DISTRICT GROUNDWATER BROCHURE

GOVERNMENT OF INDIA

MINISTRY OF WATER RESOURCES

CENTRAL GROUND WATER BOARD

GROUNDWATER SCENARIO

PRATAPGARH DISTRICT

RAJASTHAN

Western Region

Jaipur

2013

DISTRICT AT A GLANCE – PRATAPGARH, RAJASTHAN

S No	Item	Statistics
1	**GENERAL INFORMATION**	
	(i) Geographical area (sq km)	4117
	(ii) Administrative Division (As on 31.3.2007)	
	Number of Tehsils	5
	Number of Blocks	5
	Number of Villages	1008
	(iii) Population (As per 2011 Census)	867848
	(iv) Average Annual Rainfall (1971-2010) in mm	856
2	**GEOMORPHOLOGY**	
	Major Physiographic Units	Pediment, Buried Pediment, Intermontane Valley
	Major Drainage	Jakham, *Mahi*, and *Siwana* or *Shiv*.
3	**LAND USE (sq km) (As on 2010-11 – Ministry of Agriculture, GOI)**	
	(a) Forest area	1209
	(b) Net sown area	1741
	(c) Total cropped area	2724
	(d) Area sown more than once	982
	(e) Permanent pastures and other grazing lands	227
	(f) Culturable waste land	384
	(g) Fallow land	163
4	**MAJOR SOIL TYPE**	Clay loam, Black soil, Red soil
5	**AREA UNDER PRINCIPAL CROPS (As on 2010-11 – Ministry of Agriculture, GOI)**	**Crops Area (Ha)**
		Maize 57155
		Wheat 49319
		Barley 2114
		Soyabean 101124
		Rapeseed & Mustard 5585
		Cotton 2163
		Gram 22421
		Other pulses 8970
		Garlic 2896
6	**NUMBER OF GROUND WATER MONITORING WELLS OF CGWB** (As on May 2011)	
	Number of Dug wells	20
	Number of Piezometers	5
7	**PREDOMINANT GEOLOGICAL FORMATIONS**	Gneiss (Bhilwara Supergroup), Schist /phyllite (Aravalli Supergroup), Basalt,
8	**HYDROGEOLOGY**	

	Major Water bearing formation	Basalt, granite/Gneiss, Schist/phyllite
	Depth to water level (Pre-monsoon, 2011) (mbgl)	3 – 24
	Depth to water level (Post-monsoon, 2011) (mbgl)	1.5 – 20
9	**GROUNDWATER EXPLORATION BY CGWB** (As on 31.3.2011)	
	Number of wells drilled (EW, OW, Total)	EW-15 OW-1 Total-16
	Depth Range (m)	51 – 173.66
	Discharge (liter per minute)	2 – 750
	Transmissivity (m^2/day)	85
10	**DYNAMIC GROUND WATER RESOURCES (March, 2011) in mcm**	
	Net annual ground water availability	140.8559
	Gross Annual Ground Water Draft	174.8076
	Projected Demand for Domestic and Industrial Uses up to 2025	10.1984
	Stage of Ground Water Development	124.10%
11	**MAJOR GROUND WATER PROBLEMS AND ISSUES**	Declining water level Low Yield of Wells Contamination of ground water

GROUND WATER SCENARIO
DISTRICT PRATAPGARH, RAJASTHAN

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DISTRICT PRATAPGARH, RAJASTHAN

1.0 Introduction

Pratapgarh is newest constituted district in Rajasthan state. It came into existence on 26th January, 2008 as 33rd district of Rajasthan. It was carved out from Chittorgarh, Banswara & Udaipur districts. It is situated in the junction of the Aravalli mountain ranges and the Malwa Plateau; hence the characteristics of both prominently feature in the area.

The district is part of Udaipur Division and is divided into five sub-divisions namely Arnod, Chhoti Sadri, Pratapgarh, Dhariawad, and Peepalkhoont. Administratively the district is divided into 5 tehsils and 5 development blocks. Total number of villages in the district is 1008 and it also has 2 urban towns. Population of the district is 867848 including rural population of 796041 and urban population of 71807. Index map of Pratapgarh district is given in Figure 1.

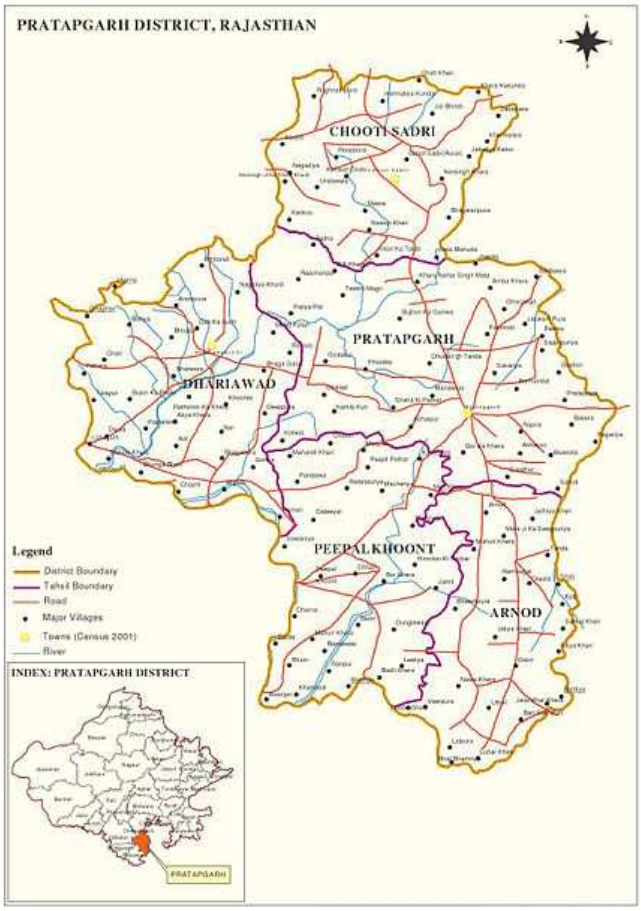

Figure 1: Administrative Divisions

Systematic Hydrogeological survey in the district was initially carried out by GSI from 1951, which were later carried out by Central Ground Water Board after the merger of Ground Water Wing of GSI with the erstwhile Exploratory Tubewells Organization. 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 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 Nagpal	1973-74	Systematic Hydrogeological Investigation in Banswara district (including Peepalkhoont block of Pratapgarh district)
2.	SAQ Abidi	1977-78	Systematic Hydrogeological Investigation of Pratapgarh Tehsil, Chittaurgarh district, Rajasthan
3.	B P Verma	1977-78	Systematic Hydrogeological Investigation in part of tribal areas of Udaipur district, Rajasthan (including Dhariawad block of Pratapgarh district)
4.	M.S.Jethra	1985-86	Reappraisal Hydrogeological Survey in parts of Banswara district
5.	R.P. Mathur	1985-86	Reappraisal Hydrogeological Survey in parts of Banswara district
6.	S.C. Dhiman	1986-87	Hydrogeological Investigation for development and management of ground water resources for tribal areas of Pratapgarh tehsil of Chittaurgarh district
7.	M.N. Khan	1986-87	Reappraisal Hydrogeological Investigation in parts of Chittaurgarh and Udaipur districts
8.	M.K. Sharma	1986-87	Reappraisal Hydrogeological Investigation in Chhoti Sadri and Bari Sadri areas of Chittaurgarh district

Besides the above studies, District Hydrogeological reports of Chittaurgarh district have been issued during 1984 and 1987, that of Banswara during 1987 and 1994 and that of Udiapur during 1982 and 1991. Under Ground Water Exploration Programme, 16 exploratory boreholes (15 EW + 1OW) have been drilled. Salient features of ground water exploration are listed in Table 2. Presently, ground water regime monitoring is being carried out in the district from a network of 20 observation wells. Water levels are monitored four times in a year during the months of January, May, August and November. Samples for water quality analyses are collected during May.

Table 2: Salient Features of Ground Water Exploration

Type of well	No.	Depth drilled (m)	SWL (m)	T (m^2/day)	Discharge (lpm)	EC (micromhos/cm) at 25^oC
EW	15	51 – 173.66	2.46 – 36.35	85	2 – 750	410 – 3760
OW	1	43.35	2.48		399.6	540

2.0 Rainfall & Climate

Average annual rainfall of the district is 856 mm. The annual rainfall gradually decreases from southern part to northern part. The climate of the district is dry except Southwest monsoon season. The cold season is from December to

February and is followed by summer from March to June. From mid September to end of November constitute 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

The district is characterized by undulating topography. The western, and southern parts are generally plain area. Hills are scattered in Chhoti Sadri, Dhariawad, Peepalkhoont and Pratapgarh tehsils. The major rivers of the district are *Jakham*, *Mahi*, and *Siwana* or *shiv*. Other seasonal rivers are *Som*, *Era*, and *Karmoi*. Physiographic map of the district is presented in Figure 2.

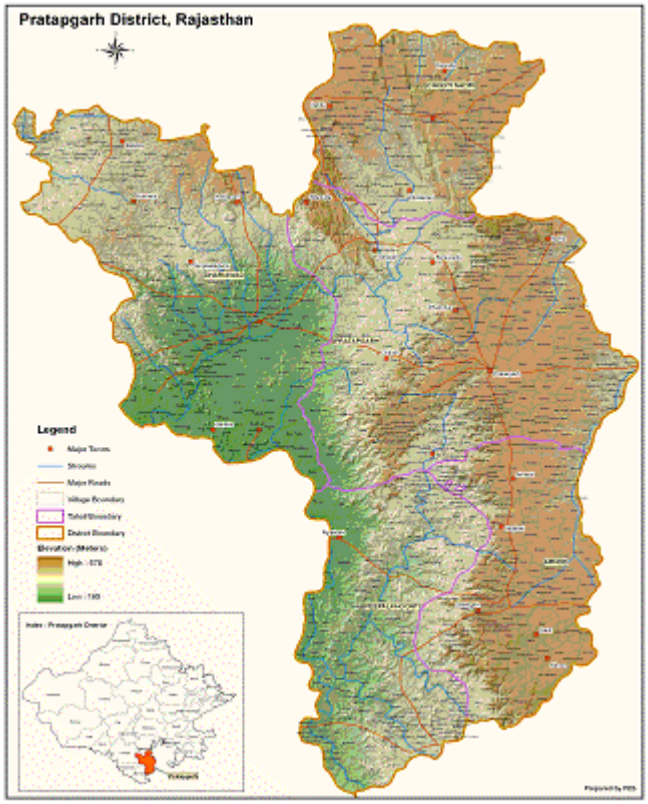

Figure 2: Physiography

4.0 Soils & Irrigation Practices

The soils of the district fall under the broad categories of red soil, black soil and clayey loam. Areal extent of each type of soil in the district is given in Table 3.

Table 3: Areal extent of various types of soils in Pratapgarh district

Soil Type	Area ('000 Ha.)	% of Total
Red soil	13.225	4.18
Black Soil	181.834	57.44
Clayey Loam soil	121.524	38.38

4.1 Irrigation

The principal means of irrigation in the district are wells/tube wells, though some areas are irrigated by canals, tanks etc. Groundwater is the main source of irrigation and is utilized through dug wells, DCB's, and bore wells. Canals form second most important source of irrigation in the district. The details are furnished in Table 4.

Table 4: Details of area irrigated by different sources (Source: Dte. of Economics & Statistics, Ministry of Agriculture)

(Area in Ha)

Source / Area	Canal	Tanks	Tubewells	Other wells	Other sources	Total
Net irrigated	7166	394	18585	56099	2025	84629
Gross irrigated	7166	394	19029	57166	2053	85808

5.0 Groundwater Scenario

5.1 Geological Framework

The geological set-up of the district is represented by various igneous and meta-sedimentary rocks. Rocks of Bhilwara supergroup of Archaean age comprising of granites and gneisses are exposed in southwestern part of the district. Deccan Traps are exposed in major part of the district.

5.2 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 while in unconsolidated rocks, ground water movement takes place through pore spaces between grains. Water bearing properties of different aquifers are described below:

5.2.1 Groundwater in Bhilwara Supergroup

Granite-Gneiss and Schist: These aquifers occur predominantly in Pratapgarh and Peepalkhoont tehsils. A few intrusives are also found which have low permeability. Groundwater is retained in weathered zones, fractures, joints etc. Depth of open wells tapping these aquifers ranges from 3 to 24m. Yield of wells varies from $6m^3$/day to $48m^3$/day. The depth to water level in the area tapping this aquifer ranges from 2m to 12m bgl. Saturated thickness tapped in most wells ranges from less than 1m to 6m.

Slates, Phyllites and Schists: These aquifers occur predominantly towards north of Pratapgarh tehsil. Groundwater occurs under water table condition and is mostly tapped by dug wells. Depth of wells ranges from 8m to 15m. The depth to water level ranges from 3m to 8m bgl. Yield of wells ranges from 6 to $12m^3$/day. Thickness of water column in most of the wells ranges from 0.50m to 6.0m

5.2.2 Groundwater in Deccan Traps

Basalts as aquifer occur in southern part of the district. The groundwater occurs under water table condition and is exploited by open wells.

Compact Basalt: The wells tapping this aquifer occur near Gyaspur, Nikor, Kunnaiy and Jokhera villages. Depth of wells ranges from 3 to 18m. Depth to water level

ranges from 2m to 15m bgl. Yield of wells ranges from 6 to 200m^3/day. Thickness of water column ranges from 0.50m to 8.0m. Specific capacity of wells ranges from 0.015m^3/min/m to 0.051m^3/min/m. Optimum yield of wells ranges from 0.1.m^3/min to 0.015m^3/min.

Weathered Basalt: Groundwater in weathered zone of basalts occurs under unconfined condition. The aquifer occurs near Pilu, Pratapgarh, Dalot and Ambirana villages. The aquifer is tapped by open wells ranging in depth from 3 to 22m. Yield of wells ranges from 6 to 250 m^3/day. The thickness of water column ranges from 1m to 10m. Specific capacity of wells ranges from 0.08 to 0.14m^3/min/m and optimum yield ranges from 0.018 to 0.081m^3/min.

Vesicular Basalt: Groundwater in vesicular zone of basalt occurs near Rampur, Thikriya, Arnod, and Chota Semlia villages. Depth of wells ranges from 4m to 18m. The depth to water level ranges from 5m to 20m,bgl. Yield of wells ranges from 6 to 200m^3/day. Thickness of water column ranges from 0.50m to 9.0m. Specific capacity of dug wells ranges from 0.074 to 0.138m^3/min/m and optimum yield varies from 0.026 to 0.073 m^3/min.

Amygdaloidal Basalt: Groundwater in amygdaloidal basalt occurs near Gandher, Nagdela and Chokhi pipli villages. Depth of wells ranges from 7m to 20m. The depth to water level ranges from 2.5m to 17m bgl. Yield of wells ranges from 23 to 300m^3/day. Thickness of water column ranges from 1m to 3.5m. Specific capacity of dug wells is of the order of 0.089m^3/min/m and optimum yield is 0.027 m^3/min

Exploratory drilling in the district reveals that basalt, granite/gneiss, phyllite etc. form the hard rock aquifer. Multiple aquifer system is found in basaltic terrain. Among all the flows, 3rd, 5th and 6th flows are potential. Moderate groundwater potentiality exists within contact zone of basalt and other lithological units. Shallow aquifer up to 30m depth is encountered in all bore wells except at Kotra, Sohagpura, and Arnod. Its yield is 2 to 15 lpm. First deep aquifer was encountered in depth range of 26m and 90m. Its yield varies from 6 lpm to 105 lpm. Yield less than 3 lpm is found at Pratapgarh and Sohagpura. Second deep aquifer is encountered in depth range of 40m to 92m, which yields 20 to 100 lpm. Third deep aquifer was observed between 95m to 105m, which forms a negative zone.

5.2.3 Depth to Water Level

The depth to water level varies widely depending upon topography, drainage, bedrock geology etc. During Pre-monsoon (May, 2011), depth to water level varied from less than 5m to more than 20m bgl (Fig. 3). In general, DTW varies from 10 to 20m in greater part particularly in the eastern part of the district. Deep water levels (>20m) have also been observed in parts of Chhoti Sadri Block.

During post monsoon period (November, 2011), depth to water level varied widely from less than 3 mbgl to more than 20m bgl. Water level is in the range of 0 to 5 m bgl in major part of the district (Figure 4). Water level is deep in northern and western parts of Chhoti Sadri block, and localized pockets in Dhariawad, Pratapgarh and Peepalkhoont blocks. Block wise average water levels during Pre- and Post-monsoon (2011) are given in Table 5.

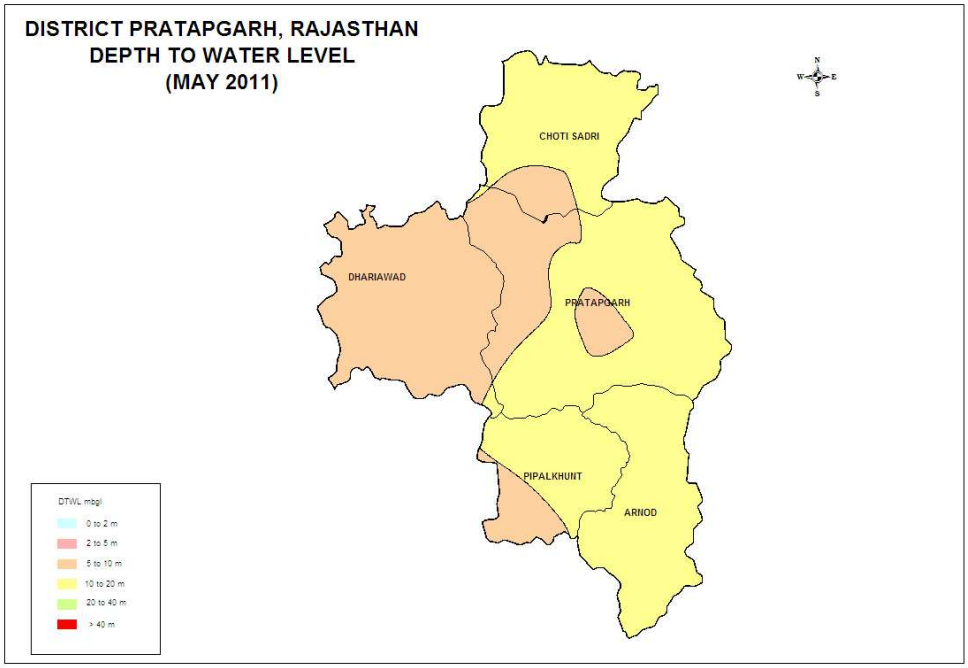

Figure 3: Depth to Water Level (May, 2011)

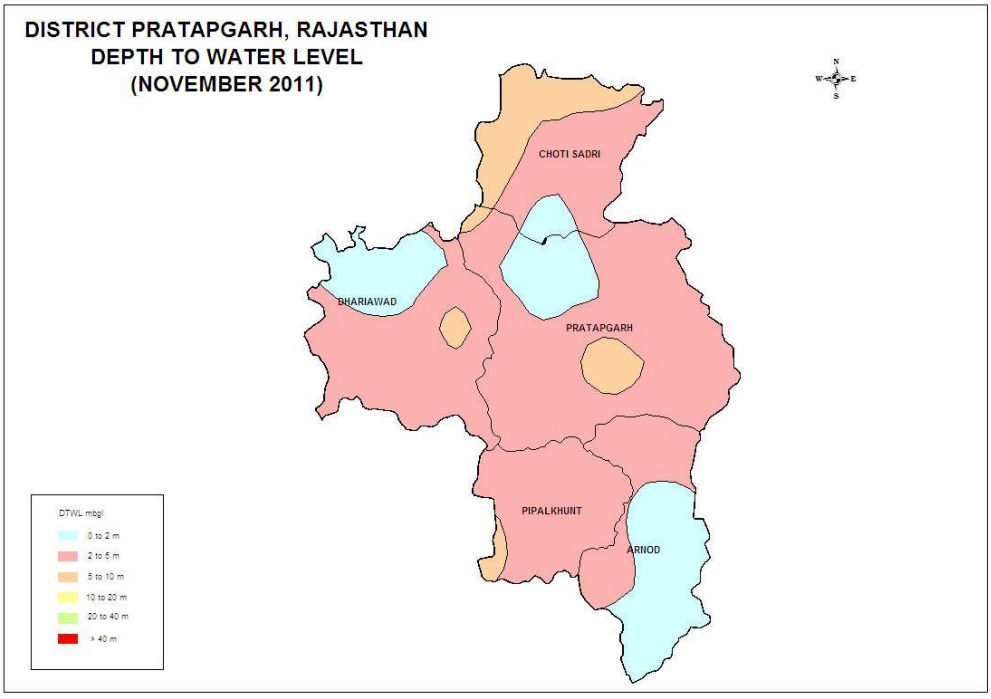

Figure 4: Depth to Water Level (November, 2011)

Table 5: Block wise average water level (2011)

Block	Pre Monsoon	Post Monsoon
Arnod	9.87	5.10
Chottisadri	16.65	12.35
Dhariyawad	8.34	7.00
Peepal Khoont	7.24	4.82

Pratapgarh	10.96	6.55

5.2.4 Water Level Fluctuations

Analysis of Pre- and Post-monsoon 2011 water level data indicates that there has been rise in water level in major part of the district. Perusal of the seasonal water level fluctuation map (Figure 5) indicates that major part of the district has recorded rise in water level of more than 4m except in parts of Dhariyawad where decline of upto 2 m in water level has been observed.

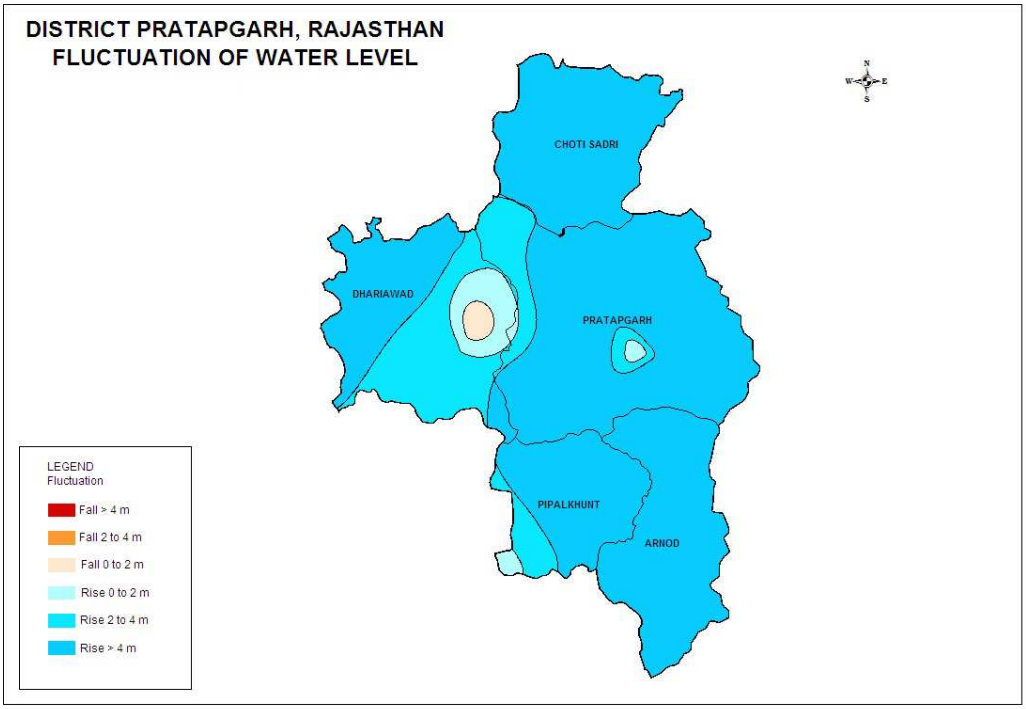

Figure 5: Seasonal Water Level Fluctuation (May, 2011 – November, 2011)

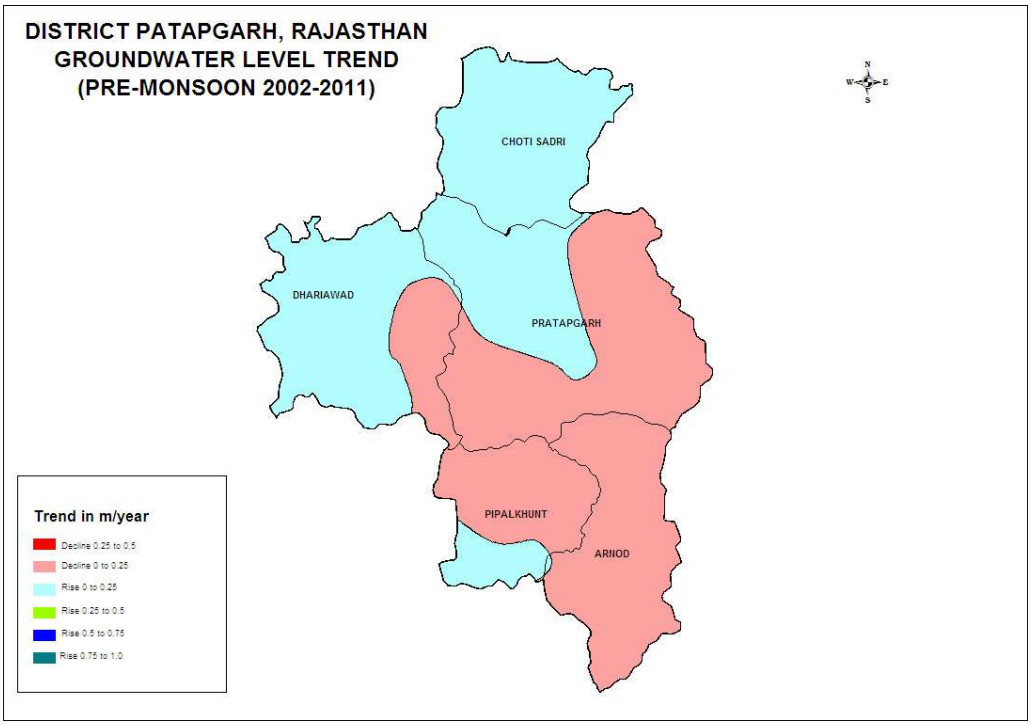

Figure 6: Decadal Water Level Trend (Pre-monsoon 2002 to 2011)

Analysis of long term Pre-monsoon water level data (May, 2002 to May, 2011) indicates that there has been rising trend in water levels upto 25 cm/ year in Chhoti Sadri block and parts of Dhariawad, Pratapgarh and Peepalkhoont blocks. Declining trend of upto 25 cm/year has been observed in Arnod block and parts of Dhariawad, Pratapgarh and Peepalkhoont blocks.

5.3 Groundwater Quality

5.3.1 Water Quality in Shallow Aquifer

Shallow groundwater of dug well zone is alkaline in nature with pH ranging from 7.5 to 8.7. The Specific Conductance is within 1500 mmhos/cm at 25^{o}C but higher values have been recorded in central part of the district (Figure 7). The Chloride content varies from 43 ppm to 376ppm. High Chloride content (>250ppm) has been observed in Arnod block.

The fluoride content in ground water is generally within the maximum permissible limit (1.5mg/lit) in major part of the district (Figure 8). Nitrate concentration in major part of the district are within 45ppm. Higher values of nitrate occur in isolated locations in Dhariyawad & Pratapgarh blocks (Figure 9).

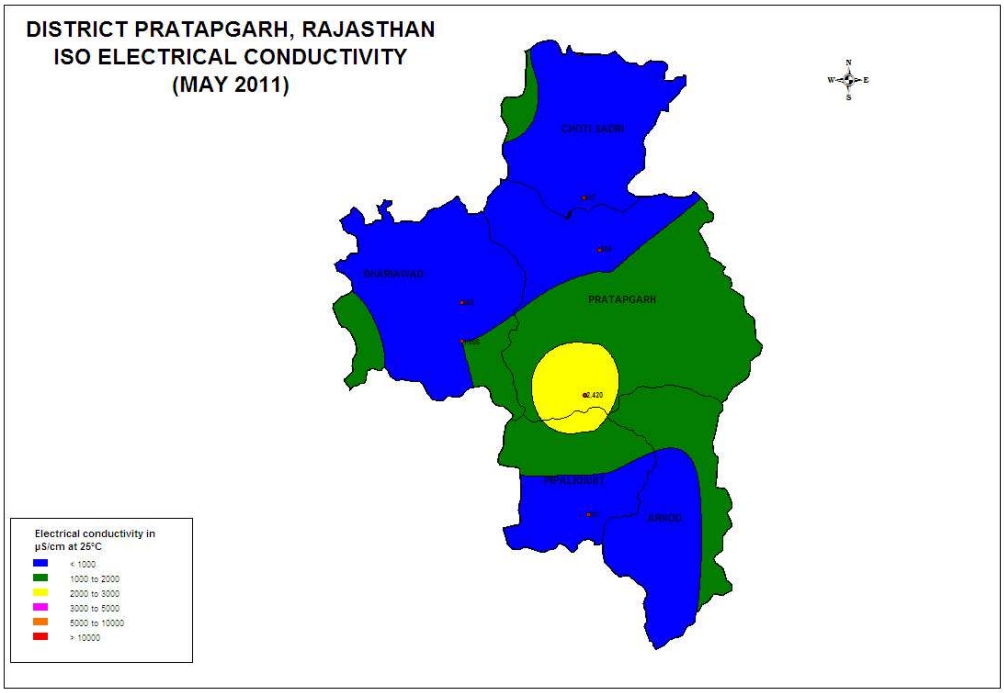

Figure 7: Iso Electrical Conductivity (May, 2011)

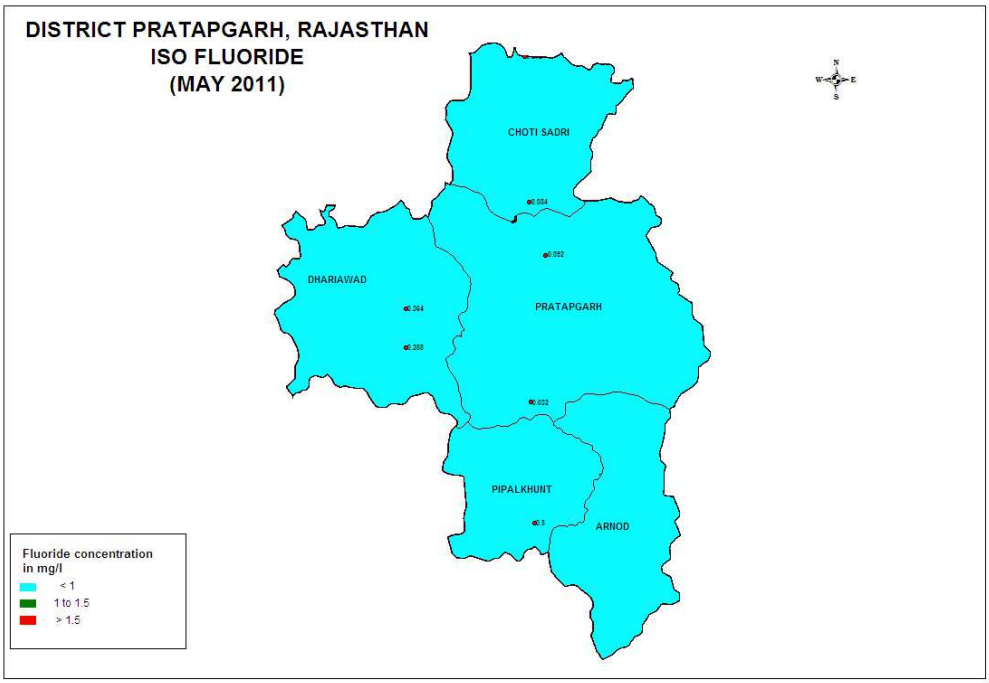

Figure 8: Iso Fluoride (May, 2011)

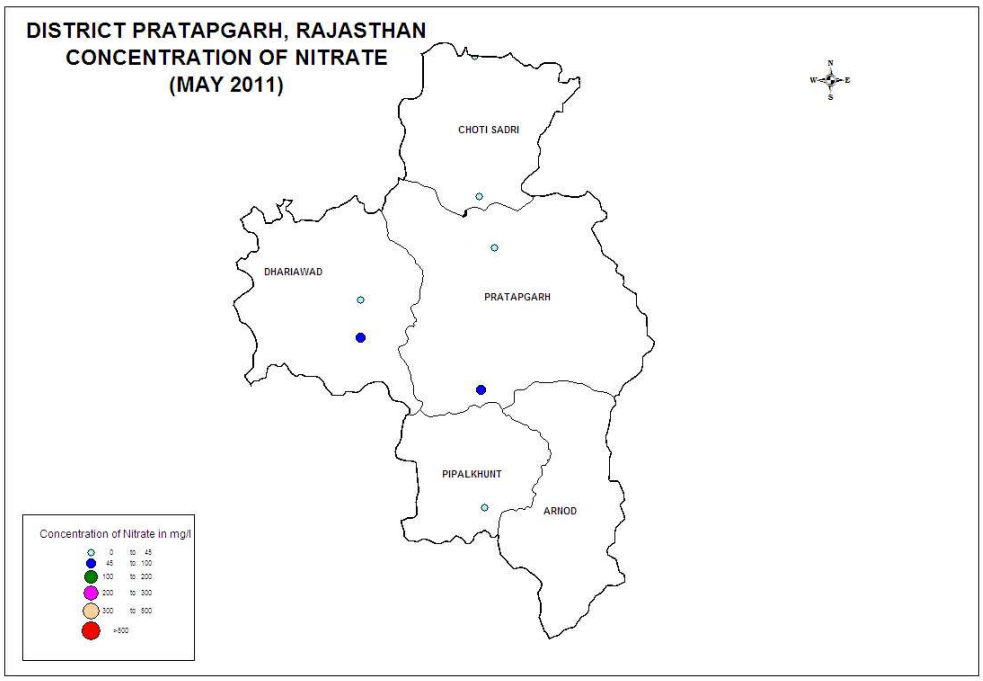

Figure 9: Nitrate distribution in ground water

Concentration of iron is within the desirable limit of 0.3 mg/litre in major part of the district and is within the maximum permissible limit of 1 mg/ litre in most part of the district (Figure 10). Higher values in excess of 1 mg/litre have been observed in northwestern & southwestern parts of the district falling in Chhoti Sadri, Pratapgarh, Dhariawad and Peepalkhoont blocks.

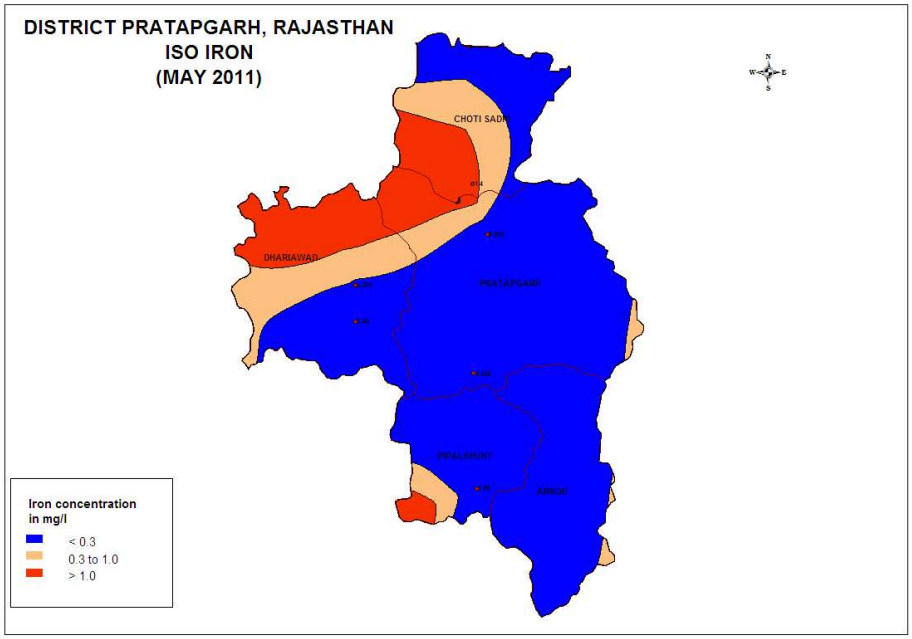

Figure 10: Iso Iron

Groundwater is moderately hard to very hard in major part of the district.

6.0 Groundwater Resources

Groundwater resources have been estimated jointly by the Central Ground Water board and the 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 annually replenishable ground water resource of the district has been estimated as 161.1583 mcm. Net annual groundwater availability is estimated to be 146.1703 mcm. Draft for all uses is 179.2197 mcm and overall stage of ground water development is 124.1%. Summarized block wise estimates of dynamic groundwater resources *are* given in Table 6. Out of five blocks, three blocks viz. Arnod, Chhoti Sadri and Pratapgarh are Over-exploited, one block viz. Dhariawad Critical and the remaining Peepalkhoont block is Semi-critical.

Table 6: Block wise replenishable ground water resources in Pratapgarh district (as on 2009)

Sl. No.	Block	Annual replenishable resource (mcm)	Net Annual Ground Water Availability (mcm)	Annual Ground Water Draft for Irrigation (mcm)	Annual Ground Water Draft for Domestic and Industrial	Gross Ground Water Draft for All uses (mcm)	Stage of Ground Water Development (%)	Category
1	Arnod	32.5449	29.2904	40.4460	0.7099	41.1559	140.51	OE
2	Chhoti Sadri	31.1947	28.0752	41.0561	0.5936	41.6497	148.35	OE
3	Dhariyawad	26.0357	23.4321	20.2800	1.6697	21.9497	93.67	Critical
4	Peepalkhoont	22.558	21.4301	15.6084	0.6008	16.2092	75.64	Semi-critical
5	Pratapgarh	48.825	43.9425	56.6625	1.5927	58.2552	132.57	OE
	TOTAL	**161.1583**	**146.1703**	**174.0530**	**5.1667**	**179.2197**	**124.10**	**OE**

7.0 Ground Water Management Strategy

7.1 *Ground Water Development*

Stage of ground water development in the district is 124.10%, which indicates that the scope of ground water development is already exhausted in 4 blocks where groundwater development has already exceeded/ is approaching 100% and categorized as “Over-exploited”/ “Critical”. Only 1 blocks falls under “Semi-Critical” category. Most of the boreholes have been drilled in the southern part of district falling in Arnod and Pratapgarh blocks. There is no scope for further development in the district for irrigation or industrial use except in Peepalkhoont block. However, exploratory drilling can be taken up in unexplored area for estimation of aquifer parameters.

7.2 *Water Conservation and Artificial Recharge*

7.2.1 Ground Water Management

In view of over-development of groundwater, further exploitation of this precious resource must be checked. 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 100%, 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 existing water harvesting structures (WHS) reveals that there has been increase in cropping area, cropping intensity, crop production and labor employment observed in the project area. Erosion from nallah bank has minimized. Cropping pattern and cropping intensity have changed. Harvested water provides supplementary irrigation during long dry spell. In view of the above, such water harvesting programmes may be taken up in the district for further development of surface water and ground water resources to enhance agricultural production.

8.0 Ground Water Related Issues and Problems

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

8.1 Groundwater Depletion Hazard

Out of six blocks, four are over-exploited and one is critical, which is leading to stress on available ground water resources. Comparison of water level data of the past decade shows that water levels have registered decline in water level. The long term depleting nature of water level causes reduction in storage, which leads to water scarcity.

8.2 *Water Quality Hazard*

In the major part of Chhoti Sadri, Dhariyawad & Peepalkhoont blocks, iron exceeded permissible limit.

8.3 Occurrence of Drought

The rainfall variation during last two decades has been a critical water sector hazard. Years 1997, 1998, 2000, 2001 and 2002 have been rainfall deficit years and are classified as serious drought years. The constant rise in population and agricultural growth has caused decrease in per capita availability of water.

9.0 Recommendations

- Ground water draft is very high in all the blocks. Stage of ground water development in the district has reached 124.10% due to indiscriminate withdrawal. It has to be controlled by preventing further development.

- Water scarcity is a perpetual phenomenon in Pratapgarh. Revival of traditional ground water storage system i.e. *Baori*, open wells, *Tanka* etc. for harvesting rainwater for use in day to day life will reduce stress on ground water resources.

- Awareness programme an 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 water harvesting structures or earthen dams, upstream of irrigation commands, at suitable sites, may be constructed to store rainwater. This will increase recharge to ground water which would ultimately result in increase of yield of wells.

- Modern agricultural management techniques 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 need 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.