs in secondary porosity developed by weathering and/ or fracturing. The ground water potential of these rocks depends upon the intensity of joints and fracture systems and their interconnection. These formations are known to be water-bearing down to more than 100 mbgl. These deeper zones are tapped by bored wells mostly for irrigation purpose.

Exploratory drilling in the district has revealed that the hard rock forms the main aquifer over large parts of the district. Depth of tubewells ranges from 20m to 150m.Yield of tube wells ranges from meagre to 2000 lpm.

6.2 Depth to Water Level

The depth to water level varies widely depending upon topography, drainage and bedrock configuration etc. During pre-monsoon (May, 2011), depth to water level in the district was found to vary between 3.2 and 11.55 mbgl. In major part of the district, the depth to water level varied from 5 to 10 mbgl (Fig. 2). Water level in the range of 2 to 5 mbgl was recorded in 11.11% of the monitoring stations, 5 to 10 mbgl in 66.67% of the monitoring stations and 10 to 20 mbgl in only 22.22% of the monitoring stations. Deep water levels beyond 20 m have not been observed in the district. Shallow water levels in the range of 2 to 5 m have been observed in parts of Anta, Kishanganj and Shahbad blocks. Water levels in the range of 10 to 20 m have been observed in parts of Anta, Baran Atru, Chhipa Barod and Shahbad blocks.

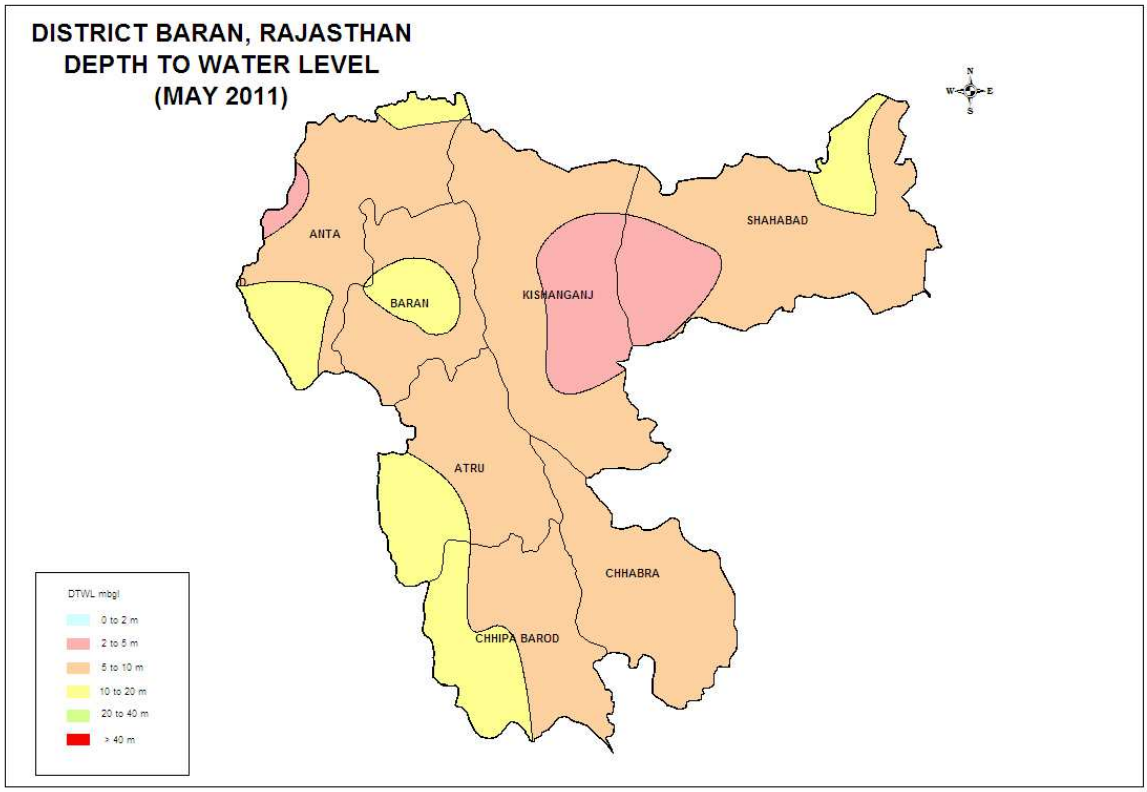

Figure 2: Depth to water level map (May, 2011)

During post-monsoon period (November, 2011), the depth to water level in the district varied from 1.75 to 17.32 mbgl. In major part of the district, depth to water level was recorded in the range of 2 to 5 m covering [arts of Chhipa Barod, Atru, Shahbad, Kishanganj and Anta blocks (Fig. 3). It was observed that depth to water level varied from 0 to 2 m in 16.67 % of the wells monitored, 2 to 5 m in 44.44 % of wells, (NHS), 5 to 10 m in 27.78% of wells and between 10 and 20 m in the remaining 11.11% of wells monitored. Water levels in the range of 10 – 20 m have been observed in localized pockets in Anta, Baran, Atru and Chhabra blocks.

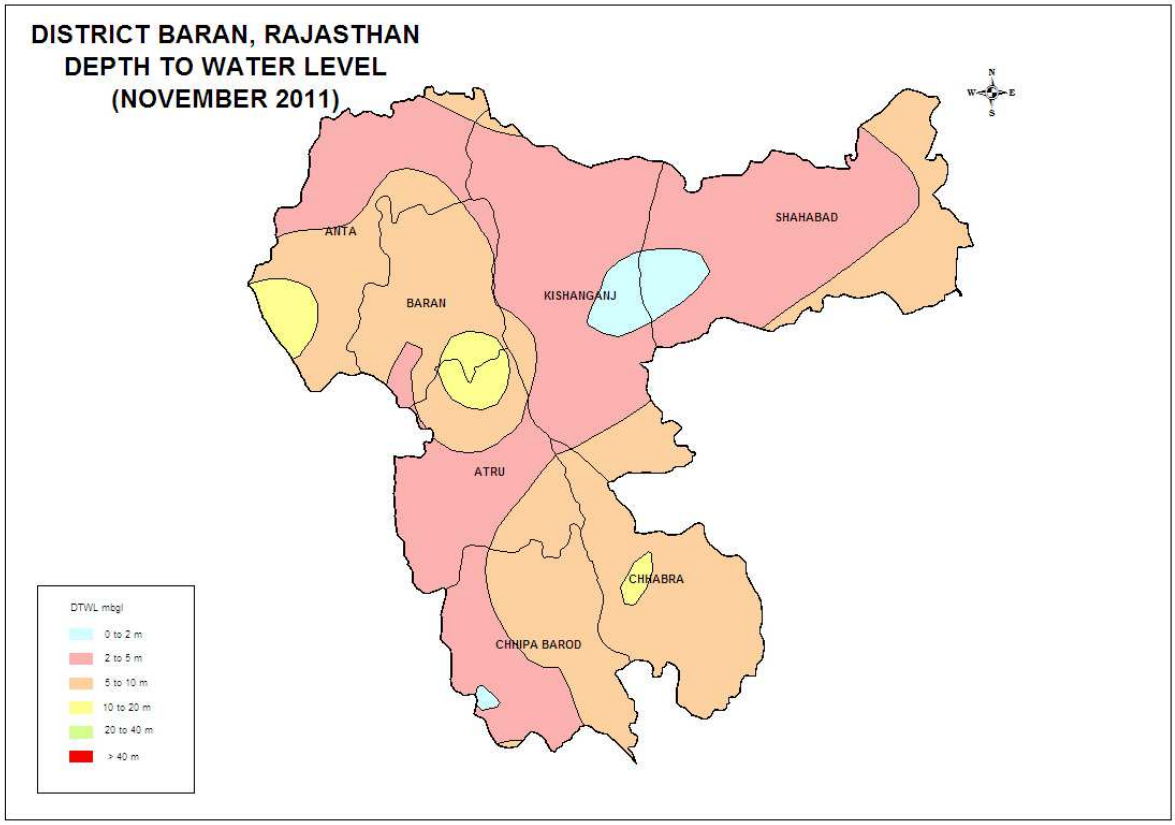

Figure 3: Depth to water level map (November, 2011)

6.3 Water Level Fluctuation

Analysis of pre- and post-monsoon water level (May and November, 2011) indicates that there has been exceptionally rise in water levels in the entire district. Perusal of the fluctuation data indicates that major part of the district has recorded rise in water level of more than 7.83 m whereas no decline in water levels has been observed in the district due to high rainfall (Fig. 4). Around 44.4% of the wells monitored have registered rise in the range of 2-5 m in water level, 22.2% wells have registered rise of 5-10 m and 33.3% of the wells have shown rise of 10 to 20 m.

Analysis of decadal pre-monsoon water level data (May, 2002 to May, 2011) indicates that there has been rising trend of ground water levels over a major part of the district (Fig. 5). The rising trend in water levels varies from 0 to 25 cm/year. Declining trend of upto 25 cm/year has been observed in northeastern, northern, southwestern and southeastern parts of the district falling in Anta, Kishanganj, Shahbad, Atru, Chhipa Barod and Chhabra blocks.

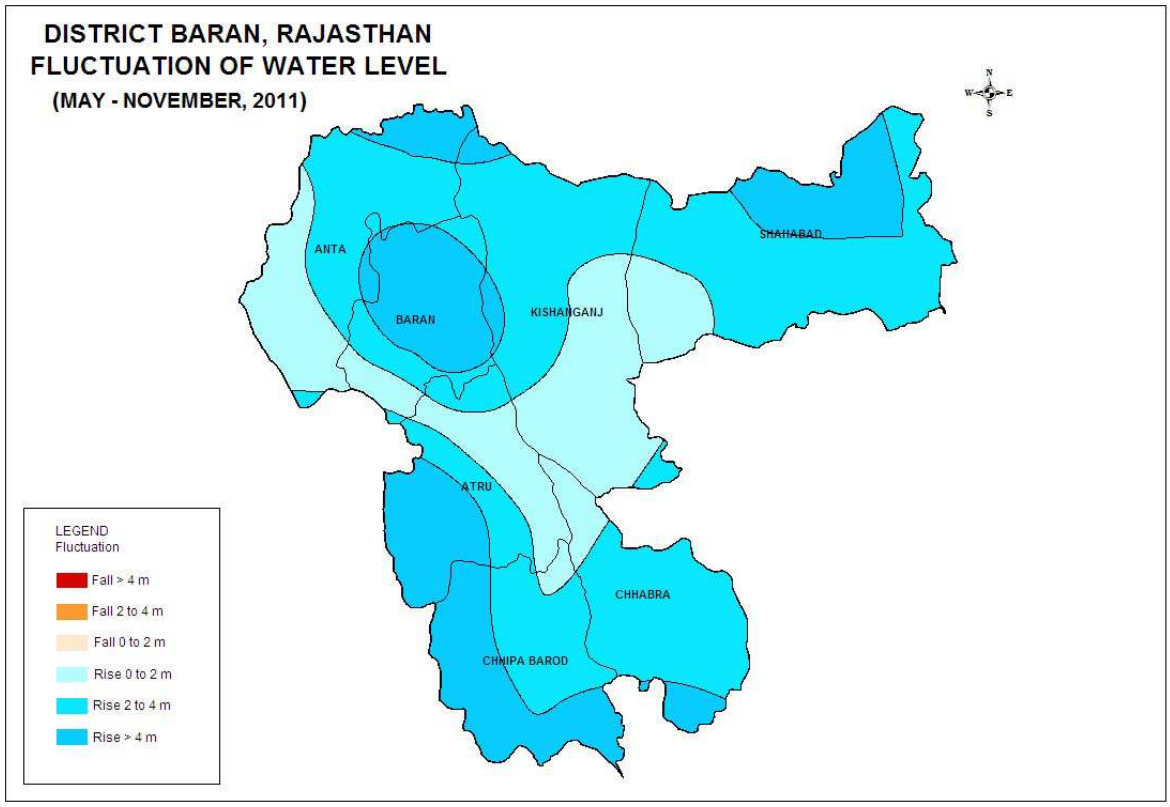

Figure 4: Seasonal water level fluctuation map (May – November, 2011)

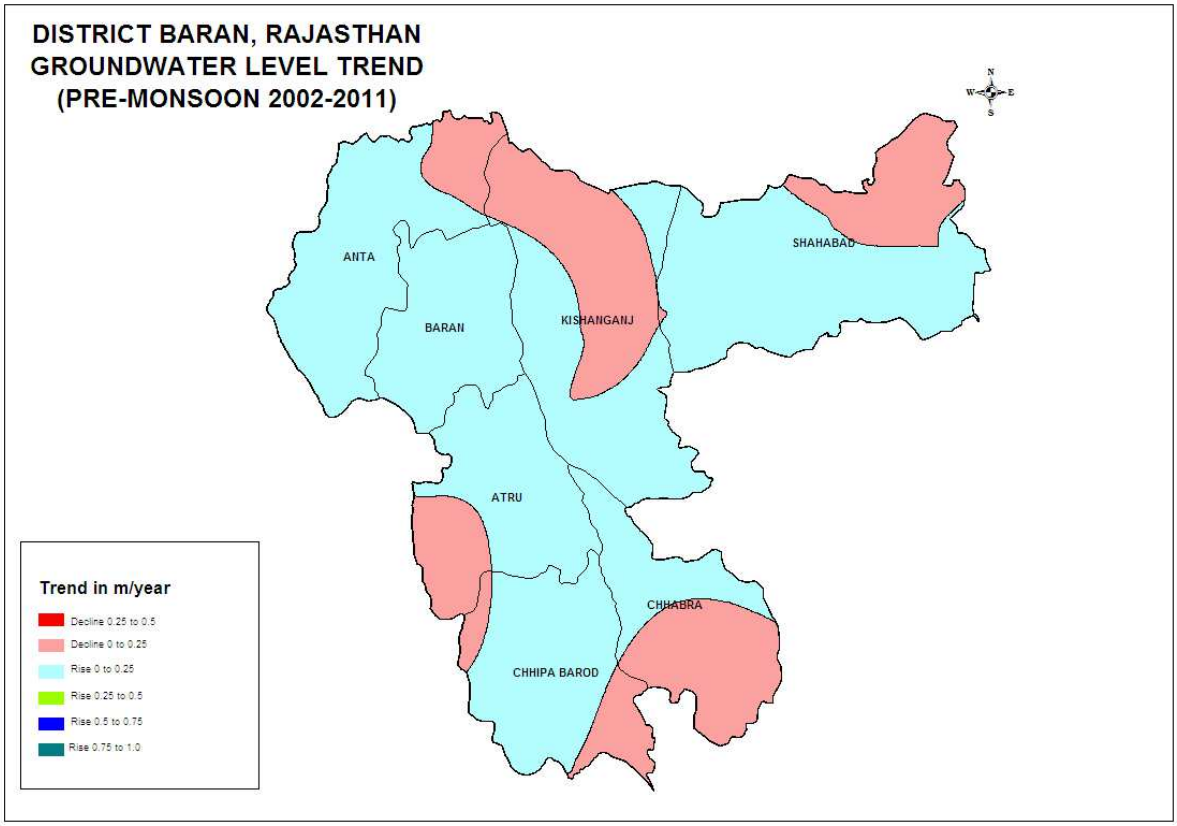

Fig. 5: Decadal pre-monsoon ground water level trend map (May, 2002 – May, 2011)

6.4 Ground Water Quality

6.4.1 Water Quality in Shallow Aquifer

The range of chemical constituents of groundwater in Baran district during pre-monsoon' 2011 is furnished in Table 6.

Table 6: Range of chemical constituents in ground water

S. No.	Chemical constituent	Range
1	pH	7.1 to 7.9
2	Chloride	35 to 710 ppm
3	Specific conductivity at 25°C	630 to 3550 µS/cm at 25°C
4	Total hardness as $CaCo_3$	200 to 980 mg/l
5	Calcium	52 to 290 mg/l
6	Magnesium	14.6 to 153.2 mg/l
7	Iron	0.04 to 0.12 mg/l
8	Nitrate	2 to 280 mg/l
9	Fluoride	0.0 to 0.5 mg/l

Shallow ground water of dug well zone is alkaline in nature with pH ranging from 7.1 to 7.9. The Chloride content in ground water has been found to vary from 35 to 710 mg/l. The specific conductance (EC) of ground water in the district is within 3550 µS/cm at 25°C. Quality of ground water is generally fresh with EC below 3000 µS/cm at 25°C in major parts of the district (Fig. 6). EC above 3000 µS/cm at 25°C has been observed in localised pockets in Anta and Baran blocks.

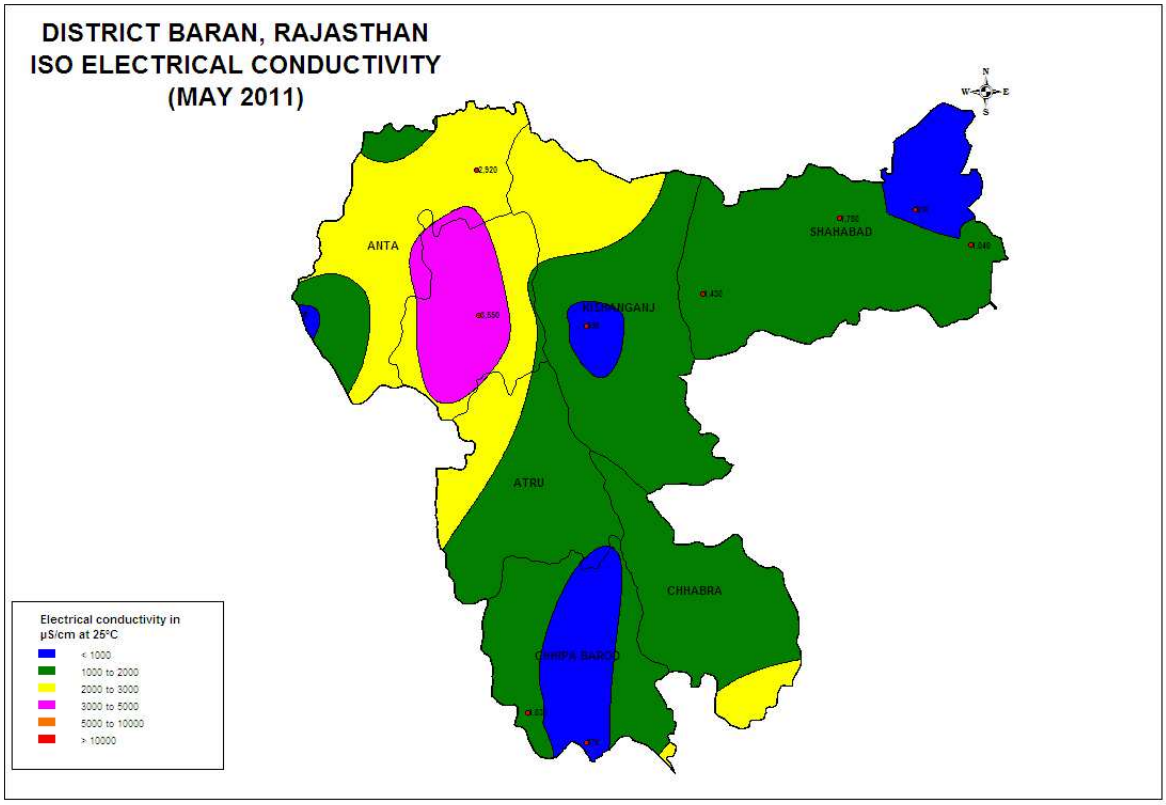

Figure 6: Iso Electrical Conductivity map (May, 2011)

The fluoride content in all the ground water samples has been found to vary from 0 to 0.5 mg/l and is well within the desirable limit of 1 mg/l (BIS prescribed limit for drinking water) in the entire district (Fig. 7).

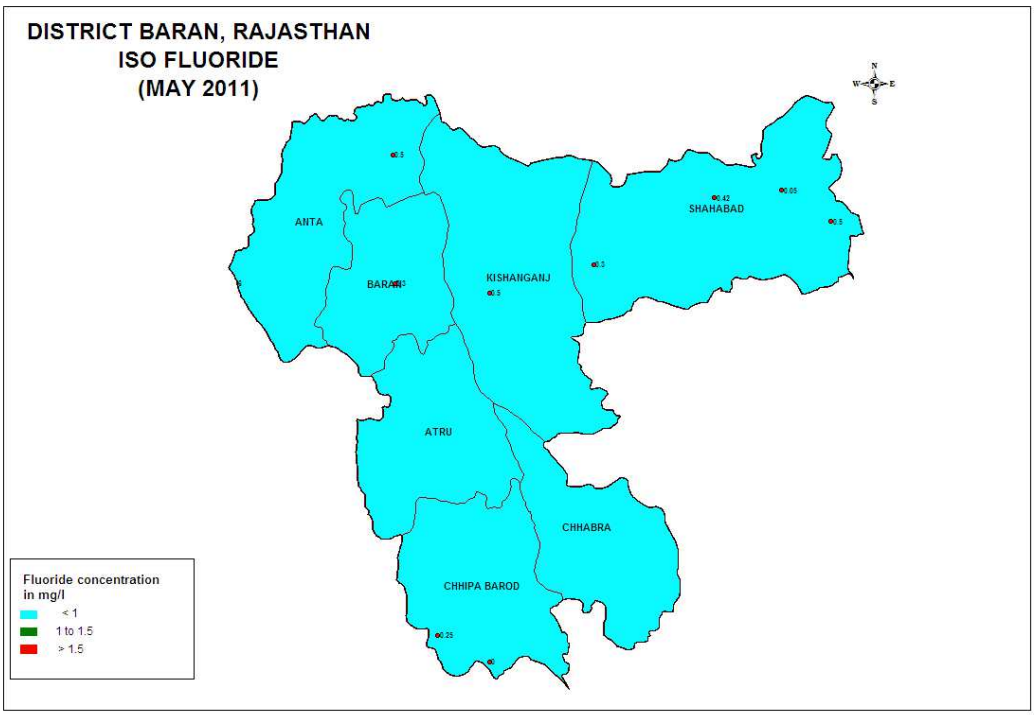

Figure 7: Iso Fluoride map (May, 2011)

The concentration of iron varies from 0.04 to 0.1 mg/l. Iron content in ground water has been found to be well within the desirable limit of 0.3 mg/l as prescribed by BIS in drinking water. Map showing spot values of Fe as on May 2011 is given in (Fig. 8).

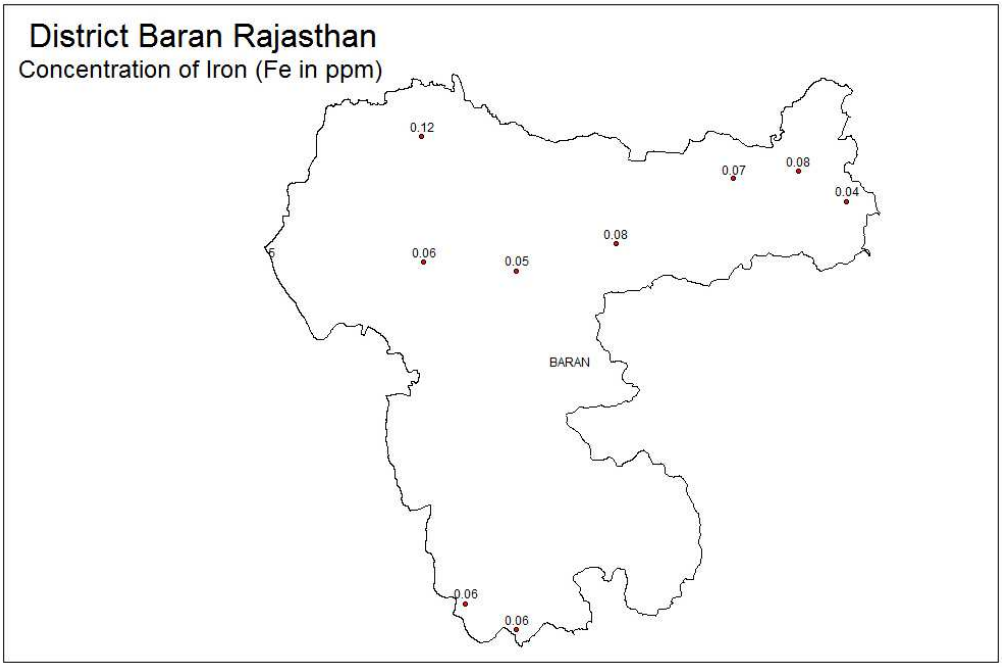

Figure 8: Iron distribution map (May, 2011)

The concentration of Nitrate ranges from 2 to 280 mg/l. Nitrate values in major part of the district are within 45 mg/l. Nitrate in excess of 45 mg/l (maximum permissible limit prescribed by BIS for drinking water) has been observed in parts of Shabad and Anta blocks (Fig. 9)

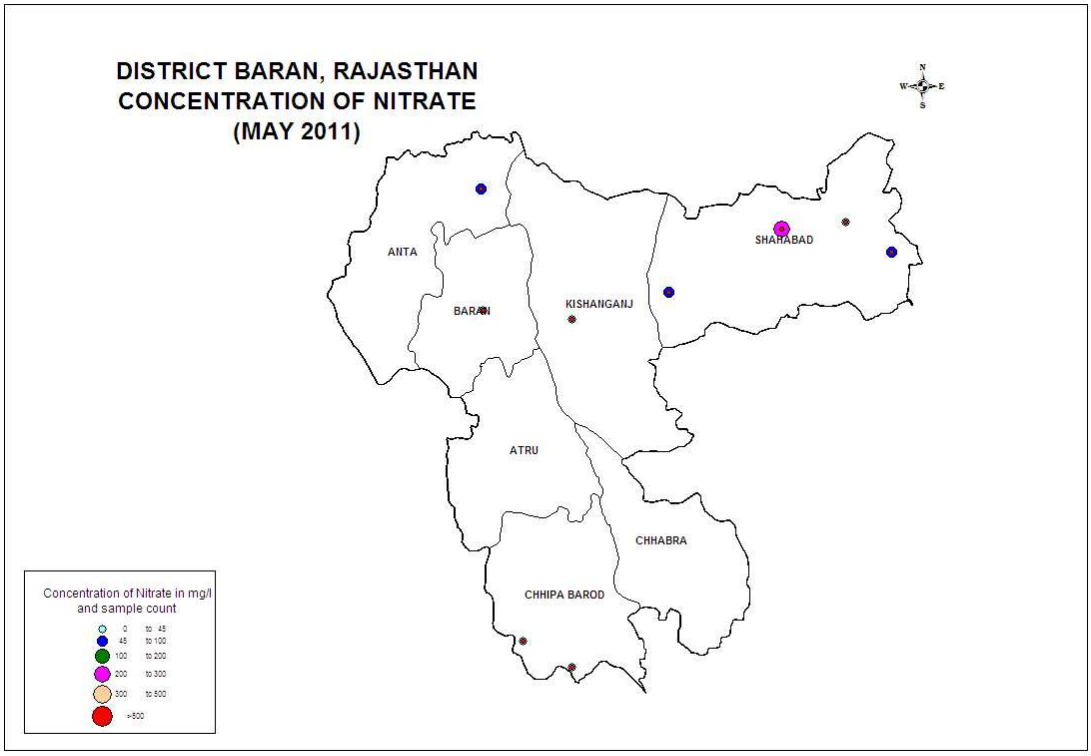

Figure 9: Nitrate distribution map (May, 2011)

7.0 Ground Water Resources

Central Ground Water Board and Rajasthan Ground Water Department (RGWD) have jointly estimated the ground water resources of Baran district (as on 2009) based on GEC-97 methodology. Ground Water Resource estimation was carried out for 6892.21 sq km area, out of which 871.23 sq km area falls under command and remaining 6020.98 Km^2 area falls under non-command area. Major part of the command area is irrigated by Chambal canals (665.84 sq km) and remaining area (205.39 sq km) by other medium irrigation projects viz. Parbati pickup weir, Parwan and Bilas irrigation projects etc.

The total annually replenishable resource of the district has been assessed to be 545.3820 MCM and net annual ground water availability has been estimated to be 494.9523 MCM. Gross annual ground water draft for all uses has been estimated to be 476.0604 MCM. The overall stage of ground water development in the district is 96.18% Two blocks viz. Atru and Baran have been categorised as Over Exploited, Chhipabarod as Critical and Anta as Semi Critical. Remaining three blocks viz. Chhabra, Kishanganj and Shahbad fall under Safe category. The block wise details of replenishable ground water resource assessment in the district are given in Table 7.

Table 7: Block wise ground water resources (As on 2009)

Block	Annually replenishable ground water resource	Net Ground Water Resources	Draft for Irrigation	Draft for Domestic & Industrial Use	Gross Draft	Stage	Category
Anta	95.4282	85.8854	71.1432	5.2141	76.3573	88.91	Semi-critical
Atru	66.9697	60.2727	70.6590	3.1501	73.8091	122.46	Over-exploited
Baran	95.6395	86.0756	121.5406	4.1374	125.6780	146.01	Over-exploited
Chhabra	58.0575	52.2517	39.5136	2.9274	42.4410	81.22	Safe
Chhipabarod	58.1442	54.0079	50.5540	2.6080	53.1620	98.43	Critical
Kishanganj	95.4767	85.9290	63.1560	3.7013	66.8573	77.81	Safe
Shahbad	75.6662	70.5300	35.0820	2.6737	37.7557	53.53	Safe
District	**545.3820**	**494.9523**	**451.6484**	**24.4120**	**476.0604**	**96.18**	

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, the groundwater levels are declining in some parts of the district. Irrigation in the area is mainly done by ground water i.e. dug wells and tube wells. The stage of ground water development for the district as a whole has reached 96.18 % as on 31.03.2009. Out of 7 blocks, two blocks viz. Atru and Baran fall under over-exploited category, one block each viz. Chhipa Barod and Anta fall under critical and semi-critical categories respectively. The remaining three blocks viz. Chhabra, Kishanganj and Shahbad fall under safe category. There is practically no scope left for further ground water development in over-exploited blocks. Caution needs to be exercised in critical and semicritical blocks so as to prevent over-exploitation of ground water. Scope for further development of ground water resources is available in Chhabra, Kishnaganj and Shahbad blocks.

8.0 Ground Water Related Issues & Problems

Out of seven blocks in the district, two are over-exploited, where stage of ground water development has exceeded 100 % leaving no further scope for ground water development. One block falls under critical category and one block falls under semicritical category. These blocks also require judicious development of ground water. Quality of ground water is generally potable, except for a few pockets, where excess nitrate has 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 groundwater abstraction structures.

9.1 Ground Water Development

Stage of ground water development in two out of seven blocks in the district has exceeded 100%, which indicates that the scope of ground water development is already exhausted in these blocks and the blocks have been categorized as “Over-exploited”. There is no scope for further development of ground water in these blocks 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 over-exploited blocks in the district. In critical and semi-critical blocks, caution needs to be exercised so as not to further deplete the resource.

9.2 Water Conservation and Artificial Recharge

Precious Groundwater 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.

Alluvial aquifer is the principal aquifer in the district, which supports maximum ground water extraction through dug wells, dug cum bore wells and tube wells. Over-exploitation of ground water resources has led to declining trend in ground water levels. 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 water shed development projects and soil conservation project should be encouraged.

Sandstone is the next important aquifer in the district. Extraction of ground water in this aquifer is through large diameter dug wells and dug cum bore wells and tube wells. The draft is mainly f or agriculture, which is more than 80% of the total draft in most of the area. The stage of ground water development in this aquifer varies from 81.88 to 156.46%. Ground water storage capacity in this hard rock aquifer is very less hence during summer season, dug wells either go dry or yield is reduced. Therefore, it is recommended that deepening of the dug wells should be carried out to have good storage during pumping so that these don’t go dry during lean period. Also the number of ground water structures in Shahbad block may be increased.

10.0 Recommendations

- Only very restricted and planned ground water development can be taken up in critical and semi-critical areas to avoid becoming overexploited.
- 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 caused by the impact of sharply declining water levels and need and ways of judicious use of water and rain water harvesting and artificial recharge needs to be created among the users.