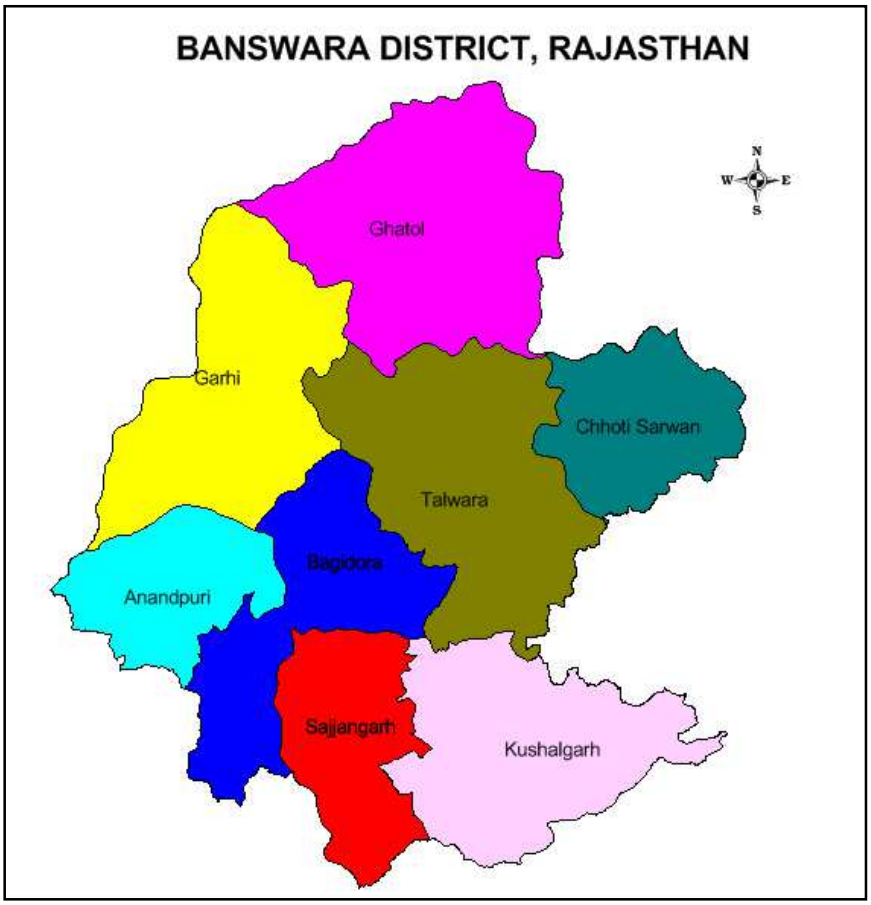
GOVERNMENT OF INDIA
MINISTRY OF WATER RESOURCES
CENTRAL GROUND WATER BOARD

BANSWARA DISTRICT
RAJASTHAN



Western Region
Jaipur
2013

DISTRICT AT A GLANCE – BANSWARA, RAJASTHAN

S No	Item	Statistics	
1	**GENERAL INFORMATION**		
	(i) Geographical area (sq km)	5037	
	(ii) Administrative Division		
	Number of Tehsils	5	
	Number of Blocks	8	
	Number of Villages	1518	
	(iii) Population (As per 2011 Census)	17,97,485	
	(iv) Average Annual Rainfall (1971-2010) in mm	935.5	
2	**GEOMORPHOLOGY**		
	Major Physiographic Units	Valley fills, Piedmont zone, Pediplains, Burried Pediplains and Plateau.	
	Major Drainage	Mahi and its tributaries Anas, Haran and Chap.	
3	**LAND USE (Ha.)**		
	(a) Forest Area	91247	
	(b) Cultivable Waste Land	50239	
	(c) Uncultivable Land	122391	
	(b) Gross Sown Area	332192	
4	**MAJOR SOIL TYPE**	**Black and Red Soil**	
5	**AREA UNDER PRINCIPAL CROPS** (As on 2011)	**Crops**	**Area in ha**
		Kharif	225019
		Rabi	109419
		Rabi Jayad	2304
6	IRRIGATION BY DIFFERENT SOURCES		
	Source	No. of structure	Area in ha
	Dug wells	22744	15393
	Tube wells/Bore wells	1043	3940
	Tanks/Ponds	691	3556
	Canals	Mahi Bajaj Sagar Project	59031
	Other Sources		18758
	Net Irrigated Area (ha)	102158	
	Gross Irrigated Area (ha)	336742	
7	**NUMBER OF GROUND WATER MONITORING WELLS OF CGWB** (As on 31.03.2012)		
	Number of Dug wells	24	
	Number of Piezometers	17	
8	**PREDOMINANT GEOLOGICAL FORMATIONS**	Granites, Gneisses and Schists of Bhilwara Super group, Phyllites, Schists and Quartzites of Aravalli Super group and	

S No	Item	Statistics
		Deccan traps.
9	**HYDROGEOLOGY**	
	Major Water bearing formation	Basalt, Limestone, Quartzite, Phyllite & Schist and Granite Gneiss.
	Depth to water level (Pre-monsoon, 2012) (mbgl)	3.27-10.22
	Depth to water level (Post-monsoon, 2012) (mbgl)	1.00-6.05
	Long term declining water level trend (1998-2012) in m/yr	No
10	**GROUNDWATER EXPLORATION BY CGWB** (As on 31.3.2012)	
	Number of wells drilled (EW, OW, Total)	EW-43 OW-4 Total-47
	Depth Range (m)	45 -154
	Discharge (liter per minute)	50 - 871
	Transmissivity (m^2/day)	Few - 753
11	**GROUND WATER QUALITY**	
	Presence of chemical constituents more than permissible limit (TDS >2000ppm, F>1.5 mg/l, Nitrate>45.0mg/l)	TDS - Nil F – >12 % Nitrate– 35 %
	Type of water	Alkaline
12	**DYNAMIC GROUND WATER RESOURCES (31.03.2009) in mcm**	
	Annual Ground Water Resource	233.73
	Net Annual Ground Water Availability	213.18
	Gross Annual Ground Water Draft	108.07
	Stage of Ground Water Development	50.70%
	Category	Safe
13	**MAJOR GROUND WATER PROBLEMS AND ISSUES**	Quality problems in some areas and water scarcity in hilly and non command area.

Ground Water Information
Banswara District
Contents

List of Figures

List of Tables

GROUND WATER BROUCHER
DISTRICT - BANSWARA, RAJASTHAN

1.0 Introduction

Banswara district is located between 23^{o} 11$^{'}$ and 23^{o} 56$^{'}$ latitude and 73^{o} 58$^{'}$ and 74^{o} 49$^{'}$ longitude covering an area of 5037 sq.km. The district is part of Udaipur Division and is divided into 3 sub-divisions namely Banswara, Ghatol, Kushalgarh, Administratively the district is divided into 5 tehsils viz. Ghatol, Garhi, Banswara, Bagidora and Kushalgarh and 8 development blocks viz. Ghatol, Garhi, Talwara, Chhoti Sarwan, Anandpuri, Bagidora, Sajjangarh and Kushalgarh.

Total number of villages in the district is 1516 and it also has 2 urban towns. Rural and Urban population of the district is 16.70 lakh and 1.27 lakh respectively. Index map of the district is given in Fig. 1.

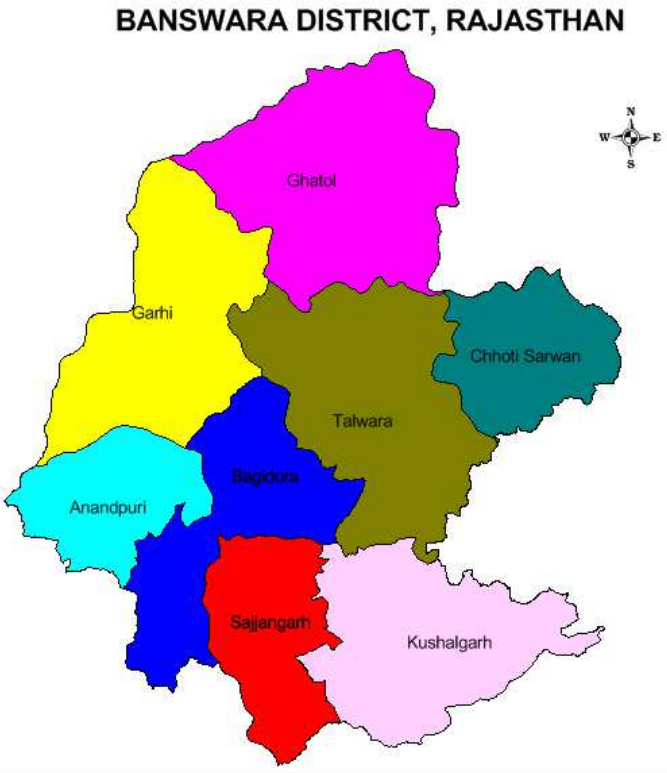


Fig. 1: Administrative Divisions

Central Ground Water Board has taken up various scientific studies in the district. A list of studies carried out in the district 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. Nagpal	1973-74	Systematic Hydrogeological Survey
2.	R.K. Nagpal	1978-79	Systematic Hydrogeological Survey
3.	M.S.Jethra	1985-86	Reappraisal Hydrogeological Survey
4.	R.P. Mathur	1985-86	Reappraisal Hydrogeological Survey
5.		2006-07	Reappraisal Hydrogeological Survey

Under ground Water Exploration Programme, 32 Exploratory (EW)N and 2 Observation wells (OW) were constructed in Aravalli and Bhilwara super groups of rock and 8 EW & 1 OW have been constructed in Deccan traps. During the recent National Aquifer mapping Project (2012-13) 3 EW and 1 OW have been constructed in the district.

Since 1973, monitoring of water level is being carried out four times a year from 41 National Hydrograph Network Stations.

2.0 Rainfall & Climate

Average annual rainfall (1971-2010) of the district is 935.5 mm. However normal rainfall for the period 1901 to 1970 is 870 mm. The annual rainfall gradually decreases from southern part to northern part. The maximum average rainfall is 1118 mm at Dhanpur and minimum average rainfall is 790 mm at Loharia.

The climate of the district is dry except S-W monsoon season. The cold season is from December to February and is followed by summer from March to June. From mid of September to end of November constitutes post monsoon season. The district experiences either mild or normal drought once in two years. Severe type of drought has been recorded very rarely. Most severe type of drought has never occurred in the district.

3.0 Geomorphology, Drainage, Soils & Irrigation Practices

The district is characterized by undulating topography. The eastern part is the extension of Malwa plateau comprising of high hills with intervening long and narrow valleys. In central part of the district, undulating to rolling topography prevails. While in western part plain and rolling topography prevails. The general slope of the area is from east to west.

Geomorphologically the district is divided into four types of units as mentioned in Table 2.

Table 2: Geomorphological units

Origin	Land Forms	Occurrence in the District
Fluvial	Valley Fills	Scattered in entire district mostly along drainage
Denudation	Piedmont zone	Northern and southern parts of Mahi dam
	Pedi plains	Main concentration in western margin
	Buried pediment	Scattered in entire district, main concentration in central part.
Structural	Plateau	Along eastern margin.
Hill	Denudational hills	In south west of the district.
	Structural hills	Mainly concentrated in south west.

3.1 Drainage

Banswara district falls in Mahi basin. Tehsil wise distribution of basin area is given in Table 3.

Table 3: Tehsil wise distribution of Mahi basin area

Sl.No	Name of Tehsil	Area in Sq. Km.
1	Bagidora	517.8
2	Banswara	1190.3
3	Garhi	754.4
4	Ghatol	1657.7
5	Kushalgarh	806.4

The district is drained by Mahi river and its tributaries namely Anas, Haran and Chap in which Mahi and Anas are the only perennial rivers. River Mahi enters the eastern part of the district south of village Ambapara & flows in the northerly direction. It takes sudden westerly turn near Sarodia. At Dhalwara, it takes a south westerly course, flowing along the boundary between Banswara and Dungarpur districts before entering the Gujarat state.

3.2 Soils

The soils of the district fall under the following broad categories

- Black soil
- Red soil

Black soil is found predominantly in the district mostly in northern, southern, central and eastern parts. Red soil is mostly found in western portion of the district from north to south.

3.3 Irrigation

The principal means of irrigation in the district are by canal in all tehsils except Kushalgarh where only groundwater is used for irrigation. Groundwater is utilized through dug wells, DCB's, and tube wells. Canal irrigation is mostly by Mahi dam project. Tanks also form an important source of irrigation in the district. Details of the gross irrigated area by different sources (2011-12) are furnished in Table 4.

Table 4: Source wise area irrigated

(Area in Ha)

Sl. No	**Tehsil**	**Total Irrigated Area**	**Tube wells / wells**	**Ponds/ Tanks**	**Canals**	**Dugwells**
1	Bagidora	19387	1527	247	11795	3246
2	Banswara	23390	1469	698	16608	3191
3	Garhi	20703	351	580	12723	2297
4	Ghatol	22891	200	417	17893	2184
5	Kushalgarh	13857	285	2410	0	3249

4.0 Groundwater Scenario

4.1 Geological Framework

The geological set-up of the district is represented mainly by the rocks belonging to Achaean metamorphic complex, Aravalli super group and Deccan trap lava flows.

4.2 Hydrogeology

Groundwater occurs under unconfined condition in saturated zone of rock formation. Its occurrence is controlled by topography, physiography and structural features of the geological formations. Movement of groundwater in hard rock areas is governed by size, openness, interconnection and continuity of structurally weak planes. In alluvium, ground water occurs in interstitial pore spaces among the grains. Water bearing properties of different aquifers are described below. Hydrogeology of the district is shown in Fig. 2.

4.2.1 Groundwater in Banded Granite Complex (Bhilwara Super Group)

These include rock assemblages of granites, gneisses, schists, migmatite and amphibolites. Granite is medium to coarse grained, grey to pink in colour in northern part, whereas due to intimate association with different rock types in the central part, it loses its original character. Gneisses are generally medium to coarse grained and crudely foliated. Schists are grey to greenish grey and medium to coarse grained. These rocks occur in parts of Pipal Khunt, Talwara and Ghatol block with small localized area in Garhi block.

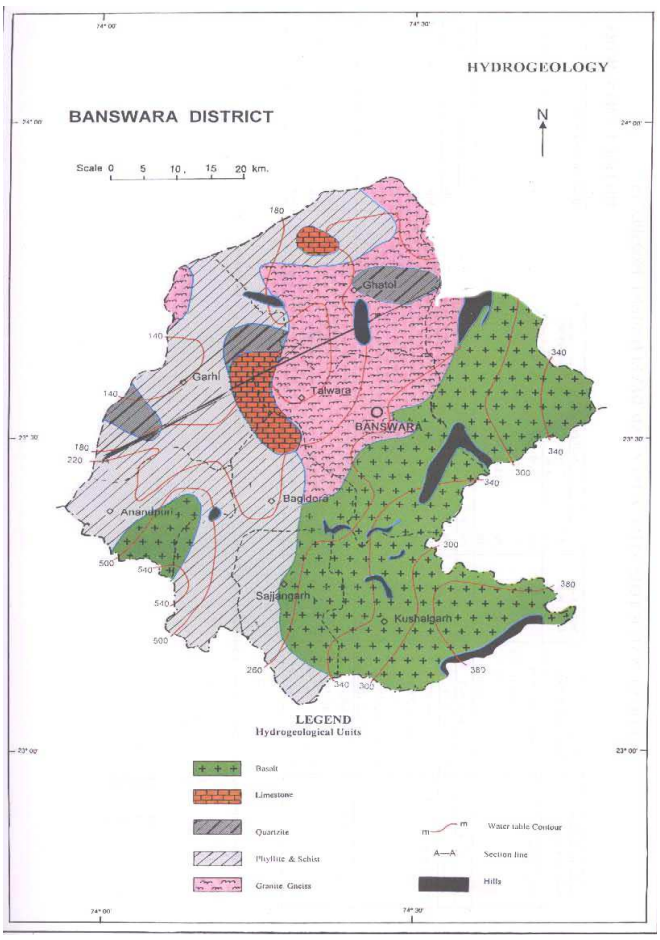


Fig. 2: Hydrogeology

Depth of open wells in this aquifer is 15 to 20 m, with yield varying from 40 to 80 m^3/ day and water level is less then 10 m.

4.2.2 Groundwater in Phyllite and Schist (Aravalli Super Group)

Argillaceous facies of Aravalli Super Group known as Udaipur Group are represented by phyllites, which are often carbonaceous, and micaceous schists etc.

These are generally soft and susceptible to weathering. The rocks have varied mineralogical composition and physical characteristics. These rocks occupy western half of the district in Anandpuri, Bagidora, Garhi, Ghatol and Sajjangarh blocks. Depth of open wells in this aquifer is 20 to 25 m, with yield from 25 to 60m^3/ day and water level varies between 10 and 15 mbgl.

4.2.3 Groundwater in Quartzites (Aravalli Super Group)

These comprise conglomeratic and gritty quartzite and contain pebbles and cobbles apparently derived from member of the gneissic complex. Bands of para amphibolites often occur in association with quartzites. These rocks occur in localized pockets in Garhi block. Depth of open wells in this aquifer is 20 to 25 m, with yield from 40 to 100 m^3/ day and water level is less then 15 m.

4.2.4 Groundwater in Limestone (Upper Cretaceous)

This formation is pale purple, massive to partially crystalline and contains quartz and concretions of chalcedony. Thickness of the aquifer is generally less than 10 m. Two localized pockets of limestone are noticed in Talwara and Ghatol blocks. Depth of open wells in this aquifer is 15 to 25 m, with yield varying from 25 to 30 m^3/ day and water level is less then 10 m.

4.2.5 Groundwater in Basalt (Upper Cretaceous to Palaeocene)

These are generally dark green to steel grey in colour. Fine to medium grained and porphyritic at places. Basalt is hard, massive amygdaloidal to vesicular type. Intra-trappeans are not common. Occasionally thin layer of reddish clayey material (red bole) occurs between the two flows. These rocks occur in Kushalgarh, Pipal Khunt blocks and extends in parts of Talwara and Sajjanagarh blocks. Depth of open well in this aquifer varies from 15 to 20 m, with yield of well ranging from 25 to 65 m^3/ day and water level in this formation ranges from 7 to 15 m bgl.

4.2.6 Groundwater in Alluvium

Alluvium occurs in a few narrow zones along some river courses. It comprises of admixture of silt, fine sand and clay. Groundwater in alluvium occurs under water table conditions. Thickness of alluvium is within 15 m. Saturated thickness as tapped in open wells varies from 3 to 5 m. Yield of these wells varies from 336 to 550 m^3/ day.

4.3 Deep Aquifer System:

Exploratory drilling in the district in hardrock formations i.e, granite gnessis, phyllite schists, quartzite, limestones and basalts has revealed that the depth of the bore wells ranges from 45 to 154 m. Discharge of the borewells is 50 to 871 lpm with a drawdown of 1.13 to 29.65 m. The Transmissivity ranges from a few to 753 m^2/day.

4.4 Groundwater Flow

General direction of ground water flow has been inferred from SE to NW or E to W. Hydraulic gradient varies considerably. It is minimum around Bagidora (1.6 m/km) The southern peripheral area around Choti Saran generally has steeper gradient.

4.5 Depth to Water Level (Pre Monsoon 2011)

The depth to water level varies widely depending upon topography, drainage, bedrock geology etc. Depth to water varies from less than 2 m to more than 15 m bgl (Fig. 3). Water level is shallower (1.60 m) in central part of the district. In general,

DTW varies from 2 to 10 m in greater part of the district. Deep water levels (> 10 m) are observed in parts of Anandpuri, Chhoti Sarwan and Garhi blocks.

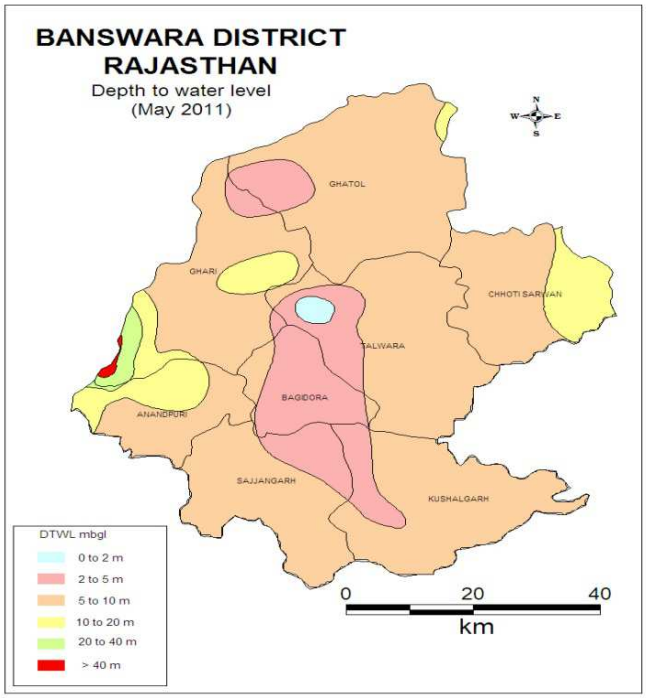


Fig. 3: Depth to water level - May 2011

4.6 Depth to Water Level (Post Monsoon 2011)

During November, 2011 water level ranges widely from less than 2 to 10 m bgl. Water level is shallower in north eastern and central part of the district. In general DTW varies from more than 2 to 5 mbgl in entire district. Depth to water level map of November, 2011 is presented in Fig. 4. Block wise ranges of water level data during May and November, 2011 are given in table 5.

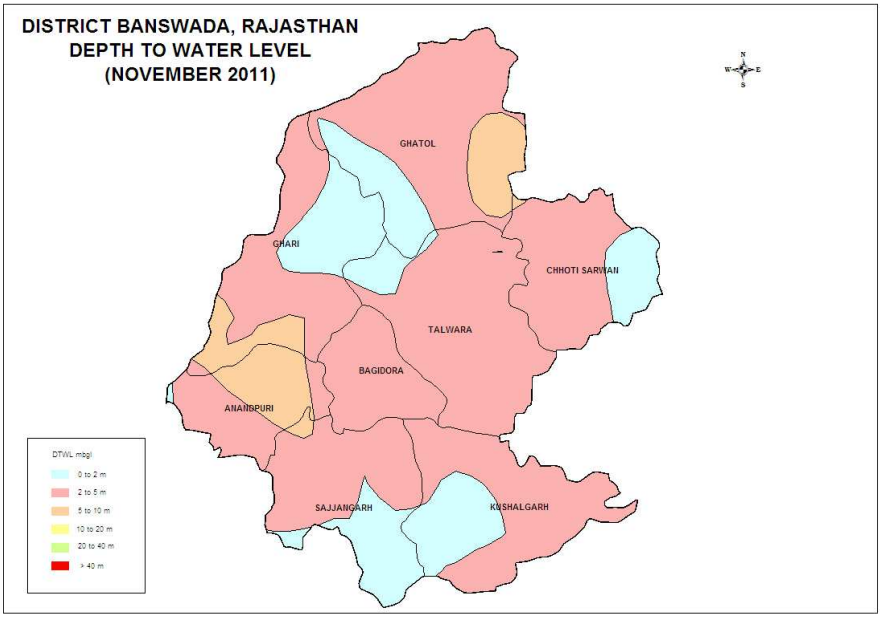


Fig. 4: Depth to water level – November 2011

Table 5: Block wise deranges of water levels during May, 2011(Pre-monsoon) and November, 2011 (Post-monsoon).

Block	Pre Monsoon		Post Monsoon	
	Min	Max	Min	Max
Anandpuri	3.00	14.42	2.15	7.65
Bagidora	2.20	15.10	1.25	5.68
Garhi	2.30	12.90	1.02	7.65
Ghatol	1.35	9.54	0.68	3.58
Kushalgarh	3.90	22.15	2.38	8.56
Choti Sarwan	5.85	19.52	1.68	9.67
Sajjangarh	5.90	14.26	3.65	7.63
Talwara	2.60	11.35	1.07	6.13

4.7 Water Level Fluctuation

Seasonal fluctuation map (Fig. 5) in water level based on Pre and Post-monsoon' 2011 indicates that there has been rise in water level in district. Perusal of the fluctuation data indicate that major part of the district has recorded rise in water level of less than 4 m except in parts of Sajjangarh, Anandpuri and Garhi where rise in water level of more than 4 m has been observed.

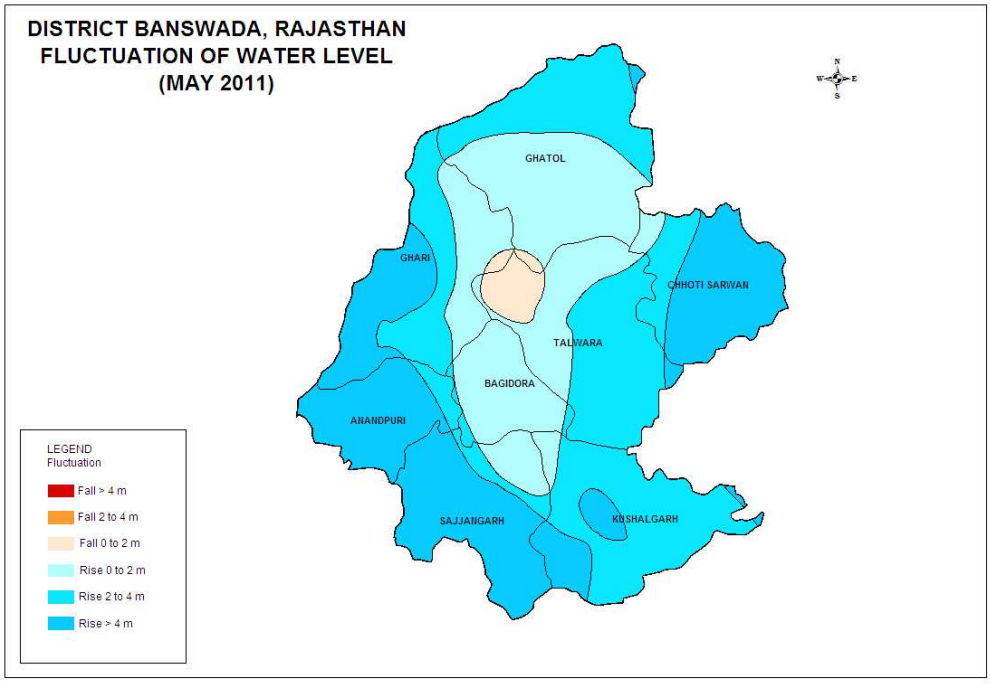


Fig. 5: Seasonal water level fluctuation - 2011

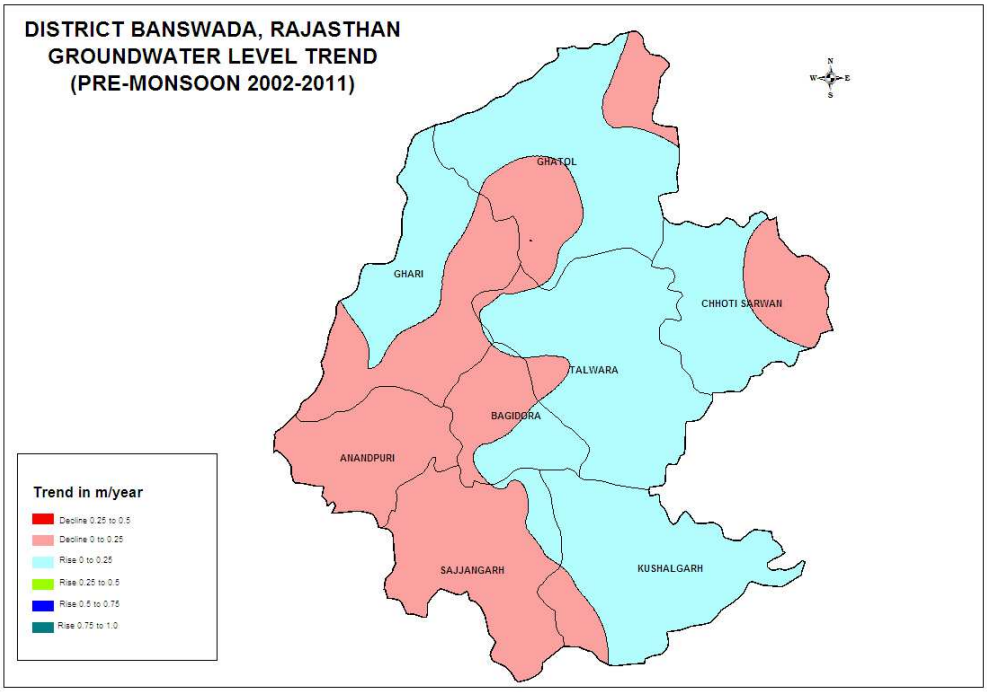


Fig. 6: Decadal pre-monsoon water level trend

Decadal water level trend map of Pre-monsoon (2002 – 2011) shows that there has been rising trend of 0 to 0.25 m/year in parts of all the blocks except Anadpuri (Fig. 6). Declining trend of 0 to 0.25 m/year has also been reported from parts of all the blocks. Declining trend is predominant in the western, northeastern and eastern parts of the district.

5.0 Groundwater Resources

Groundwater resources have been estimated jointly by Central Ground Water Board 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. Total groundwater resources based on assessment carried out in 2009 are estimated to be 174.6797 MCM. Draft for all uses is 127.4697 MCM and overall stage of development is 72.97 %. Summarized block wise estimate of dynamic groundwater resources is given in Table 6.

Table 6: Block wise ground water resource potential (as on 2009)

BLOCK	Total Annual G. W. Recharge (mcm)	Net annual G.W. availability (mcm)	Agriculture Draft (mcm)	Domestic draft (mcm)	Annual Gross Draft (mcm)	Stage of Groundwater development (%)	Category
ANANDPURI	15.0714	13.5643	7.599	1.3965	8.9955	66.32	SAFE
BAGIDORA	29.5355	27.2863	14.3910	2.2806	16.6716	61.10	SAFE
GARHI	46.9672	42.2705	15.1125	3.2908	18.4033	43.54	SAFE
GHATOL	5.2169	48.3277	16.5522	2.3386	18.8908	40.78	SAFE
KUSHALGARH	15.9126	14.3213	9.555	1.3534	10.9084	76.57	SEMI CRITICAL
CHHOTI SARWAN	16.9065	15.2158	6.4788	0.6475	7.1263	46.83	SAFE
SAJJANGARH	9.8717	8.8847	3.972	1.2841	5.2561	59.16	SAFE
TALWARA	49.2487	45.3117	18.4635	3.3602	21.8237	48.16	SAFE
G.TOTAL	235.7307	213.1823	92.124	15.9516	108.0756	50.69635	SAFE

The district as a whole is categorised as safe. All the blocks fall in safe category except Kushalgarh block, which comes under semi critical category.

6.0 Groundwater Quality

6.1 Water Quality in Shallow Aquifer

Shallow groundwater of dug well zone is alkaline in nature with pH ranging from 7.25 to 7.67. The EC value in groundwater in the district is within the range i.e. below 1000 µS/cm at 25^{o}C in the entire district except in a few localized patches found in southern part of Sajjangarh block where it is 1856 µS/cm at 25^{o}C (Fig. 7).

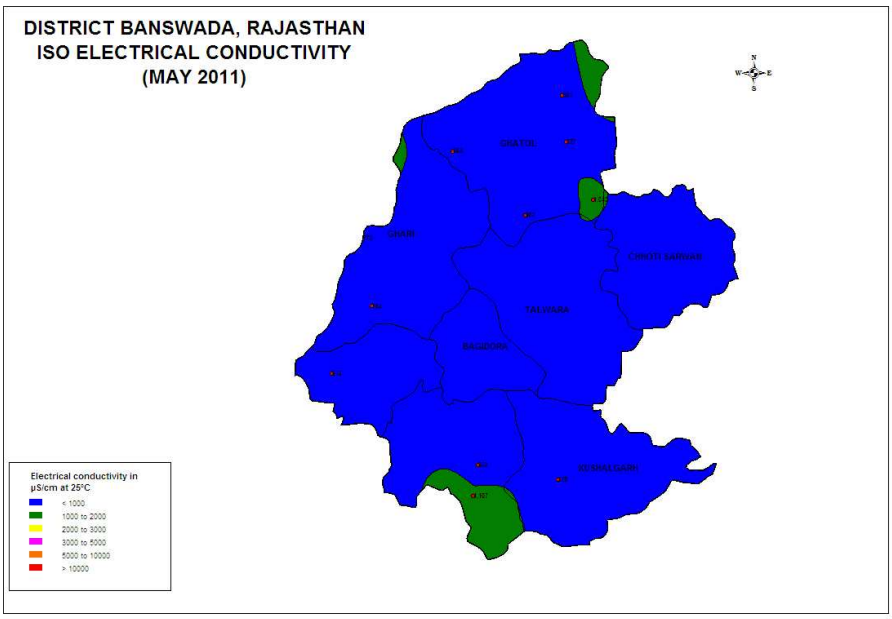


Fig. 7: Distribution of EC in ground water

Chloride content varies from 196 to 354 ppm. High Chloride content (>250ppm) has been observed at Chota Dungar of Sajjangarh block. The concentration of carbonate varies from negligible and bi-carbonate varies from 380 to 719 ppm. The concentration of carbonate varies from negligible and bi-carbonate varies from 380 to 719 ppm. Groundwater in the district is suitable for drinking and other domestic purposes.

Fluoride content is generally within 1.5mg/lit in major part of the district. It varies between 0.30 and 6.12 mg/l. Higher concentration (34mg/lit) is found at Chota Dungar of Sajjangarh block and Bhilura of Garhi block (Fig. 8).

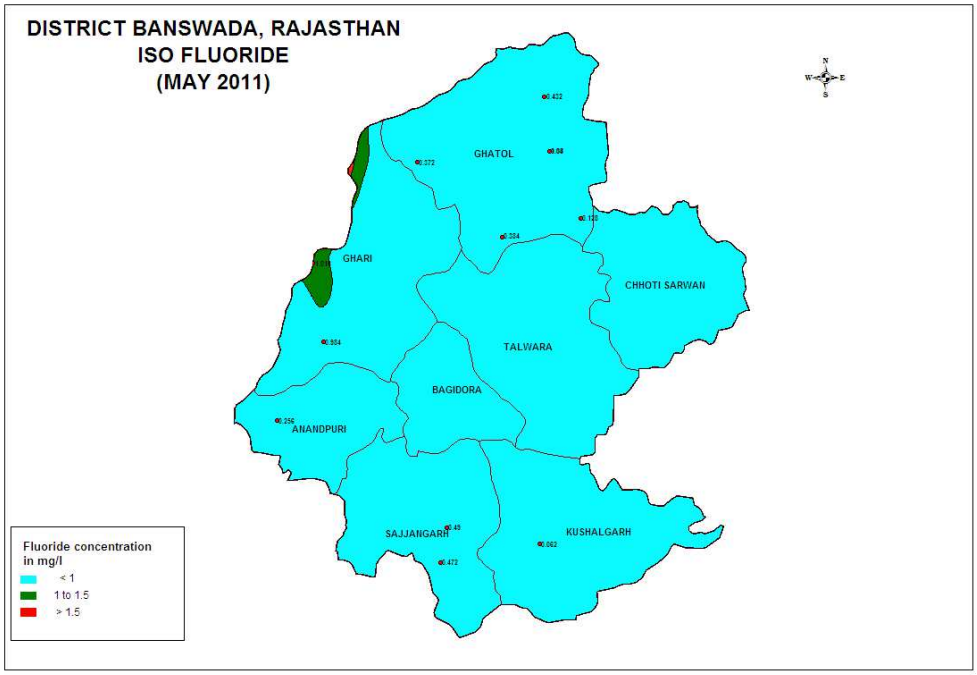


Fig. 8: Distribution Fluoride in ground water

Concentration of Nitrate ranges from 11 to 45 ppm. Nitrate values in major part of the district are within the desirable limit. Higher values of nitrate occur at Bhugra and Bhura Kua of Kushalgarh block (Fig. 9).

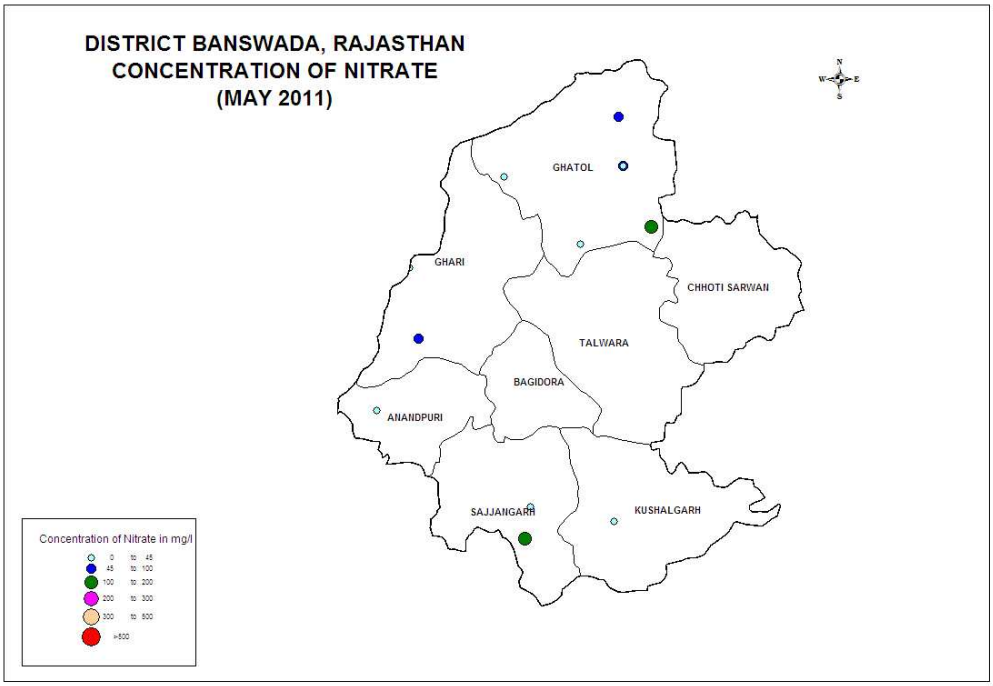


Fig. 9: Distribution Nitrate in ground water

Iron concentration in groundwater varies from 0.06 to 1.16 ppm. High iron content (>1ppm) has been observed at Chota Dungar of Sajjangarh block, Surwania, Senawasa, Surpur of Talwara block (Fig. 10).

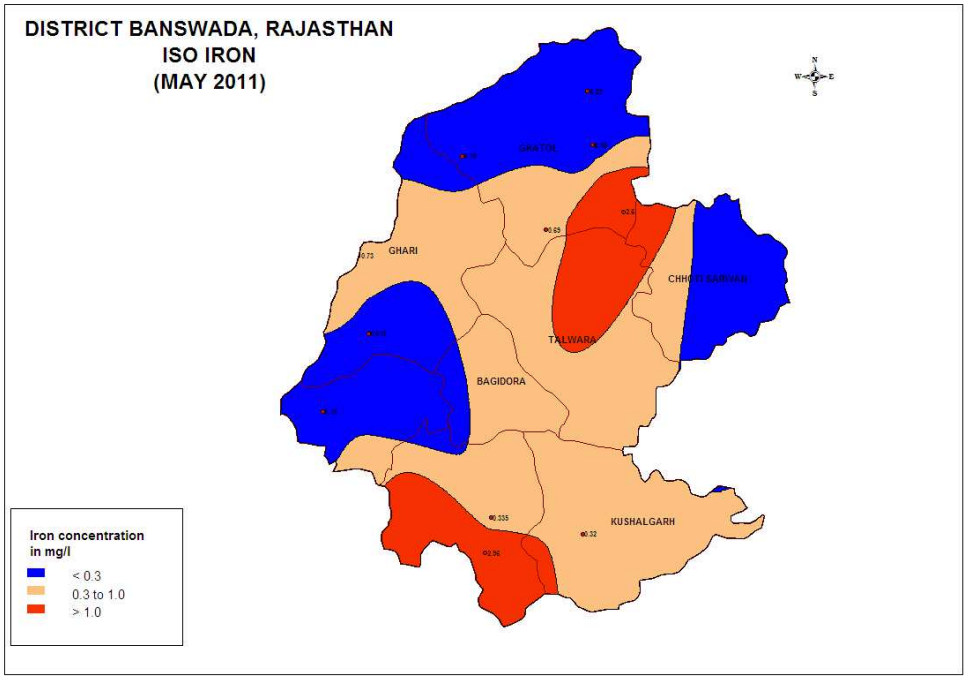


Fig. 10: Distribution iron in ground water

6.2 Water quality in Deeper Aquifer

Chemical analysis of water samples collected from tubewells shows that quality is fresh and potable except at Navgavan. The specific Conductance is generally less than 2000 µS/cm at 25^{o}C except at Navgavan (5000 µS/cm at 25^{o}C). Concentration of Chloride is within permissible limit except at Navgavan. Concentration of Fluoride is less than 1.5mg/lit in 29 out 40 tube wells constructed by CGWB. Fluoride more than 3 mg/lit has been observed in Kalimagri, Burwa and Ramgarh.

7.0 Status of Groundwater Development

Granite Gneiss, Phyllite & Schists, Quartzite, Limestone and Basalt form the aquifer in different parts of the district. Ground water occurs under unconfined to semi-confined conditions. Depth and diameter of the dug well and bore well depend on formation and geomorphology. However, general depth of dug and bore wells ranges from 15 to 20 m and 200m respectively. Details of groundwater structures are given in Table 7.

Table 7: Block wise details of feasible groundwater abstraction structures

Block	Forma tion	Avg. Yield m^3/day		Depth in m		Diameter
		Dug well	Deepening By Blasting	Dug well	Deepening By Blasting	Dug well,
Anandpuri	Ph/Sc	40-60	8-12 (additional)	20-25	3-5	3-5
Bagidora	Ph/Sc	50-70	8-12	20-25	3-5	3-5
Garhi	Gn	40-60	10-12	20-25	3-5	3-5
	Ph/Sc	50-75	8-12	20-25	3-5	3-5

Block	Forma tion	Avg. Yield m^3/day		Depth in m		Diameter
		Dug well	Deepening By Blasting	Dug well	Deepening By Blasting	Dug well,
Ghatol	Gn	50-80	10-12	20-25	3-5	3-5
	Ph/Sc	40-70	8-12	20-25	3-5	3-5
Kushalgarh	Basalt	50-75	6-10	15-20	3-5	5-5
Pipalkhunt	Gn	50-70	10-15	20-25	3-5	3-5
	Basalt	50-75	6-10	15-20	3-5	5-5
Sajjangarh	Ph/Sc	50-75	8-12	20-25	3-5	3-5
	Basalt	50-75	6-10	15-20	3-5	5-5
Talwara	Lst	70-90	15-20 (boring)	20-25	3-5 25-30	3-5 4”
	Gn	50-80	10-12	20-25	3-5	3-5
	Basalt	50-75	6-10	15-20	3-5	5-5

7.1 Urban and Rural Water supply:

Banswara district comprises of 3 urban areas and each of them is facilitated by piped water supply. Status of urban water supply (2012) is given in Table 8.

Table 8: Details of urban water supply (as on 2012)

Town	Population		Total Drinking water Production KLD	Service Level LPCD	Water Supply Interval
	Census 2011	Present			
Banswara	87308	105000	10500	100	Per day
Kushalgarh	10108	12200	854	70	Per day
Partapur	9947	12000	840	70	Per day

All the villages are benefitted by water supply for drinking and domestic purposes. Status of rural water supply is given in Table 9.

Table 9: Status of rural water supply

Block	No. of populated villages	No. of villages benefited from schemes					No. of hand pumps in block
		Piped water supply	Regional water supply	Pump & tank scheme	T S S	Hand pump scheme	
Ghatol	233	4	1	13	1	212	3365
Banswara	241	1	0	7	9	225	2642
Choti Sarwan	99	2	0	0	0	97	1312

Block	No. of populated villages	No. of villages benefited from schemes					No. of hand pumps in block
		Piped water supply	Regional water supply	Pump & tank scheme	T S S	Hand pump scheme	
Garhi	192	6	7 (21 village)	3	16	146	3339
Bagidora	172	6	1	7	2	155	2660
Anandpuri	136	1	0	5	0	130	2081
Kushalgarh	213	0	0	1	4	208	1731
Sajjangarh	185	0	2 (6 village)	1	0	178	2163

8.0 Ground Water Development Strategy

8.1 Ground Water Development

Stage of ground water development in the district is 50.70%, which indicates that there is scope for ground water development in the district. The stage of development in non command area is 63.83 % and in command area it is 38.87 %. As the district is covered by hard rock areas further groundwater development in non command area should be based on proper hydro-geological and geo-physical surveys. However, there is need to promote ground water development in command areas.

8.2 Water Conservation and Artificial Recharge

8.2.1 Ground Water Management

To avoid over exploitation of groundwater, further exploitation of this precious resource must be carried out in judicial manner. Artificial recharge is a difficult task in the district as the country rock is composed exclusively of hard rocks, water level gradient is steep and storage capacity is low. Under such condition there is likelihood that recharged water will reappear as base flow. Any induced water application will create localized mound with no change in trend of declining water level in adjacent areas.

Since the stage of ground water development has already crossed 70% in Kushalgarh block, for sustainable utilization of water resources, conjunctive use of surface and groundwater is inevitable. Water Harvesting is the only solution through construction of bunds, anicuts, and rooftop harvesting structures. The area has undergone polyphase deformation in geological past, which has resulted in a complex structure (folded, faulted and jointed) that may not be conducive for such structures. Therefore, site of these structures should be selected carefully.

Impact assessment of water harvesting structures (WHS) reveals that there is increase in cropping area, cropping intensity, crop production and labor employment observed in the project area. Erosion from nalah bank minimizes. Cropping pattern and cropping intensity changed. Harvested water provides supplementary irrigation during long dry spell. In view of the above, such WHS programmes may be taken up in the district for further development of surface water and ground water resources to enhance agricultural production.

9.0 Ground Water Related Issues & Problems

Almost entire district is facing problem of ground water scarcity. However, there are some areas vulnerable for pollution and depleted water table. Major issues in the district are as follows:

9.1 Groundwater Depletion Hazard

Comparison of pre monsoon water level between 1998 & 2011 shows that two blocks namely Bagidora and Kushalgarh have registered decline in water level during pre and post monsoon period. The long term depleting nature of water level causes reduction in storage, which leads to water scarcity in summer seasons.

9.2 Water Quality Hazard

In the district, fluoride (>1.5 mg/lit) is found in 12% villages and habitations. The nitrate hazard more than 45 mg/lit is found in 35% of villages.

9.3 Occurrence of Drought

The rainfall variation during last decade has been a critical water sector hazard. During 1998–2007, the rainfall deficit years were 1999, 2000, 2001 and 2002 which were classified as serious drought years. The constant rise in population, urbanization, industrialization and agricultural growth has caused decrease in per capita availability of water.

10.0 Recommendations

- Ground water draft is very high in all the blocks. Stage of ground water development in the district has reached 50.70% due to indiscriminate use. It has to be controlled by preventing further development.
- Water scarcity is a perpetual phenomenon in Banswara. Permanent solution to drinking water problem should be devised using Mahi dam water.
- Revival of traditional ground water storage system i.e. *Baori*, open wells, *Tanka* etc for rainwater conservation for use in day to day life will reduce ground water draft.
- Awareness programme and training on rainwater harvesting will be beneficial to check decline in water level and justified use.
- Taking advantage of uneven topography of the area, small WHS or earthen dams, upstream of irrigation commands, 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.
- Modern agricultural management techniques will have to be adopted for effective and optimum utilization of the water resources. Maintaining irrigation through minimum pumping hours as per minimum requirement of water by the crop and also selecting most suitable cost effective cropping pattern can achieve this.
- Surface runoff can be harnessed by constructing tanks at feasible sites in the area occupied by the hard rock terrain for supplementing irrigation potential to increase the agricultural production.

- High water requirement crops be discouraged. Proper agriculture extension services should be provided to the farmers so that they can go for alternate low water requirement economical crops.
- In command areas, ground water development should be promoted in order to avoid water logging.