

## SHAHDOL DISTRICT AT A GLANCE

S. N.	ITEMS	STATISTICS
<b>1.</b>	<b>GENERAL INFORMATION</b>	
	i) Geographical area	5671 Sq. Km
	ii) Administrative Divisions (As on 2006) Number of Tehsils	4 (Beohari, Jaisinghnagar, Sohagpur, Jaitpur)
	Number of Blocks	5 (Beohari, Jaisinghnagar, Sohagpur, Gohparu, Burhar)
	Number of Panchayats	4 Nagar Panchayats (Beohari, Jaisinghnagar, Khand and Burhar) 391 Village Panchayats.
	Number of Villages	513
	iii) Population (As per 2001 census)	908148 persons
	iv) Average Annual Rainfall (mm)	1211.6 mm
<b>2.</b>	<b>GEOMORPHOLOGY</b>	
	i) Major Physiographic Units	1. High Lands of Maikal mountain range 2. The Hills of Eastern Plateau, 3. Low Lands of Rivers/ Upper Son Valley
	ii) Major Drainage	Ganga Basin (Son River and its tributaries Tipan, Chandas, Bakan and Banas)
<b>3.</b>	<b>LAND USE (sq km)</b>	
	i) Forest area:	2278.85
	ii) Net area sown:	1796.68
	iii) Cultivable area:	2714.12
<b>4.</b>	<b>MAJOR SOIL TYPES</b>	
		Clayey loam and sandy loam soil. (Ustocherpts/ Ustorthents/ Rhodustalfs/ Haplustalfs/ Haplusterts as per pedological taxonomy)
<b>5.</b>	<b>AREA UNDER PRINCIPAL CROPS (Sq.Km.)</b>	
		Paddy (1087), Jowar (22.8), Maize (116.8), Tuar (77.3), Urad (60.33), Soyabean (16.7), Other Pulses (15.9), Til (54.2), Alsi (33), Wheat (241), Gram (42.5), Mustard (44.34) and Vegetables (17.84)

<b>6.</b>	<b>IRRIGATION BY DIFFERENT SOURCES</b>																						
		<table border="1"> <thead> <tr> <th></th> <th>Number of Structures</th> <th>Area (sq km)</th> </tr> </thead> <tbody> <tr> <td>Dugwells</td> <td>2442</td> <td>37.98</td> </tr> <tr> <td>Tube wells/Bore wells</td> <td>475</td> <td>26.09</td> </tr> <tr> <td>Tanks/Ponds</td> <td>422</td> <td>17.76</td> </tr> <tr> <td>Canals</td> <td>73</td> <td>48.37</td> </tr> <tr> <td>Other Sources</td> <td></td> <td>79.84</td> </tr> <tr> <td>Gross Irrigated Area</td> <td></td> <td>209.84</td> </tr> </tbody> </table>		Number of Structures	Area (sq km)	Dugwells	2442	37.98	Tube wells/Bore wells	475	26.09	Tanks/Ponds	422	17.76	Canals	73	48.37	Other Sources		79.84	Gross Irrigated Area		209.84
	Number of Structures	Area (sq km)																					
Dugwells	2442	37.98																					
Tube wells/Bore wells	475	26.09																					
Tanks/Ponds	422	17.76																					
Canals	73	48.37																					
Other Sources		79.84																					
Gross Irrigated Area		209.84																					
<b>7.</b>	<b>NUMBER OF GROUND WATER MONITORING WELLS OF CGWB (As on 31.3.2007)</b>																						
	No. of Dug Wells	15																					
	No. of Piezometers	4																					
<b>8.</b>	<b>PREDOMINANT GEOLOGICAL FORMATIONS</b>																						
		Archaean granite gneisses/ quartzite/ schist, Vindhyan Sandstone/Shale, Gondwana Sandstone/Shale, Lameta Sandstone/Limestone, Deccan Trap basaltic lava flows and older dolerite dykes/ sills and Recent laterite and alluvium																					
<b>9.</b>	<b>HYDROGEOLOGY</b>																						
	Major Water Bearing Formations	Gondwana Sandstone , Lametas underlying Deccan Trap																					
	Pre-monsoon depth to water level (2006)	5.02 to 12.22 m.bgl																					
	Post-monsoon depth to water level (2006)	3.00 to 8.92 m.bgl																					
	Long Term water level trend in 10 years (1997-2006) in m/yr	<p style="text-align: center;"><b>Rise</b></p> 0.04 to 0.44 (Pre-monsoon) nil (Post-Monsoon)																					
		<p style="text-align: center;"><b>Fall</b></p> 0.02 to 0.30 (Pre-monsoon), 0.02 to 0.25 (Post-monsoon)																					
<b>10.</b>	<b>GROUND WATER EXPLORATION BY CGWB (As on 31.3.2007)</b>																						
	No of wells drilled (EW,OW,PZ,SH, Total)	12 EW and 4 Pz																					
	Depth Range (m)	88.85 to 303 m.bgl																					
	Discharge (litres per second)	meagre to 10 lps.																					
<b>11.</b>	<b>GROUND WATER QUALITY</b>																						
	Presence of Chemical constituents more than permissible limit (eg EC, F, As,Fe)	High Nitrate (> 45 mg/l) recorded in 5 water samples																					
	Type of Water	Calcium Bicarbonate type																					

<b>12.</b>	<b>DYNAMIC GROUND WATER RESOURCES (2004) in MCM</b>	
	Annual Replenishable Ground Water Resources	865.92 MCM
	Net Annual Ground Water Draft	57.52 MCM
	Projected Demand for Domestic and Industrial uses upto 2025	32.18 MCM
	Stage of Ground Water Development	7 %
<b>13.</b>	<b>AWARENESS AND TRAINING ACTIVITY</b>	
	Mass Awareness Programmes Organised Date Place No. of Participants	Nil
	Water Management Training Programmes Organised Date Place No. of Participants	Nil
<b>14.</b>	<b>EFFORTS OF ARTIFICIAL RECHARGE &amp; RAINWATER HARVESTING</b>	
	Projects completed by CGWB (No. & Amount Spent)	Nil
	Projects under technical guidance of CGWB (Numbers)	Nil
<b>15.</b>	<b>GROUND WATER CONTROL AND REGULATION</b>	
	Number of OE Blocks	Nil
	Number of Critical Blocks	Nil
	Number of Blocks notified	Nil
<b>16.</b>	<b>MAJOR GROUND WATER PROBLEMS AND ISSUES</b>	
		<p>i. Dewatering of Coal Mines leading to decline in groundwater level</p> <p>ii. Under-utilisation of groundwater resources for irrigation</p>

## 1.0 INTRODUCTION

Shahdol district is predominantly a tribal district, situated in the eastern part of Madhya Pradesh. Prior to 1998-99, district Umaria and district Anuppur were parts of Shahdol district. A new district Umaria was formed out of district Shahdol, in the year 1998-99 and a new district Anuppur was formed out of district Shahdol in the year 2003. Because of the division of the district on 15-8-2003, the area of the district at present remains 5671 Sq. Kms. It is surrounded by Koriya district (Chhatisgarh State) and Sidhi district in the East, Bilaspur district (Chhatisgarh State), Anuppur and Mandla districts in the South, Satna and Sidhi districts in the North and Umaria district in the West. This district is situated between 23°00' N and 24°18'N latitude and 81°00' E to 82°00' E longitude, extending 100 Kms. from East to West and 141 Kms. from North to South. It is covered in Survey of India Degree sheet Nos. 63H and 64E. Shahdol is the district headquarter and Sohagpur, Beohari, and Jaisinghnagar are some of the major towns. Shahdol is located on the Bilaspur-Katni Section of the South-Eastern Railways. The district is divided into four Tehsils and five development Blocks (Plate-I).

Table - 1 : Administrative Divisions, District Shahdol, M.P.

Tehsils	Block	Area Sq.Km.	Population (2001)	Municipalities	Nagar Panchayats
Beohari	Beohari	109509	137400	-	Beohari
Jaisinghnagar	Jaisinghnagar	153243	154324	-	Jaisinghnagar
					Khand
Sohagpur	Sohagpur	81160	181110	Shahdol	-
	Gohparu	91143	93294		
Jaitpur	Burhar	125951	139215	Dhanpuri	Burhar
	<b>District Total</b>	<b>561006</b>	<b>908148</b>		

### **DRAINAGE**

The entire district is drained by Son River and its tributaries. Thus the area falls in the Ganga Basin. The river Son flows due north till the northern extent of the district, marking the western boundary of the district Shahdol with Umaria District. Thereafter, the river Son flows due east and marks the northern boundary of Shahdol district with Satna district. The important tributaries of the Son river are the Kunak nadi and the Chuwadi nadi. The river son draining the south eastern parts of the district through its important tributaries like Tipan, Chandas and Bakan flow in the north-west direction with a dendritic pattern, draining the central plains of the district.

Another important tributary of the Son River is the Banas river, flowing along the eastern boundary of the district, marking the boundary of the district Shahdol with Sidhi District. The north-western part of the district is drained by the Banas river and its tributaries namely the Jhanapar river, Kormar nadi, the Rampa nadi, and the Odari Nadi. Banas River confluences with the Son River at the northernmost tip of Shahdol District.

## IRRIGATION

Bansagar is a multipurpose river valley project on Son River situated in Ganga Basin in Madhya Pradesh, envisaging both irrigation and hydroelectric power generation. The Bansagar Dam across Son River is constructed at village Deolond in Shahdol district on Rewa – Shahdol road. However, irrigation through this Project will benefit only a small area in the north of the District. Shahdol district still has poor irrigation facility. Only 9% of the total crop gets irrigation facility. Tribals of the district prefer the cultivation in the old traditional method and depend mainly on rain. The area irrigated by canals, tubewells, dugwells and tanks are tabulated below in Table 2.

Table 2. : Irrigation (2005-2006)

S. N.	Sources of Irrigation	Block					District Total	
		1	2	3	4	5		
	Number and Area Irrigated in Sq.Km.	Beohari	Jaisingh Nagar	Sohagpur	Gohparu	Burhar	Shahdol	
1	Canals	Number	29	10	18	5	11	<b>73</b>
		Area	34.55	4.53	4.61	3.68	1.00	<b>48.37</b>
2	Tubewells	Number	218	88	141	11	17	<b>475</b>
		Area	10.32	2.79	12.02	0.80	0.09	<b>26.09</b>
3	Dugwells	Number	826	910	307	175	224	<b>2442</b>
		Area	15.55	1254	624	200	165	<b>37.98</b>
4	Tanks	Number	55	39	135	142	186	<b>422</b>
		Area	7.69	2.58	3.10	5.44	2.05	<b>17.76</b>
5	Other sources	Area	12.94	15.83	31.71	6.93	12.43	<b>79.84</b>
6	Gross area irrigated from all sources		<b>8105</b>	<b>3823</b>	<b>5759</b>	<b>1575</b>	<b>1722</b>	<b>209.84</b>

## CROPPING PATTERN

District is very backward in the field of agriculture. The size of the fields is very small and the tribals are mainly marginal farmers. The yearly yield of the products from the fields is not enough for their home use. Paddy, Kodo, Kutko and Maize are the crops of the district. Til, Mustard and Groundnut are the main oilseeds produced here. The farmers have started the production of Sunflowers and Soyabean. In the central and southern part of the district, paddy is the main crop grown during Kharif season and in the north-west, wheat is the main crop grown during Rabi season.

## **CGWB ACTIVITIES**

Central Ground Water Board has carried out extensive field work in the district of Shahdol to provide scientific base to understand the dynamic system of ground water in the region. Systematic hydrogeological surveys were carried out in the district during the year 1987-88 by Sh. R.N. Sharma and Sh.A.K.Budhaliya, then Junior Hydrogeologists and Sh. A.K.Jain, Sh. M.L.Parmar, Sh. M.V.Gopal and Sh. I.Javid Ali, then Assistant Hydrogeologists.

Detailed hydrogeological work was carried out in the District under Technology Mission Programme for drinking water during the period 1988 to 1991 by Sh. R.N. Sharma, then Junior Hydrogeologist and Sh. I.Javid Ali, Sh. A.Srinivas and Sh. R.M.Verma, then Assistant Hydrogeologists.

Reappraisal Hydrogeological Surveys of the area was carried out by Shri A.K.Jain, Junior Hydrogeologist during year 1998-99. CGWB had carried out regular Groundwater Exploration in the district during the period 1988-93 and a total of 11 exploratory wells were drilled at various places in different geological formations of the district.

## 2.0 RAINFALL & CLIMATE

Shahdol district experiences a temperate climate characterized by a hot summer, well-distributed rainfall during the south-west monsoon season and mild winter. The winter season commences from December and lasts till the end of February followed by the summer from March to middle of June. The south-west monsoon or rainy season continues from middle of June to September when south west monsoon is active while October and November months constitute post-monsoon or retreating monsoon season. The climate of Shahdol District, as calculated by Thornthwaite Precipitation Effectiveness Method, is humid climate with forest type vegetation.

The month of May is the hottest month with mean daily maximum temperature at 41.4<sup>0</sup>C and mean daily minimum temperature at 26.5<sup>0</sup>C. With the onset of south-west monsoon during June, there is an appreciable drop in day temperature, while at the end of the September or in early October, there is slight increase in day temperature but nights become progressively cooler. January is generally the coolest month with the mean daily maximum temperature at 25.6<sup>0</sup>C and the mean daily minimum temperature at 8.4<sup>0</sup>C. The average daily maximum temperature is about 41.4<sup>0</sup>C and minimum temperature is about 26.5<sup>0</sup>C. During the southwest monsoon season the relative humidity generally exceeds 88% (August month). In rest of the year is drier. The driest part of the year is the summer season, when relative humidity is less than 38%. April is the driest month of the year. The wind velocity is higher during the pre-monsoon period as compared to post monsoon period. The maximum wind velocity of 6.8 km/hr is observed during the month of June and minimum 2.3 km/hr during the month of December. The average normal annual wind velocity of Shahdol district is 4.3 km/hr.

The normal average rainfall of Shahdol district is 1211.6 mm of which about 86.6% of the total precipitation falls in the south-west Monsoon period. The maximum rainfall received in district is at Pushparajgarh i.e. 1500 mm and minimum is at Beohari i.e. 1108.5 mm.

As per rainfall statistics, frequency of occurrence of Normal drought in the area is 25 % and that of Mild drought is also 25 % times while severe droughts occurred in the area 5 % times. i.e. on an average there is a possibility of occurrence of a normal or mild drought once in every seven years, while that of severe draughts is once in every 20 years. The area does not experience any most severe drought.

### 3.0 GENERAL GEOLOGICAL FEATURES

#### 3.1 General Geological Succession

The stratigraphic sequence of various geological units with their respective rock types are described below.

AGE	LITHOSTRATIGRAPHIC UNIT	LITHOLOGY
Recent to sub recent	Alluvium, Laterite	Sandy loam, silty sand, coarse medium laterite
Cretaceous to Eocene	Deccan Trap	Basaltic lava flows and older dolerite dykes and sills.
Upper Cretaceous	Lameta	Sandstone, siliceous limestone, marl and Shales.
Lower Cretaceous	Chandia	White clays and medium grained sandstone
Late Norian to Rhaetic	Parsora	Coarse-grained sandstone variegated shale and lilac coloured clays.
Upper Permian to Larnic	Tihki Pali	Coarse grained sandstone grey shale, red shale, red green and mottled clay with thin coal bands
	} Gondwana Supergroup	
Late Permian	Barakar	Sand stone, Shales and Coal seams
Upper Carboniferous to Lower Permian	Talchir	Tillite, sandstone and green shale
Pre - Cambrian	Lower Vindhyan (Semri series)	Porcellanite shales sandstone basal conglomerates
	Bijawar	Quartzes, Gneisses
Algonkian	Archaean	Granite, Gneisses, Schists etc.

### **3.2 Geomorphology And Soil Types**

The District is located in the north-eastern part of the Deccan Plateau. It lies at the trijunction of Maikal Ranges of the Satpura Mountain, the foot of the Kymore Range of the Vindhya Mountain. In between these hill ranges lies the narrow valley of the Son and its tributaries.

Physiographically, structural landforms, represented by plateau and low lying plains with average altitude of 450m to 500m above MSL, are developed in northern, northeastern and northwestern and central parts of the district. In the southern part of the District, hills and highlands of Maikal Range and high to medium level (500m to 990m) plateau and flat topped, step like terraces are developed. Fluvial Land Forms represented by flood plains are present along the western boundary of the district. The maximum elevation of the area is 1123m above mean sea level at Singingarh Hill (23°03'40" : 81°27'37") in Satpura hills, in southern part of the district.

#### **Soil**

The soils in the area are generally of clayey loam types with sandy loam soil in some areas. In the northern and central parts of the District, the undulating plateau with mounds are covered with slightly deep soil, well drained, fine to fine loamy soils on gentle slopes marked by moderate erosion. The southern hilly region is covered by very shallow loamy soils, some what excessively drained. The soils developed on moderately steep slopes are marked by severe erosion. The soils have been classified as Ustocherpts/ Ustorthents/ Rhodustalfs/ Haplustalfs/ Haplusterts, as per pedological taxonomy.

## **4.0 GROUND WATER SCENARIO**

### **4.1 Hydrogeology, Aquifer System And Aquifer Parameters**

The water bearing properties of different hydrogeological units occurring in Shahdol District are described below. Hydrogeology of the district is shown in Plate-II.

#### **4.1.1 Bijawar Series**

This consists of Quartzites, Gneisses and Schists, which are moderately weathered and jointed. Weathering in quartzites has gone as high as 10 m. These rocks out crop in the area of Beohari block. Groundwater occurs in the secondary porosity, developed in the weathered, sheared, fractured portion of these rocks. The dug wells yield as high as 40,000 litres per day to as low as 400 litres per day. The wells dry up in summer. The premonsoon water level in wells go as deep as 12m and rise up during post monsoon to as high as 1.60m bgl.

#### **4.1.2 Lower Vindhyan**

Semri series of rocks represent Lower Vindhyan in the district. They also support development of ground water through open wells. Porcellanite shales layer and its stratification allow some percentage of water to percolate downward and move along the planes of bedding and water gets pooled up in weathered zones/disintegrated crushed zones, along the contact planes. Semi weathered yellowish shale from undulating topography. The Vindhyan have also developed aquifer with the groundwater flow gradient of 1 in 200 in the NE direction, almost in the dip direction of the shales (600N).

The dugwells in Vindhyan aquifer vary in depth range from 16.6-20mbgl. The depth to water level in the wells during pre monsoon ranges between 4.80 to 15m bgl.

#### **4.1.3 Gondwanas**

The Gondwana group of rocks, that bears the coal deposit, is also a fine groundwater repository in this district. The felspathic medium to coarse grained sandstone, bears groundwater in the interconnected primary pores in the formation as well as the contact planes between shales and sandstone. Groundwater is also mined out along with the coal in almost all the coal fields of the district. Groundwater occurs in both unconfined conditions in the Gondwana formations of the district.

Due to excessive pumpage of groundwater from the underneath coal mines, there has been excessive lowering of water levels in the phreatic groundwater regime overlying the coal field areas. Gondwana formation particularly the upper part of the Barakar sandstone supports development of phreatic aquifers which extends from few meters below ground level to 25 m below land surface.

The fluctuation of groundwater level is between 3-5m.

#### **4.1.4 Lametas**

These are sedimentary deposits resting over Gondwana formations (some times resting over the Granites directly). Generally, these are compact and impervious rocks (siliceous limestone). However, at places the nodular limestone and poorly consolidated sandstone have allowed the development of ground water in confined and unconfined system.

Since the Lametas are generally thickly forested, population and habitation is been rather sparse. However, there are quite a few number of dug wells that are used for drinking purpose by the tribal population. It is found that about 80% of the dug wells are within the depth range of 8 m to 16 m bgl. with a diameter of 3-4 m. The pre-monsoon depth of water level goes as deep as 17m to 20 m and rise up to as high as 12-16 m . The yield of the well is between 50,000 litres per day to 75,000 liter per day.

#### **4.1.5 Deccan Traps**

Many basaltic / doleritic dykes and sills (equivalent to Deccan Traps) cut across Gondwana and Lameta formations. These dykes and sills are spread near the surface or spread over the paleo-topography surface in limited area as basaltic flows and form hills wherever exposed. These are weathered, vesicular, jointed and fractured similar to Deccan Trap basalts without the layering feature of basaltic flows. These exhibit scope of groundwater development because of the development of secondary porosity. The yield is limited and vary according to the degree of weathering, weathered mantle, presence of fractures and joints etc. However, on drilling a borehole piercing the thin dolerite/ basalt near the base of these hills (dyke/ sills), where the dolerite/ basalt flow pinches, good yields are obtained from the underlying Gondwana and Lameta formations.

The wells in the basaltic flows of Deccan Traps vary in depth between the range of 6-9 m bgl. With a diameter of 2m to 3m . The wells go dry during summer. The yield varies between post monsoon and premonsoon from 1,30,000 litres per day to 70,000 litres per day.

#### **4.2 Water Levels**

Ground water levels form a very important parameter of the ground water system. The groundwater balance expresses itself in the change in water levels; hence a continuous record is important and useful. CGWB has 15 National Hydrograph Monitoring wells and 4 Peizometers in Shahdol district.

#### **Pre Monsoon Depth to Water Level ( May-2006 )**

In general depth to water level in the area ranges from 5.02 to 12.22 m below ground level. Shallow water level of less than 6 m has been recorded at Kanadi Khurd and Tihki in the north-central part of the district. Depth to water level between 6 to 9 m bgl. is occurring in major part of the district and observed at Beohari, Bhikampur, Bahgarh, Amjhor, Bansukli, Jaisinghnagar, Karki, Sanausi, Shahdol and Singhpur. Depth to water level between 9 to 12 m. bgl. is recorded in isolated well at Gohparu. Deepest water level of 12.22 m. bgl. is recorded at Burhar.

### **Post Monsoon Depth to water level ( November-2006)**

In general, during post-monsoon period, depth of water levels in the district ranges between 3.0 and 8.92 m below ground level. Shallow water level of less than 6 m is occurring in major part of the district has been recorded at Beohari, Bhikampur, Bahgarh, Amjhor, Bansukli, Jaisinghnagar, Kanadi Khurd, Sanausi, Tihki Shahdol and Singhpur. Depth to water level between 6 to 9 m bgl. is observed at Karki, Sidi, Gohparu and Burhar.

### **4.3 Change in Ground Water Levels**

#### **Water Level Fluctuation between Pre and Post-Monsoon 2006**

Rise in water level between pre and post monsoon seasons have been recorded in entire district. Rise in water level ranges between 0.91 m at Tihki in north-central part of the district and 4.31 m at Bansukli in central part of the area. Rise in water levels of less than 2 m is observed in monitoring wells at Beohari, Tihki, Karki, Sanausi, and Sidi. Water level rise between 2 to 4 m is observed in almost entire central and southern part of the district. Rise in water levels more than 4 m is recorded in an isolated monitoring well at Bansukli.

#### **Long Term Trend Analysis**

To study change in ground water regime of the area during pre and post monsoon periods over 10 years (1997 to 2006), water level data of 15 Hydrograph Monitoring Wells, is summarized in table 3. have been used. Perusal of long term trend analysis indicate that there is no significant change in water levels over 10 year period. Ten National Hydrograph Monitoring wells of the district show declining trend during pre-monsoon as well as post monsoon period, only one National Hydrograph Monitoring well show falling trend during pre-monsoon and rising trend during post monsoon period; four National Hydrograph Monitoring well show rising trend during pre-monsoon and falling trend during post monsoon period, while no National Hydrograph Monitoring well of the district show rising trend during pre-monsoon as well as post monsoon period. 11 National Hydrograph Monitoring wells of the district show declining trend during pre-monsoon period. Average rate of decline ranges from 0.02 m/year at Gohparu to 0.3m/year at Burhar. 4 National Hydrograph Monitoring Wells located at Sanousi, Tihki, Karki and Sidi indicate rising trend with an average rise of water level from 0.042 m/year (at Karki) to 0.45m/year (at Sidi). During post-monsoon period, the rate of decline ranges from 0.05 m/year at Bansukli to 0.26m/year at Sidi.

Table 3. : Long Term (1997 to 2006) Water Level Trend Analysis of CGWB Hydrograph Monitoring Wells

Village Monitoring Well	Block	Pre-monsoon		Post-monsoon	
		Rise	Fall	Rise	Fall
		m./year	m./year	m./year	m./year
Beohari	Beohari	-	0.12	-	0.22
Burhar	Burhar	-	0.3	-	0.2
Bhikhampur	Burhar	-	0.24	-	0.18
Bahgarh	Burhar	-	0.12	-	0.12
Sanousi	Jaisinghnagar	0.196	-	-	-
Tihki	Jaisinghnagar	0.132	-	-	0.05
Karki	Jaisinghnagar	0.042	-	-	0.1
Kanadi (khurd)	Jaisinghnagar	-	0.09	0.06	-
Bansukli	Jaisinghnagar	-	0.27	-	0.05
Jaisinghnagar	Jaisinghnagar	-	0.14	-	0.19
Sidi	Jaisinghnagar	0.445	-	-	0.26
Amjhor	Jaisinghnagar	-	0.07	-	0.05
Gohparu	Gohparu	-	0.02	-	0.14
Shahdol	Sohagpur	-	0.1	-	0.21
Singhpur	Sohagpur	-	0.11	-	0.24

Long term decline in water levels is perhaps due to increased dependency on ground water resources for various uses and continuous withdrawal of it at various places.

#### 4.4 Ground Water Exploration

Groundwater Exploration through deep drilling was carried out by deploying four direct rotary rigs to drill through semi consolidated Gondwana sediments. Central Ground Water Board carried out exploratory drilling programme in the area between 1990 and 1994 and during this period 12 exploratory wells and 7 observation wells were constructed. 4 number of piezometers were drilled in Shahdol district under Hydrology Project for water level monitoring purpose. The details of piezometers are given in table 4.

Exploration revealed occurrence of potential aquifer within Lameta formation. The Gondwana formations – the clay and mudstone facies of Tihiki stage overlying the arenaceous facies of Pali beds have an aquifer system of moderate to high yield potential in Beohari Block. The yields range from 6 to 10 lps with average drawdown of 12 to 15 m over static water level (which vary from 6 to 7.5 m.bgl). However exploratory well at Bhejari site was abandoned due to insignificant yield. The Upper Barakar Sandstone of Gondwana Super Group has a positive piezometric head and at many places, auto-flowing condition occur, e.g. in Churmura (Shallow), Churmura (Deep) and Gohparu exploratory tubewells.

The Upper Barakar Sandstone are devoid of coal seams while Middle and Lower Barakars have a number of coal seams occurring at different depths, from surface exposures to 150 m.bgl. The well at Gohparu was auto flowing, but its yield was meagre. Well at Churmura confirmed a three aquifer system, out of the middle aquifer (80 – 160 m.bgl) and third aquifer (lowest / 210 – 240 mbgl) showed auto-flowing condition with piezometric head of 3.3 m agl and 5 m agl respectively with free flow discharge of 3 lps. At Bijha site, very shallow water level of 0.19 m bgl was recorded with a discharge of 3.4 lps.

**Table 5. : Hydrogeological Details of Piezometers drilled in Shahdol district.**

S.N	Name of site	Depth ( m )	Aquifer zones	SWL mbmp	Yield (lpm)	E.C. (µS/cm)	Aquifer
1	Burhar-D 23°13'30" 81°31'28"	58.15	12.6-17.8 50.0-52.0	22.0	4.2	365	Barakar Sandstone
2	Burhar-S 23°13'30" 81°31'28"	30.69	12.6-17.8	9.8	4.2	570	Barakar Sandstone
3	Jaisinghnagar-D 23°40'42" 81°23'48"	46.48	32.0-35.0	1.58	1.25	166	Upper Gondwana Sandstone
4	Shahdol-D 23°17'55" 81°21'35"	61.77	37.5-38.5 46.0-50.1	9.75	0.5	466	Gondwana Sandstone

#### **4.5 Ground Water Resources**

The groundwater resources of the District are under-developed and under-utilised. 475 tubewells and 2442 dugwells facilitate to irrigate an area of 64.07 sq.km. of agricultural land as against 2714.12 sq.km cultivable area and 1796.68 sq.km of net sown area in the district. Total annual replenishable groundwater resource of the district is 911.492 MCM and after deducting unaccounted natural discharge, the net available ground water resource is 865.92 MCM, while total groundwater draft in the district is only 57.52 MCM. The stage of ground water development of the district is only 6.64%. Shahdol comes under safe category from ground water development point of view.

Net Groundwater Availability for future irrigation development is 793.36 MCM. There is ample scope for development of groundwater for irrigation, industrial and domestic purposes.

Block wise ground water resources are given in Table-5

Table 5: Ground Water Resources of Shahdol district, M.P.

Assessment Unit/ District	Command/ non- Command/ Block Total	Net Annual Ground water Availability  (%)	Existing Gross Ground water Draft for Irrigation	Existing Gross Ground water Draft for Domestic & Industrial water Supply	Existing Gross Ground water Draft for All uses	Allocation for domestic & industrial requirement supply upto next 25 years	Net Ground water Availability for future irrigation	Stage of Ground water Development
1	2	3	4	5	6	7	8	9
Sohagpur	Command	0	0	0	0	0	0	0
	Non-Command	141.55	8.03	3.6	11.63	6.32	127.2	8.21
	<b>Total</b>	<b>141.55</b>	<b>8.03</b>	<b>3.6</b>	<b>11.63</b>	<b>6.32</b>	<b>127.2</b>	<b>8.21</b>
Jaisingh nagar	Command	0	0	0	0	0	0	0
	Non-Command	262.93	11.92	3.54	15.46	6.72	244.29	5.88
	<b>Total</b>	<b>262.93</b>	<b>11.92</b>	<b>3.54</b>	<b>15.46</b>	<b>6.72</b>	<b>244.29</b>	<b>5.88</b>
Beohari	Command	3.73	0.03	0.29	0.32	0.51	3.19	8.5
	Non-Command	128.6	15.65	3.07	18.72	5.79	107.16	14.56
	<b>Total</b>	<b>132.33</b>	<b>15.68</b>	<b>3.36</b>	<b>19.04</b>	<b>6.3</b>	<b>110.35</b>	<b>14.39</b>
Burhar	Command	0	0	0	0	0	0	0
	Non-Command	209.86	2.97	4.64	7.61	9.47	197.41	3.63
	<b>Total</b>	<b>209.86</b>	<b>2.97</b>	<b>4.64</b>	<b>7.61</b>	<b>9.47</b>	<b>197.41</b>	<b>3.63</b>
Goparu	Command	0	0	0	0	0	0	0
	Non-Command	119.25	1.78	2	3.78	3.37	114.1	3.17
	<b>Total</b>	<b>119.25</b>	<b>1.78</b>	<b>2</b>	<b>3.78</b>	<b>3.37</b>	<b>114.1</b>	<b>3.17</b>
	<b>District Total</b>	<b>865.92</b>	<b>40.38</b>	<b>17.14</b>	<b>57.52</b>	<b>32.18</b>	<b>793.36</b>	<b>6.64</b>

#### **4.6 Ground Water Quality**

In order to determine the Chemical Quality of ground water to assess the suitability for agriculture and drinking purposes, a total number of 15 water samples from phreatic aquifer were collected and their analytical results are given in Table 6.

##### **Quality of Ground Water for Drinking Purpose**

The quality of ground water in district is being assessed by the analysis of groundwater samples from 17 number of hydrograph stations and their analytical results are given in Table 6. The analysis of water samples for year 2006 indicate that the pH values of all water samples varies between 7.37 to 7.91 showing alkaline nature of water in the district. The electrical conductivity (EC) values, indicative of total dissolved solids in groundwater were found to be in the range of 252 and 953  $\mu\text{S}/\text{cm}$  at 25<sup>0</sup>C. Hardness of water, caused by the presence of calcium and magnesium and to some extent iron and other metallic cations, may be beneficial in some traces. As per standards of GOI, the highest desirable limit of total hardness is 300 ppm and maximum permissible limit is 600 ppm. Total Hardness in the shallow ground water in Shahdol District ranges between 95 and 370 mg/l. Referring to Piper Diagram for Water Type most of waters are Calcium Bicarbonate type attributing to Temporary Hardness of water.

Temporary Hardness of water can be removed by boiling. However, shallow ground water is vulnerable to contamination from different sources. At times nitrate concentration is seen high wherever the excess fertilizer/ animal waste/sewage mixes with water percolating to ground water. High nitrate concentration is recorded at Amiliya (123 mg/l), Gohparu (92 mg/l), Amjhor (62 mg/l), Beohari (56 mg/l), and Bhikampur (49 mg/l) and this water should not to be used for drinking purpose by infants and pregnant/lactating mothers. The study of analyzed data shows that Shahdol district does not have any problem of fluoride since all the wells have fluoride less than 1.5 ppm of BIS (1990) permissible limit. No arsenic content was detected in the groundwater of district as per analysis carried out in year 2003. In general, groundwater in phreatic aquifer is fresh and fall in classification of good category for drinking purpose.

##### **Quality of Ground Water for Irrigation Purpose**

The chemical quality of groundwater is an important factor to be considered in evaluating its suitability for irrigation purpose. The parameters such as EC, Sodium Absorption Ratio (SAR), percent sodium (% Na) and Residual Sodium Carbonate (RSC) are used to classify the water quality for irrigation purpose. US Salinity Laboratory suggested a diagram of classifying waters for irrigation purposes in 1954. It is clear that more than 82% groundwater samples from the district fall under C<sub>2</sub>-S<sub>1</sub> class (medium salinity and low sodium) which means that these waters can be used for all type of crops on soils of low to high permeability, without causing problem of salinity. The groundwaters representing the wells of Singhpur, Gohparu and Beohari are grouped under C<sub>3</sub>-S<sub>1</sub> (high salinity and low sodium) class, indicating that groundwater from these areas can be used for irrigation purposes on well drained soils or used for salt tolerant crops like groundnut, safflower etc.

Table. 6.: Different chemical constituents of shallow ground water in Shahdol District (2006-07)

Sl. No.	BLOCK	VILLAGE	pH	EC ( $\mu$ S/cm at 25C)	Total Hardness as CaCO <sub>3</sub> mg/l	MAJOR CATIONS				MAJOR ANIONS					PO <sub>4</sub> mg/l	F mg/l	SAR (millimole/ lit) <sup>1/2</sup>	RS (me)	
						Concentration in milligram per litre													
						Ca	Mg	Na	K	CO <sub>3</sub>	HCO <sub>3</sub>	Cl	SO <sub>4</sub>	NO <sub>3</sub>					
	Beohari	Beohari	7.67	790	280	84	17	47	2	Nil	232	71	50	56	BDL	0.6	1.22	-1.	
	Burhar	Bhikhampur	7.77	534	235	74	12	11	12	Nil	128	35	25	49	BDL	0.3	0.31	-2.	
	Burhar	Bahgarh	7.81	328	140	52	2.5	14	2	Nil	134	18	13	11	BDL	0.1	0.51	-0.	
	Burhar	Burhar	7.76	463	175	60	6.2	16	25	Nil	104	50	20	75	BDL	0.3	0.53	-1.	
	Jaisinghnagar	Amjhor	7.42	679	200	62	11	60	12	Nil	140	89	37	62	BDL	0.3	1.85	-1.7	
	Jaisinghnagar	Bansukli	7.73	465	190	60	9.8	19	3	Nil	177	50	7	3	BDL	0.2	0.6	-0.9	
	Jaisinghnagar	Jaisinghnagar	7.37	344	95	28	6.1	37	5	Nil	73	50	23	29	BDL	0.1	1.65	-0.	
	Jaisinghnagar	Kanadikhurd	7.87	352	160	48	9.8	7	3	Nil	140	18	8	25	BDL	0.3	0.24	-0.	
	Jaisinghnagar	Karki	7.69	376	145	42	9.8	18	10	Nil	122	25	22	42	BDL	0.3	0.65	-0.	
	Jaisinghnagar	Sanousi	7.91	252	115	38	4.9	6	5	Nil	128	11	6	4	BDL	0.2	0.24	-0.	
	Jaisinghnagar	Sidi	7.4	325	130	48	2.5	16	6	Nil	98	21	30	27	BDL	0.1	0.61	-0.9	
	Jaisinghnagar	Tihki	7.69	422	170	60	4.9	21	2	Nil	195	21	15	3	BDL	0.4	0.7	-0.	
	Gohparu	Gohparu	7.53	904	370	110	23	42	4	Nil	146	128	76	92	BDL	0.4	0.95	-5.0	
	Sohagpur	Shahdol	7.74	529	185	50	15	37	10	Nil	232	32	19	4	BDL	0.8	1.18	0.1	
	Sohagpur	Singhpur	7.64	953	345	80	35	58	13	Nil	232	103	125	3	BDL	0.6	1.36	-3.	

## **5.0 GROUND WATER MANAGEMENT STRATEGY**

Shahdol district has been identified as drought prone area. Drought has been recognised as a hydrological phenomena which occurs in certain frequency of incidence and cause misery and economic crises practically every alternate third year. Therefore, a scientific study of its cause and effects and pooling these experiences for the most optimum utilisation of the limited water resources should be the first task of the district's development authorities. Groundwater development and management is an important measure for drought mitigation.

### **5.1 Ground Water Development for Rural Water Supply**

Practically, the entire district of Shahdol has been suffering from the problem of drinking water. The problems get more pronounced during the year of deficient rainfall. Though the State Public Health Engineering Department with its division at Shahdol, which is entrusted the task of providing drinking water supply to urban and rural population, has made considerable progress in providing drinking water facilities in problem villages under accelerated Rural water supply Scheme, much work is to be done through concrete and concerned plan of action to tackle the problem on short term and long term. Water is being supplied through dugwells, tubewells, hand pumps in 820 villages and tap water supply scheme in 14 villages. At places mine discharge water and water from surface water sources is also being supplied. Detailed hydrogeological surveys for proper source of drinking water supply is to be investigated in villages which have no source of drinking water, in villages where tube wells failed and villages where yield dwindle in the summer as also in 75 villages affected due to coal mining activities and 10 villages where piped water supply schemes are to be strengthened and in villages which are partially covered.

### **5.2 Problem related with Deforestation and Soil Erosion**

Due to improper and unscientific management as well as exploitation of forest to yield high revenue, there has been a regular degradation in forest quality and its coverage during the pre independence period. Deforestation has been also caused by large scale mining of coal through open cast system and rehabilitation and construction of residential colony surrounding mine area.

In Shahdol district there has been tremendous depletion of the forest cover in the recent past due to heavy human interference. After Independence, survey and demarcation was carried out but the ecological degradation could not be controlled due to natural influence of unfavorable geological formation and human interference. Poverty and ignorance of local Adivasis, regular fire incidence and periodical droughts have also contributed to devastation of vegetation resulting in retrogression of forest. Regression in ecology and degradation in vegetation cover has done a great damage to soil and moisture conservation in the district, there is an urgent need to reverse this process by a proper a forestation program with latest management technique and innovations.

Soil erosion in general occurs when rains are heavy and flow of water through the field occurs with high velocity. This erosion by water is accelerated due to defective method of cultivation, burning or destruction of forest for shift cultivation, excessive grazing by animals, inadequate precipitation etc. As a result, vegetation cover is reduced and soils are exposed to erosion. Thereby fissures and gullies are formed within cultivated areas through which rain water flows and carries away the fertile soil. There is thus a need for a scientific approach for implementing soil conservation measures. To begin with the task of reviving unproductive land into productive land, proper and improved technology of plantation vis-a-vis protection of land against varieties of erosion can lead to a successful programme of afforestation in this district. Vast tract of waste land needs reclamation. The moisture retention capacity of the degraded land has to be restored by suitable engineering skill and schemes. Groundwater development plays an important role in forest development

### **5.2.1 Problems related with the Dewatering of Phreatic Aquifer Due to Mining of Coal**

Sohagpur coal field is the main coal mining area of the district. There are 71 village which fall in the various coal fields of the district. These are identified for the problem of depletion in the general water table and decline in the tube well discharge. Gondwana formation particularly the upper part of Barakar Sandstone support development of phreatic aquifers which extends from few metres below ground level to 25 m below land surface. Underground and opencast excavations behave as large sinks and create hydraulic gradient towards the mine. Mine water is pumped out for trouble free mining operations. Continuous withdrawal of water from Coal mines for their mining activities is causing adverse impact on ground water regime of the area which ultimately results in declining water levels, drying up of wells, dwindling of their discharge and some times land subsidence. As per Central Mine and Design Institute, Bilaspur, in Sohagpur Coalfield area daily 29,890 cubic metre water is being pumped for trouble free mining operations. Out of 29,890 cubic metre water per day, 9,869 cubic metre is used for domestic water supply, 2,667 cubic metre is used for mine industry and balance 21,223 cubic metre water per day goes as discharge runoff. These figures indicate that such a huge quantity of important ground water resource go as waste.

Strict water management practices should be adopted for the coal-mining belt. Abandoned mines can be treated as a big rainwater harvesting and artificial recharge structure. Hence, priority needs to be given for mine water harvesting and sustainable development. In post-mining, the abandoned mine voids should be backfilled to serve as huge groundwater reservoirs and recharge structures. In open cast mines, the permeability of the reclaimed area is usually higher than the in-situ and allows to infiltrate up to 40% of rainfall. These areas can be the major water pockets for future development. Thus, with proper water management, by mining out one resource 'Coal', another valuable resource 'Water' may be generated. Coal mining can an eco-friendly engineering activity by adopting groundwater resource management.

## **6.0 RECOMMENDATIONS**

Based on the hydrogeological studies the following recommendations are made for proper development and utilization of the available groundwater resources and management of ground water resources.

Shahdol comes under safe category from ground water development point of view. Net Groundwater Availability for future irrigation development is 79336 ham. There is ample scope for development of groundwater for irrigation, industrial and domestic purposes.

Groundwater development should be carried out in the district in a planned manner for agricultural development, industries and afforestation. Groundwater development and management is also an important measure for drought mitigation.

Detailed hydrogeological surveys for proper source of drinking water supply is to be investigated in villages which have no source of drinking water, in villages where tube wells failed and villages where yield dwindles in the summer as also in 75 villages affected due to coal mining activities and 10 villages where piped water supply schemes are to be strengthened and in villages which are partially covered.

The areas, where tubewells are to be constructed, should be geophysically surveyed since these recommendations are based on the hydrogeological surveys on regional scale and furnished a broader picture of hydrogeological conditions in the district.

These areas are recommended for dugwells having depth of 12-15 mbgl and 8-10 m diameter. Horizontal boring is recommended in the dugwells constructed in valley portions to enhance the yields of the wells.

In some watershed areas, where deforestation has occurred and soils are exposed to erosion, watershed management may be adopted by constructing gully plugs, contour bunding and artificial recharge structures after detailed micro level surveys, to increase retention of soil moisture, stop soil erosion and increase the ground water potential. Stop dams are recommended across the streams sections near villages, so that the stored water can be used for domestic purposes in the tribal pockets.

Strict water management practices should be adopted for the coal-mining belt. Mines can be treated as a big rainwater harvesting and artificial recharge structure. Hence, priority needs to be given for mine water harvesting and sustainable development.

In post-mining, the abandoned mine voids should be backfilled to serve as huge groundwater reservoirs and recharge structures.

In open cast mines, the permeability of the reclaimed area is usually higher than the in-situ formations and allows infiltration up to 40% of rainfall. These areas can be the major water pockets for future development. Thus, with proper water management, by mining out one resource 'Coal', another valuable resource 'Water' may be generated.

Coal mining can be an eco-friendly engineering activity by adopting groundwater resource management.

---

**Compiled by-**  
Anu Radha Bhatia,  
Scientist 'B'

**Under the able guidance of –**  
Shri. R.N.Singh,  
Regional Director,  
Central Ground Water Board, North Central Region, Bhopal, M.P.

# DISTRICT GROUND WATER INFORMATION BOOKLET



## SHAHDOL DISTRICT MADHYA PRADESH



Ministry of Water Resources  
Central Ground Water Board  
North Central Region  
Government of India

JUNE, 2009

