DISTRICT GROUND WATER INFORMATION BOOKLET

BARWANI DISTRICT

MADHYA PRADESH

Ministry of water Resources
Central Ground Water Board
North Central Region
BHOPAL
2013

DISTRICT PROFILE – BARWANI DISTRICT

S.No.	ITEMS	Statistics	
1.	GENERAL INFORMATION		
	i) Geographical area (sq. km)	5422	
	ii) Administrative Divisions (As on 2013) Number of Tehsil/Blocks Number of Panchayats/Villages	 6 / 7 383 / 724	
	iii)Population	13,85,659	
	iv)Normal Rainfall (mm)	738.6	
2.	GEOMORPHOLOGY		
	i) Major Physiographic Units ii) Major Drainage	a) Narmada Valley b) Satpura Range c) Vindhyan Range a) Narmada b) Goi c) Kharka d) Deb e) Tapti	
3.	LAND USE (sq km)		
	i) Forest area	1829.60	
	ii) Net area sown	2289.90	
	iii) Cultivable area	2716.00	
4.	MAJOR SOIL TYPES	Medium Black Cotton Soil Alluvial type of soil along the drainage.	
5.	AREA UNDER PRINCIPAL CROPS sq. km	Cotton 546 Sorghum 466 Wheat 344 Maize 326 Soybean 297 Groundnut 156	
6.	IRRIGATION BY DIFFERENT SOURCES (Area and Number of Structures)	Area (Sq. km)	No. of Structures
	Dug wells	367	26728
	Tube wells/Bore wells	217	4970
	Tanks/Ponds	51	106
	Canals	76	109
	Other Sources	179	
	Net Irrigated Area	849	
	Gross Irrigated Area	849	

7.	NUMBER OF GROUND WATER MONITORING WELLS OF CGWB (As on 31.3.2013) No. of Dug Wells No. of Piezometers	 8 4
8	PREDOMINANT GEOLOGICAL FORMATIONS	Alluvium Laterite Deccan Trap
9	HYDROGEOLOGY Major Water Bearing Formation Pre-monsoon depth to water level during 2012 Post-monsoon depth to water level during 2012 Long Term water level trend in 10 years (2003-2012) in m/yr	 Alluvium & Deccan Trap 3 - 21 mbgl 3 - 8 mbgl Rising Trend 0.0031 – 0.2093
10.	GROUND WATER EXPLORATION BY CGWB (As on 31.3.2012)	
	No of wells drilled (EW,OW,PZ,SH, Total)	EW=3, Pz=4, Total=7
	Depth Range (m)	41 - 129
	Discharge (litres per second)	0.5 - 5
	Storativity (S)	$1.84x10^{-4}$ - $4.1x10^{-4}$
	Transmissivity (m^2/day)	7-32.30
11.	GROUND WATER QUALITY	
	Presence of Chemical constituents more than permissible limit (eg EC, F, As,Fe)	Nil
	Type of Water	Alkaline
12	DYNAMIC GROUND WATER RESOURCES (2009) in ham	
	Net Annual Ground Water Avaialability	39593
	Gross Annual Ground Water Draft	28382
	Projected Demand for Domestic and Industrial Uses upto 2033	4761
	Stage of Ground Water Development	72%
13.	AWARENESS AND TRAINING ACTIVITY	
	Mass Awareness Programmes Organised	Nil
	Water Management Training Programmes Organized	Nil
4	EFFORTS OF ARTIFICIAL RECHARGE & RAINWATER HARVESTING	
	Projects completed by CGWB (No. & Amount Spent)	Nil
	Projects under technical guidance of CGWB (Numbers)	Nil
15.	GROUND WATER CONTROL AND REGULATION	
	Number of OE Blocks	1
	Number of Semi-Critical Blocks	2
	Number of Blocks notified	Nil
16	MAJOR GROUND WATER PROBLEMS AND ISSUES	

1.0 INTRODUCTION

Barwani district is located in the south western part of Madhya Pradesh, occupying an area of 5422 sq.km. The district is bounded on the north by Dhar district, on the south and west by Dhule district of Maharashtra State and in the east by Khargone district. The district extends between the parallels of latitude 21º 22' and 22º 22' north and the meridian of longitude 74º 27' and 75º 30' east and falls in Survey of India toposheet Nos. 46J, 46K, 46N and 46O. The district is divided into six tehsils and seven Development Blocks.

Block-wise distribution of the district as follows:

Block	Geographical area (sq km)	Hilly area (sq km)	Non command area (sq km)
Barwani	767.10	209.10	558.00
Niwali	596.10	240.49	355.61
Pansemal	590.40	298.60	291.80
Pati	712.20	486.28	225.92
Rajpur	773.90	43.54	730.36
Sendhwa	1225.30	437.83	787.47
Thikari	757.00	37.85	719.15
Total	5422.00	1753.69	3668.31

1.1 Drainage

About 88% of the district lies in Narmada Basin and 12% in Tapti Basin. The major tributaries of Narmada are Deb and Goi. No major tributary of Tapti flows in the district. The surface water availability at 75% dependability for both the Basins is 966.70 MCM of which 921.95 MCM is from Narmada Basin and 44.75 MCM from Tapti Basin. The district area is drained mainly by the Narmada river and its tributaries like Goi and Deb. All of these tributaries flow from south to north and join Narmada. Similarly, tributaries like Tori, Churi, Dudhikheda etc. flow from north to south. Major rivers are perennial to semi-perennial.

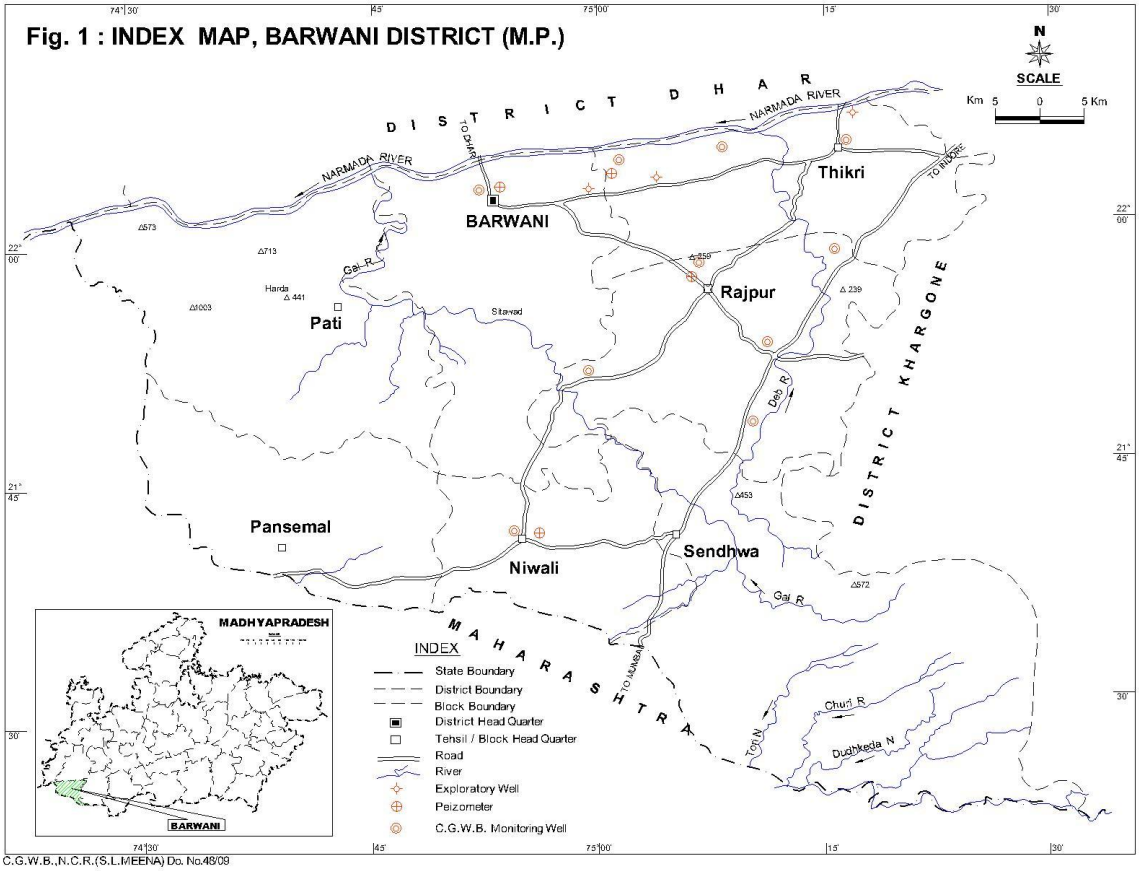
1.2 Irrigation

The total area irrigated by canals is 76 sq km, net area sown 2289.90 sq. km. The total area irrigated by tube wells is 217 sq. km., by open wells 367 sq. km and by ponds & Tanks 51 sq. km. The total area under assured irrigation from various sources is 849 sq. km. This was only 37.07% of the net sown area .Thus almost 67% of the sown area in the district is dependent on rain-fed irrigation.

1.3 Studies carried out by CGWB

Systematic Hydrogeological Survey was carried out during the period 1982-83 in parts of toposheets 46O/9, 13, 14, 46N/16, during the period 1985-86 in toposheets 46K/13, 46O/1,5, in the year 1986-87 in parts of toposheet 46J/3,4,8 & 46 K/1, 5(Pt), 9, 14(Pt). Reappraisal survey was carried out in the

year 1992-93. Exploratory drilling in the district was taken up in the district under Narmada Sagar Command area in 1983-84.



2.0 RAINFALL AND CLIMATE

The climate of the district on the whole is tropical and dry, except during south west monsoon season (middle of June to September). Winter Season is between November to February. Summer season starts from March and ends by June.

2.1 Rainfall

The district is influenced by South-West Monsoon which extends from June to September. The mean annual rainfall is 738.64 mm. There is very little rainfall in the winter season. The monsoon rainfall accounts for 80% - 85% of the annual rainfall.

2.2 Temperature & Humidity

May is the hottest month of the year when general temperature goes upto 42º C, occasionally, it goes upto 47º C. December is the coldest month of the year when the mean daily temperature comes down to about 11º C.

Relative humidity is maximum in the monsoon season and is very low in dry months. It is as low as 10% in dry months and as high as 94% in the monsoon season.

3.0 GEOMORPHOLOGY & SOIL TYPES

3.1 Geomorphology

Physically, the district comprises of three distinct natural divisions viz. Narmada valley in the northern part, uplands along southern and western margins (Satpura Range and highly dissected Deccan Plateau) and Narrow belt of scarp ridges (Vindhyan Hill Range). The area of the district displays undulatory topography which includes highly dissected plateau, linear ridges, residual hills and low lying plains. The highest elevation in the district is 1033 m amsl south of Ramgarh fort in Sendhwa Block. The lowest point is at elevation 149 m amsl near Talwda Deb in Rajpur Block.

3.2 Soil Types

Generally, five types of soils are found in the district namely Kali–I, Kali–II, Kali-III, Halki Khadri and Bardi. The soils of Barwani district are classified as medium black cotton soils containing nearly 50% silt and clay together. Mostly the soils are lighter, open and drained.

Alluvial type of soil is found on both the sides of the river Narmada and in some patches on the banks of its tributaries like Goi, Deb & Bour. This type of soil is deep fertile & well drained. The sois of the rest of the district are mostly shallow & poor in fertility.

4.0 GROUND WATER SCENARIO

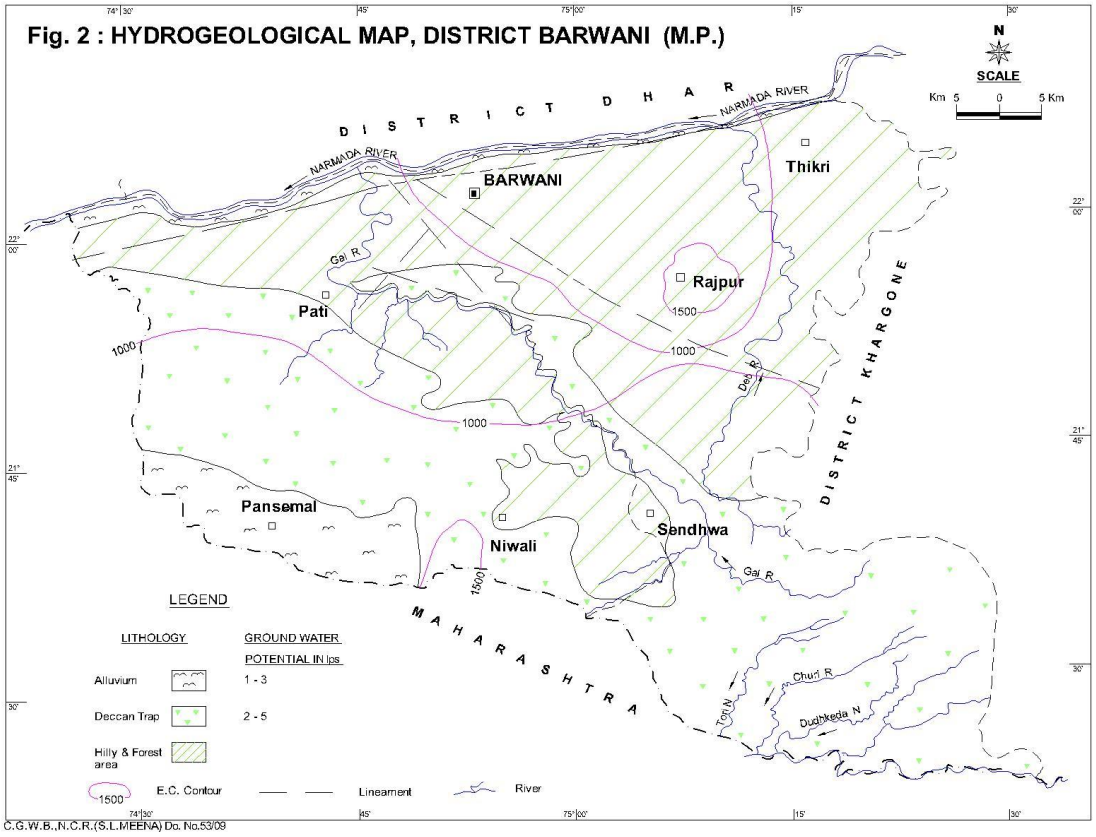
4.1 Hydrogeology

The occurrence and movement of ground water is governed and conditioned by geomorphic configuration of the place and water bearing properties of the lithounits like porosity, permeability etc.

4.1.1 **Deccan Traps**

These are basaltic lava flows and form the most predominant and widespread hydrogeological formations in the district. The top weathered mantle where thickness and presence of secondary porosity change according to geomorphic situation offer ground water occurrence under unconfined condition. However, fractures, joints are the pre-dominant features to form the occurrence of water under semi-confined conditions. The weathered, jointed, fractured and vesicular units of basalts form moderately potential aquifers. The zeolitic basalt, in fractured form also makes good aquifers. The red bole bed is predominantly clay. This formation has highly variable yields, being higher in dug wells.

In the unconfined pheratic basaltic aquifer, the ground water is extracted by open wells (depth range 5 –16m) whose diameter varies from 2-9 m. Depending on the type of ground water extraction device, the ground water yields varies between 10 cu. m/day to 432 cu. m/day.



4.1.2 **Alluvium**

The alluvial deposits are confined mainly to Narmada & Goi rivers and are not very extensive in thickness. The thickness of alluvium in the piezometer at Anjad has been found to be 10 m. The ground water in alluvium occurs under pheratic conditions. The specific capacity of the wells located in pheratic zone is about 490 lpm/meter of drawdown.

4.1.3 **Aquifer Parameters**

4.1.3.1 **Pheratic Aquifer**

Controlled pumping tests results on number of dug wells in the district shows that the yield of wells tapping vesicular basalts and massive traps ranges from 24 to about 70 cu.m/day. The specific capacity of wells varies from 25 lpm/m of drawdown to 285 lpm/m of drawdown in weathered vesicular basalt.The specific capacity of wells in alluvial aquifer is about 490 lpm/m of drawdown.

4.1.3.2 **Confined Aquifer**

Depending upon the intensity of fractures and its areal extent, the basaltic aquifers are found to be yielding as low as 5 lpm to as high as 300 lpm in the district. The transmissivity characteristics of confined aquifer ranges from 2 m^2 /day to as high as 312 m^2 /day.

4.1.4 **Ground Water Levels**

4.1.4.1 **Pre-monsoon Ground Water Level**

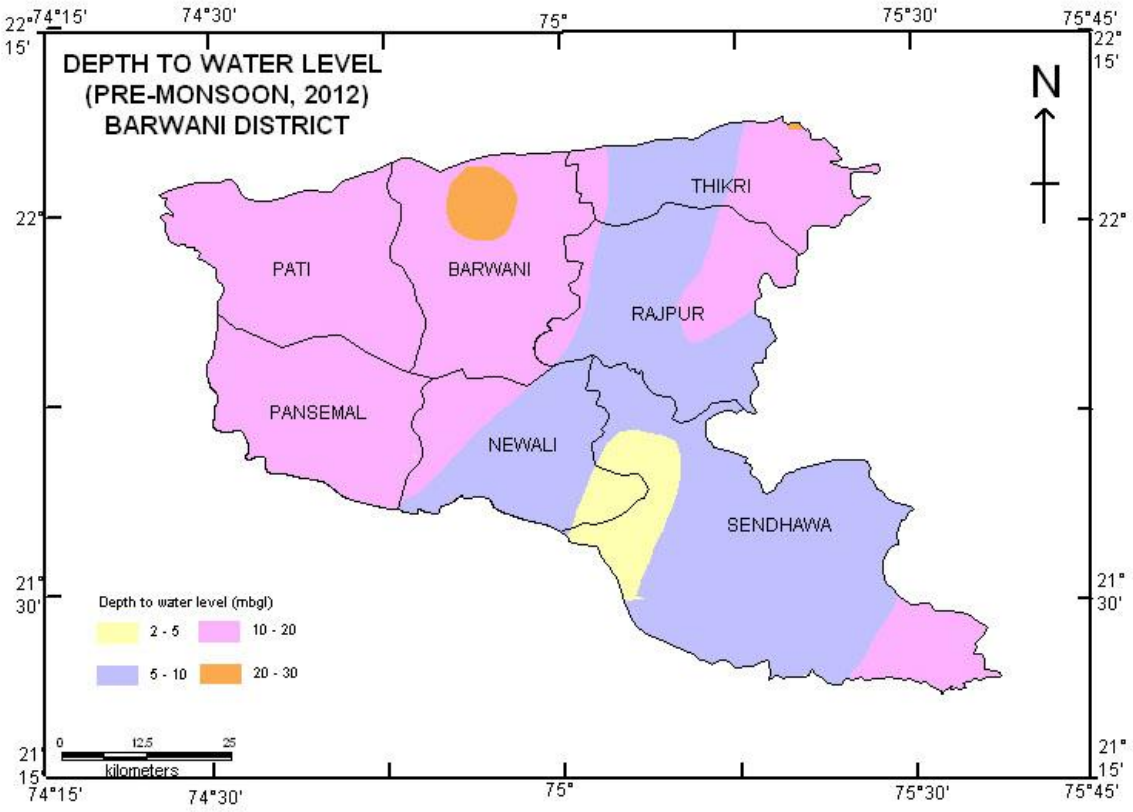
A perusal of the pre-monsoon ground water (2012) reveals that in a major part (53%) of the district, the ground water levels are between 10-20 mbgl, in 41% area water level is between 5 & 10m. Deeper Ground water levels > 20 m bgl are found in parts of Barwani and Thikri blocks. Shallower water levels of < 5 mbgl are found in Sendhwa & Newali blocks.

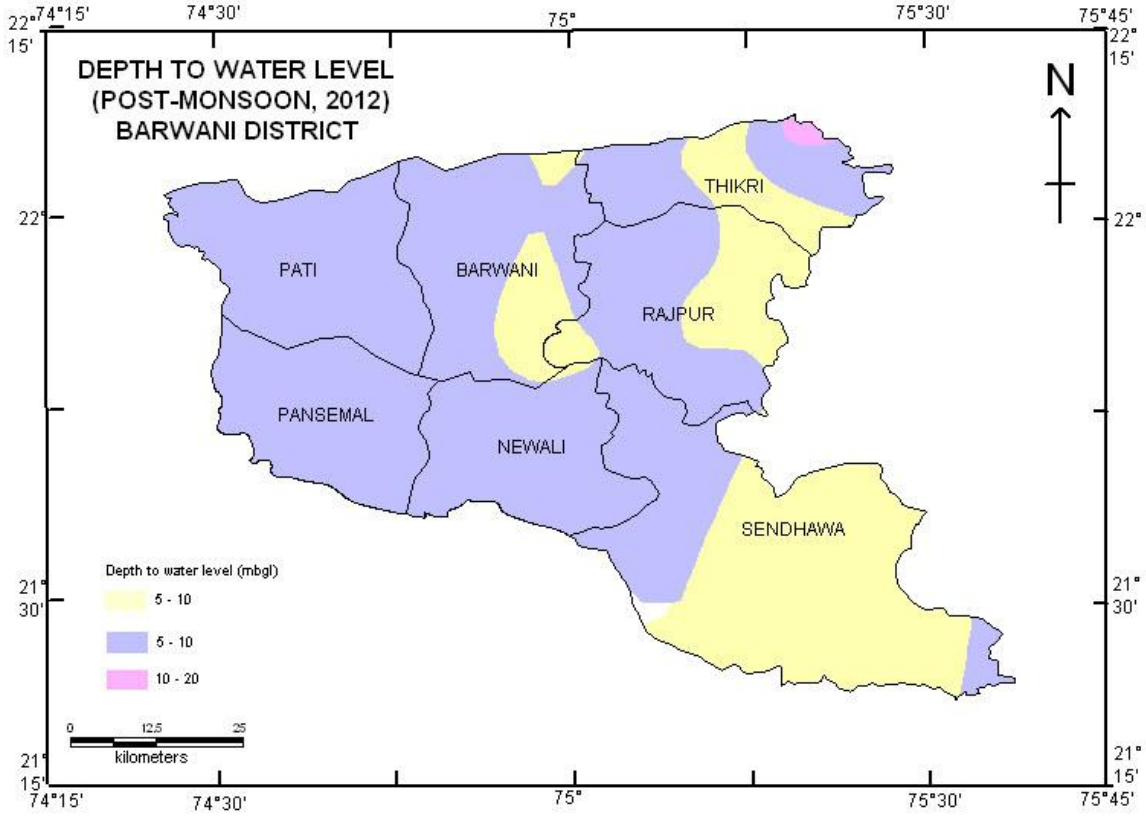
4.1.4.2 **Post –monsoon Ground Water Level**

During the post monsoon period (2012), ground water levels, in about 69% area of the district are between 5 & 10 m bgl. Shallower water levels of 2-5 m bgl are observed in parts of Sendhwa, Barwani, Rajpur and Thikri Blocks. Deeper water levels of 10-20 m bgl are observed in isolated patch in the northeastern part of Thikri block.

4.1.4.3 **Long Term Water Level Trend**

The long term water level trend (pre monsoon 2003-2012) indicates that 89% wells showing a rising trend between 0.0031 & 0.2093 m/yr whereas 12% showing a decline of 0.1127 m.


DEPTH TO WATER LEVEL
(PRE-MONSOON, 2012)
BARWANI DISTRICT
N
THIKRI
PATI
BARWANI
RAJPUR
PANSEMAL
NEWALI
SENDHAWA
Depth to water level (mbgl)
2 - 5
10 - 20
5 - 10
20 - 30
0
12.5
25
kilometers
74°15'
74°30'
75°
75°30'
75°45'
22° 15'
22°
21° 30'
21° 15'


DEPTH TO WATER LEVEL
(POST-MONSOON, 2012)
BARWANI DISTRICT
N
THIKRI
PATI
BARWANI
RAJPUR
PANSEMAL
NEWALI
SENDHAWA
Depth to water level (mbgl)
5 - 10
5 - 10
10 - 20
0
12.5
25
kilometers
74°15'
74°30'
75°
75°30'
75°45'
22° 15'
22°
21° 30'
21° 15'

Ground Water Quality

As per chemical analysis data of pre-monsoon, 2011, ground water in the area is generally alkaline in nature and the pH values are within acceptable limits. The Chloride concentration in the area is below 250 mg/l. The higher chloride values generally coincide with areas having high EC thus indicating that the salinity in ground water is mainly due to chloride. Concentration of magnesium and calcium in Barwani district are within permissible limits. The nitrate concentration in the district ranges between 2.5 – 68 mg/l with only Sendhwa having a value of 68 mg/l. The fluoride concentration in the district ranges between 0.14 to 0.61 mg/l. The total hardness in the district ranges between 65 to 530 mg/l falling within permissible limit. The plot of the Piper diagram indicates that alkaline water is found at Baru phatak, Julwania, Niwali and Rajpur. At Sendhwa, ground water is of alkaline earth sulphate and chlorite type, having permanent hardness, which can be removed by ion-exchange method. At Palsud, the water is alkali sulphate and chloride type.

The Wilcox diagram of Barwani district indicates that the ground water has low sodium hazard and medium to high salinity hazard. Thus, the ground water is chemically fit for drinking as well as agriculture purposes.

4.2 Ground Water Resources

Dynamic ground water resources of the district have been estimated for base year-2008/09, on block-wise basis.. There are seven number of assessment units (block) in the district which fall under which fall under non-command su-unit. Barwani, Niwali, Pati and Sendhwa blocks of the district are categorized as safe blocks, Rajpur and Thikri as semi critical and Pansemal as over exploited with highest stage of ground water development which is computed as 112 %. The net ground water availability in the district is 39,593 ham and ground water draft for all uses is 28,383 ham, making Stage of Ground water development 72 % (66 % in 2004/03) as a whole for district. After making allocation for future domestic and industrial supply for next 25 years, balance available ground water for future irrigation would be 9,582 ham.

Ground Water Resources (as on 31.3.2011)

District/ Assessment Unit	Sub-unit Command / Non-Command /	Net Annual Ground water Availability (ham)	Existing Gross Ground water Draft for Irrigation (ham)	Existing Gross Ground water Draft for Domestic & Industrial water Supply (ham)	Existing Gross Ground water Draft for All uses (ham)	Provision for domestic, and industrial requirement supply to next 25 year (2033 (ham)	Net Ground water Availability for future irrigation development (ham)	Stage of Ground water Development (%)	Category
Barwani									
Barwani	Command								
	Non-Command	6203	3858	303	4161	445	1900	67	Safe
	Block Total	**6203**	**3858**	**303**	**4161**	**445**	**1900**	**67**	Safe

Niwali	Command								
	Non-Command	3745	1549	327	1877	430	1766	50	Safe
	Block Total	**3745**	**1549**	**327**	**1877**	**430**	**1766**	**50**	Safe
Parasmal	Command								
	Non-Command	3577	3726	287	4013	287	-436	112	Over Exploited
	Block Total	**3577**	**3726**	**287**	**4013**	**287**	**-436**	**112**	Over Exploited
Pati	Command								
	Non-Command	2175	797	321	1117	685	694	51	Safe
	Block Total	**2175**	**797**	**321**	**1117**	**685**	**694**	**51**	Safe
Rajpur	Command								
	Non-Command	8752	6910	456	**7366**	858	984	84	Semi Critical
	Block Total	**8752**	**6910**	**456**	**7366**	**858**	**984**	**84**	Semi Critical
Sendhwa	Command								
	Non-Command	6932	2659	1089	3747	1470	2804	54	Safe
	Block Total	**6932**	**2659**	**1089**	**3747**	**1470**	**2804**	**54**	Safe
Thikari	Command								
	Non-Command	8209	5751	349	6101	587	1871	74	Semi Critical
	Block Total	**8209**	**5751**	**349**	**6101**	**587**	**1871**	**74**	Semi Critical
	District Total	**39593**	**25250**	**3132**	**28382**	**4761**	**9582**	**72**	

4.3 Status of Ground Water Development

Ground water is the main source of irrigation and drinking water in Barwani district. Out of a net sown area of 2289.90 sq km, only 849 sq km is under irrigation. The total number of dug wells and tube wells in the district, in the year 2010, was 26728 and 4970 respectively. There has been a steady rise in the development of ground water. The stage of ground water development in the district is 72% (as on 31.3.2009). There are 5 urban areas in the district viz. Barwani, Thikri, Rajpur, Pansemal and Sendhwa which have population growth rate of 28.34%, 17.84%, 24.43%, 13.90% and 34.34% respectively. Among the above-mentioned urban areas, only two towns have organized surface and ground water drinking water supply and the rest are dependent on ground water only. Barwani has designated capacity of 1.80 mgd (million gallons per day) with a per capita supply of 65 liters/day, while Sendhwa has designed capacity of 0.90 mgd with a per capita supply of 32 liters/day.

5.0 GROUND WATER MANAGEMENT STRATEGY

5.1 Ground Water Development

The development of ground water resources of Barwani district is increasing every year. The development, so far, has been mostly through dug wells. However, in recent years, the number of tube wells is also increasing. The availability of ground water for irrigation in the district is 41301 ham and the stage

of ground water development in the district is 72%. However, this rate is bound to increase in the future and may lead to a situation wherein the annual withdrawal of ground water may exceed the natural recharge in a normal monsoon year. This may happen since the cropping intensity and hence, number of ground water abstraction structures is likely to increase. This, coupled with increased drinking water requirement would create a stress on the existing ground water resources. It is thus essential that the available resources are utilised judiciously.

Based on the availability of ground water for future irrigation, dug wells in the depth range of 10-20 m with diameter of 4-8 m and tube wells in the depth range of 30-100 m may be feasible except in Pansemal block where stage of ground water development has already exceed 100%.

5.2 Water Conservation and Artificial Recharge

The main problem in Barwani district is not so much due to non availability of ground water, but lack of natural replenishment to ground water. The annual rainfall and its yearly variation has been leading to severe drought conditions over the past few years.

Deccan Traps in Barwani district constitute aquifers mainly with low to moderate permeabilities.

On account of extreme temperature and climatic variations, weathering in shallow zones is quite intense, creating an overburden with moderate to high infiltration rates. Although the weathered zones are not present over the entire aerial extent of Trap, yet fracture porosity of the rocks also gets increased due to weathering action.

Such locales with fractures and high weathered overburden having moderate to high infiltration rates are ideally suitable for construction of injection wells and percolation tanks.

Streams that generally flow on weak surface zones having high permeability also constitute good recharge zone. Numerous volcanic dykes cutting across surface drainage are seen in the district. The sub surface continuation of these dykes is generally impermeable, resulting in impounding of some water in the stream channel on the upstream side.

There is ample scope for increasing the potential of these zones by grouting leaks, if any, in the dykes or by constructing a small anicut or check dam over these dykes for impounding surface water for recharge.

The weathered and fractured zone overlying the fresh rock constitutes a profitable zone for development. The thickness of weathered zone varies from negligible to a maximum of about 20 meters.

All the major streams and rivers in the district are gaining in nature i.e. the ground water flow is contributing to the base flow. This flow, if arrested, could increase the storage potential of the weathered and fractured portion of the aquifer. This can be achieved by constructing sub-surface dykes in the weathered portion, resting on the fresh rock.

The alignment of the dyke should be perpendicular to the ground water flow direction. This would have the effect of creating a sub-surface dam and thus arresting the flow from the area. The area upstream of this dyke can then be exploited through tube wells or large diameter dug wells depending upon the site-specific conditions.

Although, Central Ground Water Board has not financed any artificial recharge scheme in the district, the State Government, under the 'Jal Abhishek Abhiyan', has taken up construction of 1023 artificial recharge structures, out of which 210 had been completed.

6.0 RECOMMENDATIONS

(i) In view of the limited regional extent an poor potential of the deeper aquifers in the district, it is recommended that the ground water exploitation from the deeper aquifer should be restrained and limited to drinking water supply only.

(ii) For construction of shallower tube wells, hydraulic troughs and areas upstream of dykes, especially at the intersection of dykes with the drainage should be selected. As regards semi-confined aquifer, it is essential to locate minor vertical or steeply dipping shear zones by aerial photo and geophysical studies.

(iii) It is recommended that additional dug wells and tube wells should be constructed at favourable locations in a phased manner over a period of 10 years in Pati, Barwani, Rajpur, Sendhwa & Niwali Blocks.

(iv) Open wells should have diameter in the range of 4-6 m and depth of about 12-16 m. The dug cum bore wells should have a 150 mm bore of 20 m depth from the bottom of the dug well. Shallow bored wells of 150 mm diameter could be drilled upto 150 m depth. 3-5 HP Centrifugal pump are adequate for dug wells.

(v) Actual spacing norms may not be strictly applicable for open wells yielding less than 20 lpm but a spacing of 150-200 m should be observed for wells yielding more than 20 lpm.

(vi) Artificial recharge to ground water in areas by creating storage of fresh water through rain water harvesting in an integrated water shed scheme and maintain the impounded head of water in small reservoir for as long as possible to promote induced infiltration. Structures like Check Dams, Sub-surface dykes, percolation tanks, recharge wells should be constructed through public participation.