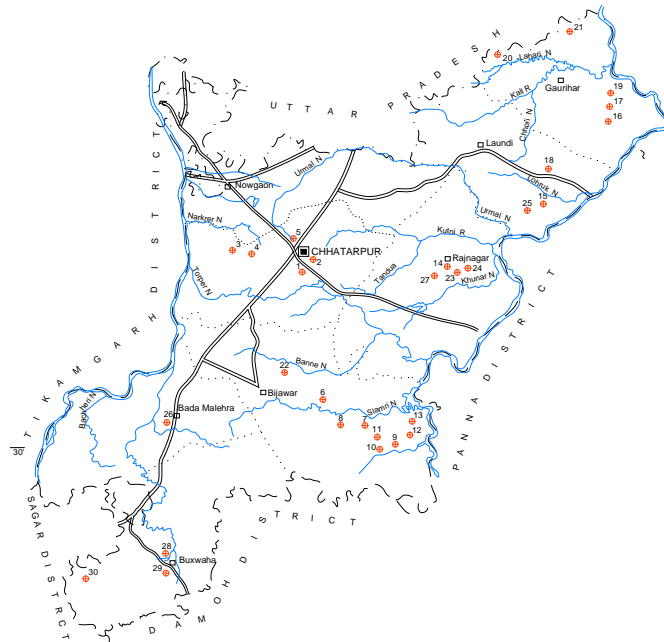


DISTRICT GROUND WATER INFORMATION BOOKLET



CHHATARPUR DISTRICT MADHYA PRADESH



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

MAY, 2009

CHHATARPUR DISTRICT AT A GLANCE

S. No.	Items	Statistic	
1	General Information		
	(i) Geological Area	8616.82 Sq. km	
	(ii) Administrative Division : (As on 2006)		
	Number of Tehsils	6	
	Number of Blocks	8	
	Number of Panchayat	558 Village & 8 Janpad Panchayats	
	Number of villages	1080	
	(iii) Population (As on 2001 Census)	14,74,723	
3	(iv) Average Annual Rainfall (mm)	1068.3	
2	Geomorphology		
	Major Physiographic Units :	Panna Range, Central Plateau and Northern Plains	
	Major Drainages	Yamuna Sub-basin of Ganga basin	
3	Land Use (2004-05)		
	(a) Forest Area	1826.95 Km ²	
	(b) Net area sown	4038.63 Km ²	
	(c) Cultivable area :	651.67 Km ²	
4	Major Soil Types	Alluvial, Red & Yellow, mixed red & black and medium black soils	
5	Area Under Principal Crops (As on 2004-05)	5113.09 Km ²	
6	Irrigation by Different Sources	Nos.	Irrigated Area (Sq.Km)
	Dug wells	66,980	1707.87
	Tube well/Bore wells	373	16.99
	Canala	45	204.66
	Tanks/Ponds	143	36.35
	Other Sources	-	280.04
	Net Irrigated Area	-	2265.81
7	Number of Ground Water Monitoring Wells of CGWB. (As on 31.3.2007)		
	No. of Dug Wells	27	
	No. of Piezometers	7	
8	Predominant Geological Formations :	Recent Alluvium, Deccan Traps, Vindhyan, Bijawar & Granite	

9	Hydrogeology	
	Major Water Bearing Formation.	Recent Alluvium, Deccan Traps, Vindhyan, Bijawar & Granite
	<p style="text-align: center;">Pre-Monsoon Depth to water level during 2006</p> <p style="text-align: center;">Post-Monsoon Depth to water level during 2006</p> <p style="text-align: center;">Long Term water level trend in 10 years (1997-2006)</p>	<p style="text-align: center;">4.50-14.57 mbgl</p> <p style="text-align: center;">2.57-12.55 mbgl</p> <p style="text-align: center;">Rising trend during- Pre-monsoon 0.006 to 0.202 m/year Post-monsoon 0.01 to 0.22 m/year</p> <p style="text-align: center;">Falling trend during- Pre-monsoon 0.06 to 0.33 m/year Post-monsoon 0.01 to 0.61 m/year</p>
10	Ground Water Exploration by CGWB (As on 31.3.2007)	
	No. of wells drilled EW	49
	Depth range (m)	120.42 to 200 m
	Discharge (lps)	0.50 to 8.00 lps
11	Ground Water Quality	
	Presence of chemical constituents more than permissible limit. (e.g. EC, F, As, Fe)	EC less than 1000 μ S/Cm at 9 villages NO ₃ less than 45 mg/l in 50% samples, Laundi has high F (2.65 mg/l)
	Type of Water	Alkaline C ₂ S ₁ & C ₃ S ₁
12.	Dynamic Ground Water Resources (2004)	
	Annual Replenishable Ground Water Resources	948.41 MCM
	Net Annual Ground Water Draft	536.10 MCM
	Projected Demand for Domestic and Industrial uses upto 2025	30.43 MCM
	Stage of Ground Water Development	57%
13	Awareness and Training Activity	
	Mass Awareness Programme organized No. of Participant	At Chhatarpur 120

1.0 Introduction

Chhatarpur district is located on the central portion on the plateau of Bundelkhand in M.P. the district is spread over an area of 8616.82 sq. km and is located at the northern boundary of the state, lying between north latitudes 24⁰ 06' and 25⁰ 20' and east longitude 79⁰ 59' and 80⁰ 26 falls under the survey of India toposheet No. 54O, 54P, 63D. The district is bounded by Mohaba district U.P in the north, Panna district, in the east Tikamgarh district in the west and Sagar & Damoh district in the south (fig.-1)

The district is divided into six Tehsil (Gaurihar, Loundi, Nowgaon, Chhatarpur, Rajnagar, and Bijawar) and eight development blocks (Gaurihar, Loundi, Nowgarn, Chhatarpur, Rajnagar, Bijawar, Badamalhera & Buxwaha). There are 1080 inhabited villages in the district (Table- 1).

As per census 2001, the total population of the district is 147423 out of which 1150428 belong to rural areas. The scheduled caste & scheduled tribes population is 342990 & 51593 respectively.

Table – 1 : Administrative Units of Chhindward district.

S. No	Tahsils	S. No	Blocks	Area in Sq. km
1	Gaurihar	1	Gaurihar	888.47
2	Loundi	2	Loundi	787.99
3	Nowgaon	3	Nowgaon	800.83
4	Chhatrpur	4	Chhatrpur	1042.32
5	Rajnogar	5	Rajnogar	1373.83
6	Bijawar	6	Bijawar	1535.22
		7	Badamalheva	1080.85
		8	Buxwaha	785.02
			Total Area	8616.82

The district as a whole lies in the Yamuna sub basin of the Ganga basin and traversed by the left bank tributaries of the Ken & the right bank tributaries of the Dhasen. The catchment area of Ken Dhasen rivers falling in the district are 6033.15 Sq.km and (69.99%) and 2594.25 Sq. km (30.10%) respectively.

Crops

Paddy, Jowar, Maize, Tuar, Urad, Til groundnut Soyabean, Sugarcane (Kharif) and wheat, Gram, Alsi, Muster, Rai & Vegetable (Rabi) are the main crops. The total irrigated area is 2265.81 sq. km of which 204.66 sq km irrigated by canals, 16.99 sq. km by tube wells and 1707.87 Sq. Km by open wells.

Activities Carried out by CGWB

- Shri U. I. Pitale (GSI) carried out reconnaissance hydrogeological survey of Chhatarpur district during field season 1971-72.
- Shri A. Mukkerji (CGWB) carried out systematic hydrogeological survey around Buxwaha during 1984-85.
- Shri. R. N. Sharma (CGWB) Carried out systematic hydrogeological survey in parts of Bijawar & Rajnagar blocks during 1985-86.
- Shri Babu Nair, (CGWB) Carried out integrated ground water development & management studies during AAP 1998-99 in Gourihar, Loundi & Rajnagar blocks.
- Shri. A. K. Budhaliya (CGWB) carried out detailed hydrogeological investigation for hard core source finding villages for Kishangarh block in the year 2001.
- Shri. M.L. Parmar and Shri. Rakesh Singh attended contractual drilling operation in the district during year 2002- 2005.

2.0 Rainfall and Climate

- A hot summer and general dryness except during the South west monsoon season. The year may divided into four season. The cold season. December to February is followed by hot season from March to middle of June. The period from middle of June to September in the south west monsoon season. October and November from the post monsoon or transition period. The nearest IMD observatory in Nowgaon.
- The normal annual rainfall of Chhatrpur district is 1068.3 mm. the district receives maximum rainfall during south west monsoon period i.e. June to September. About 90.2% of the annual rainfall received during monsoon season. Only 9.8% of the annual rainfall takes place between October to May period.
- The normal maximum temperature received during the month of May is 42.3⁰C & minimum during the month of January is 7.1⁰ C the normal annual means maximum & minimum temperature of Chhatarpur district is 32.7⁰ C and 18.1⁰ C respectively.
- During the south west monsoon season the relative humidity generally exceeds 88% (August month) & the rest of the year is drier. The driest part of the year is the summer season, when relative humidity is less than 30% may is the driest month of the year.
- The Wind velocity is higher during the pre-monsoon period as compared to post monsoon observed during the month of June and minimum 1-8 km/hr. during the month of November. The average annual wind velocity in the district is 4.1 km /hr.

3.0 Geomorphology and Soil Types

Physiographically the district has been divided broadly in to three main geomorphic units. The Panna range, the central plateau & northern plains range which traverses district in a south west north east direction. This range separates the upper Bundelkhand from lower bundelkhand plateau. Overlying the archeans is if formed by Bijawar and vindhyan beds which are highly folded and are also dissected by the superimposed drainage system.

The highest peak likes at Ban pathar ($24^{\circ} 37'$: $79^{\circ} 45'$) in the district at 607 m amsl. The central plateau runs to the north as an offshoot of Panna range. It lies mainly on the Bundelkhand granites & forms the central sub water divide. The give way to lower plains along the ken and Dhasan in the east & west respectively. The northern plateau lies between 150 to 300 m amsl & covers nearly the whole of loundi Tehsil. It is covered by varying thickness of alluvium but is cut in ravines resulting in “bad land” topography.

The soils in the district are generally of classified in four groups viz alluvial soils which occurs in north eastern part of the district. Red and yellow soil in north eastern parts mixed red & black yellow soil in central part and medium black soil in the south western extreme of the district.

4.0 Ground Water Scenario

4.1 Hydrogeology

(i) Aquifer System

About 65% of the district is occupied by Bundelkhand granite in northern & north central part with a thin soil cover. The granite is pink in colour, medium to coarse grained porphyiatic in texture. It is very hard & compact with well developed joints. The joints are open at the surface and persist to about 20 m below land surface. However, beyond 45m these arevery tight, thus restricting the storage and movement of ground water. The depth of weathering is as high as 20m in areas where the granite in coarse grained & well jointed. The granite country in the district is traversed by quartz reef and basic dykes. The basic dykes generally occupy topographic depression where as quartz reefs stand out as wall like structure. From the ground water important & act as surface water barriers leading to prominent surface water tanks and also act as ground water barriers Bundelkhand granites are overlain by the rocks of Bijawar beries.

The exposure of Bijawars triangular in shape and constitute about 15% of the south eastern part of the district. The vindhyans are exposed in the form of NE-SW trending strike ridges and alternating valley in the southern part of the district these occupy about 20% of the district areas represented by conglomerates, sandstone, shale and limestone in a sequence. Exposure of Deccan trap flows are seen in the south western extremity of the district. Alluvium is restricted mainly to the area along the ken and Dhasan on the left bank of ken it has maximum thickness of 30 m and along Dhasan, it has maximum thickness of 10m.

Ground water in granites occurs in joints, fractures planes and in weathered zone mostly under water table conditions and its occurrence is controlled by extent, size and interconnection of joints and degree of weathering which varies from place to place and under favourable conditions tube wells having discharge of 0.5 to 7.8 lps. Bijawar limestone, where Karst and well developed solution cavities are available are quite promising from ground water point of view. Vindhyan sandstone and limestone when occurring at lower deviation and having well developed joints, yield moderate amount of ground water generally below 3 lps. The semri limestone at places, has well developed and inter connected solution opening and ground water occurs under confined conditions. The yield recorded in vindhyans and Bijawar formation ranges from 1.8 lps to 9.5 lps(Table-7).

Ground water in the deccan traps also occurs in the weathered mantle in joints and fracture under water table conditions and can sustain well having upto 2 lps discharge ground water in the alluvium also occurs under water table conditions. The grain size of Dhasan alluvium is coarser as compared to ken alluvium and thus Dhasan alluvium can sustain tube wells having discharge upto 15-20 lps and tube wells of ken alluvium have discharge in range of 10-15 lps (fig. – 2).

(ii) Water Levels

Water level data, including historical data are essential for not only to know the present ground water conditions but also for forecasting future trends in response to ground water reservoir operations. Using the water level data of 26 monitoring well of Chhatarpur district. Pre and post monsoon depth to water level maps are reproduced.

Pre Monsoon (May 2006)

Pre-Monsoon depth to water level in the year 2006 range from 4.5 to 14.57 mbgl. Shallow water level (< 6.00 m) occurs north eastern and south eastern part of the district. Water levels between 6.00 – 12.00 mbgl is observed in northern and southern part the deepest water level 14.57 mbgl was recorded at Khairkalan.

The longterm water level trend (1997-2006) shlows declining trend ranges from 0.06 to 0.51 m/year (pre monsoon) water level fall is noticed in all block where a large scale withdrawl of ground water for irrigation purpose is observed (Fig-3).

Post Monsoon November 2006.

During post monsoon period, water level ranges from 2.57 to 12.55 mbgl shallow water level (< 5 mbgl) occurs in northern central & southern parts while deep water levels (710 mbgl) observed in north west and past. The deepest water level of 12.55 mbgl was recorded in the well at Maharajpur. (Fig-4.) water level fluctuation between pre and post monsoon period ranges from 0.10 to 9.45. m.

4.2. Ground Water Resources :

The Entire district command and non command areas falls under safe category, except Chhatarpur block table – 5. which is falling under semi critical category where stage of ground water development is 84%.

The net annual ground water available in the district is 948.41 MCM and draft form all uses is 53610 Ham net Ground water availability for future irrigation use is 40698 MCM. (Table -5) and shown in Fig-5.

4.3 Status of Ground Water Development

1. Rural & Urban water supply

Ground Water is the main source for drinking water supply both in rural and urban areas and is supplementing the surface water supply schemes more or less all the villages in the district falling under the category of problem villages or drinking water scarcity villages. A total number of 1064 villages have 7600 shallow tube wells fitted with hand pumps are operational of provide drinking water & 64 villages having piped water supply schemes through tube wells during the year 2001. & 2005. The CGWB carried out accelerated exploration of ground water (on contractual basic) drought effected district and drilled 49 bore holes for urban and rural areas of Chhatrpur district between depth range of 140 to 200 mbgl. (Table-7).

2. Ground Water Development for Irrigation

Ground Water development for irrigation is through dug wells, dug cum bore wells and shallow bore wells. There are 66980 dug wells, dug cum bore well and 373 shallow bore wells in the district to irrigate 1724.86 sq km agriculture land the depth of irrigation open well ranges from 6.00 to 22.00 mbal and yield ranges from 45 to 240 m³/day. Farmer generally use diesel / electric engines with 3.00 to 5.00 HP on dug wells and submersible pumps on bore well to lift water for irrigation purpose. Rocks of Archean granite, Bijawar, Vindhyan deccan traps alluvium mainly occupy the district area. By looking into the characteristic of rock formation, it is felt suitable rig for the area is DTH preferably having rotary / DTH system.

The tube well tapping the top weathered portion as well as deeper joints and fracture should have a 200 mm diameter assembly with 1.60 mm slots in the weathered portion and the bore hole can be left naked below the weathered zone. The naked portion of the bore hole should also be developed properly through hydro fracturing.

Table-4 : STAGE OF GROUND WATER DEVELOPMENT OF MADHYA PRADESH AS ON 31ST MARCH,2004

Assessment Unit/District	Command/ Non command/Total	Net Annual Ground Water availability (MCM)	Existing Gross Ground Water Draft for Irrigation (MCM)	Existing Gross Ground Water Draft for Domestic & Industrial Water Supply (MCM)	Existing Gross Ground Water Draft for all uses (4+5) (MCM)	Allocation for domestic & Industrial requirement supply upto next 25 yrs. (MCM)	Net Ground Water availability for future Irrigation Development (MCM)	Stage of Ground Water Development (6/3)x100 (In %)
1	2	3	4	5	6	7	8	9
CHHATARPUR								
Bada Malhara	Command	10.31	0.64	0.13	0.77	0.15	9.52	7
	Non- Command	98.47	57.76	2.92	60.68	3.33	37.38	62
	Block Total	108.78	58.40	3.06	61.45	3.48	46.90	56
Chhatarpur	Command	18.61	1.15	0.06	1.21	0.19	17.26	7
	Non- Command	125.16	101.64	3.69	105.33	4.23	19.29	84
	Block Total	143.77	102.79	3.75	106.54	4.42	36.55	74
Laundi	Command	-	-	-	-	-	-	-
	Non- Command	91.36	35.14	3.47	38.61	3.92	52.30	42
	Block Total	91.36	35.14	3.47	38.61	3.92	52.30	42
Rajnagar	Command	27.98	4.95	0.79	5.75	1.23	21.79	21
	Non- Command	137.68	97.95	3.92	101.87	6.08	33.65	74
	Block Total	165.66	102.90	4.71	107.62	7.31	55.44	65
Nowgaon	Command	0						
	Non- Command	156.03	98.71	3.45	102.16	4.04	53.28	65
	Block Total	156.03	98.71	3.45	102.16	4.04	53.28	65
Gaurihar	Command	0						
	Non- Command	83.71	9.26	3.18	12.43	3.43	71.03	15
	Block Total	83.71	9.26	3.18	12.43	3.43	71.03	15
Bijawar	Command	0						
	Non- Command	117.27	49.16	2.43	51.59	2.62	65.49	44
	Block Total	117.27	49.16	2.43	51.59	2.62	65.49	44
Buxwaha	Command	0						
	Non- Command	81.84	54.65	1.04	55.68	1.22	25.98	68
	Block Total	81.84	54.65	1.04	55.68	1.22	25.98	68
	DISTRICT TOTAL	948.41	511.00	25.10	536.10	30.43	406.98	57

Table-5: Chemical Quality of Ground Water in Chhatarpur District (2006)

S.N.	Village	PH	EC	CO ₃	HCO ₃	Cl	SO ₄	NO ₃	F	PO ₃	TH	Ca	Mg	Na	K	RSC	SAR
CHHATARPUR																	
1	Harpalpur	7.22	902	0	464	32	6	14	0.97	0.53	320	96	19.57	66	1.20	1.2	1.6
2	Ghuara	6.89	732	0	317	35	25	28	0.58	0.45	225	66	14.67	70	1.20	0.7	2.03
3	Sadwa	7.39	848	0	342	43	23	58	0.50	0.80	285	84	18.34	66	0.90	-0.09	1.7
4	Sendpa	7.3	831	0	293	46	47	60	0.35	0.36	335	122	7.44	39	1.00	-1.9	0.93
5	Buxwaha	7.51	935	0	329	50	42	87	0.52	0.28	335	76	35.35	69	1.30	-1.31	1.64
6	Bijawar	7.2	1352	0	409	170	50	51	1.04	0.18	410	158	3.84	136	1.00	-1.5	2.92
7	Gulganj	7.46	413	0	189	18	11	9	0.34	0.31	135	50	2.49	37	0.80	0.4	1.39
8	Khair Kalan	7.33	459	0	226	25	4	10	0.34	0.49	155	54	4.93	37	3.60	0.6	1.29
9	Raipura	7.27	1244	0	451	78	68	81	0.37	0.32	355	132	6.24	128	6.00	0.29	2.96
10	Tapra	7.37	527	0	256	21	2	15	0.31	0.51	195	68	6.16	36	1.40	0.3	1.12
11	Issanagar	7.61	914	0	329	82	72	5	0.65	0.29	295	50	41.39	81	4.50	-0.51	2.05
12	Maharajpur	7.44	788	0	287	78	18	23	0.53	0.72	285	102	7.42	60	1.60	-1	1.55
13	Mankari	7.54	802	0	397	25	10	24	1.40	0.12	270	82	15.90	62	1.30	1.11	1.64
14	Matgawan	7.50	779	0	323	43	25	55	0.46	0.67	265	86	12.26	64	0.40	-0.01	1.71
15	Niwari	7.34	1417	0	384	199	60	48	1.10	0.19	385	126	17.17	160	0.90	-1.41	3.55
16	Sarwai	7.32	1609	0	409	191	77	138	0.31	0.47	425	126	26.90	184	2.90	-1.8	3.88
17	Chandla	7.56	748	0	336	50	12	18	0.65	0.31	285	70	26.83	47	0.40	-0.19	1.21
18	Laundi	7.23	1685	0	372	216	130	106	2.65	1.12	470	164	14.79	178	1.00	-3.3	3.57
19	Kukrel	7.41	833	0	348	53	26	41	1.43	0.28	320	90	23.21	53	0.60	-0.7	1.29
20	Nowgaon	7.31	1397	0	439	135	60	89	0.37	0.62	325	104	15.93	180	1.50	0.7	4.34
21	Putaria	7.41	871	0	366	43	44	31	0.69	0.12	270	80	17.12	75	5.60	0.6	1.99
22	Tamtapur	7.24	1489	0	354	149	80	187	0.91	0.17	615	184	37.91	56	8.90	-6.5	0.98
23	Chandranagar	7.52	894	0	366	67	22	26	0.76	0.71	315	70	34.12	67	2.50	-0.3	1.64
24	Ganj	7.49	1037	0	323	99	35	83	0.84	0.17	245	84	8.61	134	1.00	0.39	3.72
25	Kurri	7.24	1153	0	421	71	82	38	1.13	1.39	420	90	47.52	77	3.60	-1.5	1.63

Table-6: Details of Exploratory Wells constructed by Contractual Drilling under Drought Assistance in Chhatarpur District.

S. N.	Location	Month of Construction	Depth Drilled (m)	Zone Tapped	Geology	SWL (mbgl)	Tested Discharge (lps)	Draw Down (m)	Chemical Quality
1	Bada Malhara	Jan-2002	200	9.00 - 14.00 30.00 - 39.00 149.00 - 160.00	Granite	3.17	7.8	-	Good
2	Bandha	Jan-2002	200	12.00 - 14.00 (1 lps) 84.00 - 89.00	Granite	3.40	1.0	2.05	Good
3	Bhagwa	Jan-2002	120.42	7.45 - 14.30 44.00 - 60.00 94.28 - 101.14	Granite	3.86	2.5	0.44	Good
4	Nainagir	Jan-2002	200	12.00 - 14.00 (1 lps)	Granite	3.37	0.6	22.0	Good
5	Buxwaha	Jan-2002	200	32.00 - 39.00 66.00 - 73.00	Granite	11.04	0.7	11.04	Good
6	Bamnora	Jan-2002	183.40	12.50 - 14.00 (0.5lps) 28.00 - 31.00 (0.5lps) 64.00 - 66.00	Sand Stone	5.89	0.7	17.0	Good
7	Kishangarh	Jan-2002	200	-	Bijawar/ Shale/S.Stone	19.1	1.0	0.91	Good
8	Garhi Malhara	Jan-2002	200		Granite		Dry	-	Good
9	Tatam	Jan-2002	200	21.00 - 32.59 41.00 - 48.00 169.00 - 174.00	Granite	7.36	1.0	0.91	Good
10	Khajwa	Jan-2002	200	14.00 - 32.00 46.00 - 53.00 96.00 - 105.00	Granite	7.58	1.0	3.89	Good
11	Karri	Jan-2002	200	142.00 - 155.00	Bijawar/ Shale/S.Stone	46.0	1.8	-	Good
12	Mehrakuan	Jan-2002	168.84	67.00 - 75.00	Granite	14.81	1.8	-	Good
13	Garda	Jan-2002	200		Bijawar/ Shale/S.Stone		Dry	-	Good
14	Ganj	Jan-2002	200	8.00 - 9.50 (1.5lps) 12.50 - 14.00 (0.5lps)	Granite	5.74	1.0	1.94	Good
15	Khera Kalan	Jan-2002	190.42	32.50 - 37.00 (1.0lps)	Granite	10.80	0.8	-	Good
16	Jata Shankar	Jan-2002	200	21.00 - 30.00	Bijawar/ Shale/S.Stone	4.75	1.0	-	Good
17	Amkhera	Jan-2002	160	12.00 - 14.00	Granite	7.79	0.5	-	Good
18	Nayagaon Hatwa	Jan-2002	192.54		Granite	5.60	1.0	24.0	Good
19	Kurra	Jan-2002	200	14.50 - 17.00	Granite	5.49	1.0	2.86	Good

4.4 Ground Water Quality of Chhatarpur District

Ground water quality in Chhatarpur district is assessed annually by CGWB on the basis of analysis of ground water samples collected from 25 no. of hydrograph stations in the district. On the basis of examination of data for the year,2006(Table-4), the water quality is described as follows-

Quality of Ground Water for Drinking purpose-

The pH value of water samples of all the stations(ranging from 6.89-7.61) did not show significant variations and all the values were within permissible limit(6.5-8.5) as set by BIS-1991. The EC values were found to be in the range of 413 and 1685 $\mu\text{S}/\text{cm}$. The EC values exceeding BIS limit(1000 $\mu\text{S}/\text{cm}$) were noticed at 9 villages i.e. Laundi(highest 1685 $\mu\text{S}/\text{cm}$), Sarwai(1609 $\mu\text{S}/\text{cm}$), Tamtapur (1489 $\mu\text{S}/\text{cm}$), Niwari(1417 $\mu\text{S}/\text{cm}$), Nowgaon(1397 $\mu\text{S}/\text{cm}$), Bijawar(1452 $\mu\text{S}/\text{cm}$), Raipura(1244 $\mu\text{S}/\text{cm}$), Kurrai(1153 $\mu\text{S}/\text{cm}$) and Ganj(1037 $\mu\text{S}/\text{cm}$). The Anion chemistry shows that none of the well had abnormal concentration of more than 250 mg/l chloride as safe loimit fixed by BIS-1990. The concentration of Nitrate exceeding 45 mg/l (BIS-1990) were reported in 50% wells with highest as 138 mg/ l of Sarwai village. The possible cause of pollution is excessive use of Nitrogenous Fertilizers followed by improper disposal of sewage. A scrutiny of data shows that only one well of Laundi village had 2.65 mg/l Fluoride greater than 1.5 mg/l of BIS-1990 limit. No Arsenic content was detected in ground water of the district as per the analysis carried out in 2003.

Quality of Ground Water for Irrigation purpose-

In classification of water for irrigation purpose, it is assumed that the water will be used under average conditions with respect to soil texture, infiltration rate, drainage and climate. The chemical data of all the water samples pertaining to Chhatarpur district were plotted on U.S. salinity laboratory diagram. It is clear that nearly 20% wells of the study area namely Ghuara(2), Gulganj(7), Khair Kalan(8),Tapra (11) and Chandla(18) were observed under C2-S1 class(Medium salinity & low Sodium) which means that these water can be used for irrigation purpose without any fear for most of the crops with no chances of development of soil salinity. The remaining wells were observed under C3-S1 (High salinity & low sodium) class. These water can be used on soils with restricted drainage. Special Management practices are required for salinity control. Salt tolerance crops may be grown.

5.0 Ground Water Management Strategy

Although all the blocks of the district area, except Chhatarpur block, categorized safe irrigation by ground water is developing fast in the recent decades. Farmers are seen constructing well for irrigation purpose without much consideration of well spacing and recharging resulting in adverse impact on the ground water regime in some of the water sheds, which has caused the water levels to deplete declining trend of water levels in noticed in about 75% wall of NHS of the district. As the phreatic aquifer started yieldin less, farmer started to dig the well down to deeper levels annual growth rate in th area irrigated by ground water is increasing at almost 4% per annum. With the increase in ground water development every year the ground water resource of the district are likely to become over development in about a decade and may be even earlier in case of successive drought years.

The topography and soil cover, as well as underlying rocks, in Chhatarpur district are such which forces most of the rainfall to go as runoff instead of recharging the aquifers. It is thus essential that available resources are utilized judiciously as well as conserved properly. To achieve this, it is essential to recharge the ground water body i.e. aquifer water shed wise.

The thickness of alluvium of the occurrence & thickness of weathered factured granite below it along ken and Dhasan should also be ascertained accurately, so that the tube wells/ dug wells could be located at suitable sites.

The limestone units in Bijawar also hold promise for ground water development where well development solution opening in strike and ip aligment are water bearing. The area between Bhimkheda ($24^{\circ} 26' : 79^{\circ} 22'$) and Arjunkund ($24^{\circ} 26' : 79^{\circ} 12'$) hold promises for development of ground water.

6.0 Recommendations

Chhatarpur district by & large underlain by hard rock terrain and alluvial deposits of only limited thickness are confined to the ken and Dhasan the hard rock terrain do not allow much water to percolate through. However artificial recharge measures would increase the ground water potential. To harness the available as well as the increased storage of ground water location of suitable areas for construction of ground water abstraction structures has to be based on scientific studies.

The hydrogeomorphological and hydro geological maps plays a vital role in such studies. The lineaments shown are weak ones where the water holding and transmitting capacity of the underlying rocks is relatively higher than the surrounding areas. The lineaments, where ever cross each other is still more important since the intersection points is the most potential area for ground water. Such intersecting areas have been plotted on fig – 4. these areas are promising for ground water development. However before construction of an abstraction structures, it is required that detailed hydrogeological investigation coupled with surface electrical resistivity surveys be also taken up to demarcate the most potential area.

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Table-2 : Water Level Trend Report (1997 to 2006)

Block	Village	Pre Monsoon		Post Monsoon	
		Rise m/Yr.	Fall m/Yr.	Rise m/Yr.	Fall m/Yr.
1	2	3	4	5	6
NOWGAON	KukreJ		0.18	-	0.26
NOWGAON	Putaria		0.09		0.16
NOWGAON	Nowgaon	-	0.32	-	0.55
ESHANAGAR	Mlaharajpur	-	0.28	-	0.58
NOWGAON	Tatampur	-	0.27	-	0.44
ESHANAGAR	Mankari	0.202	-	-	0.61
ESHANAGAR	Issanagar	-	0,07	-	0.37
ESHANAGAR	Matgawan	-	0.12	-	0.34
ESHANAGAR	Niwari	-	0.51	-	0.21
ESHANAGAR	Chhatarpur	-	-	-	0.61
RAJNAGAR	Kurri	-	0.11	-	0.04
RAJ NAG AR	Khajuraho	-	0.23	-	0.13
RAJNAGAR	Ganj	-	011	-	0.06
BADA	Ghuara	-	0,1	-	0.18
BIJAWAR	Gulganj	-	0.12	-	0.3
BIJAWAR	Bijawar	-	0.24	-	0.38
BADA	Sendpa	0.054	-	-	01
BIJAWAR	Tapra	-	0.06	0,07	-
BIJAWAR	Khair kalan	0.08	-	-	0.09
RAJNAGAR	Chandra nagar	0.093	-	-	0.14
BADA	Sadwa	0006	-	0.01	-
BIJAWAR	Raipura	0042	-	-	0.01
BAK3WAHA	Buxwaha	-	0,14	0.22	-
GALJRIHAR	Gaurihar	0.018	-	-	0.48
LAUNDI	Laundi	-	0.33	-	0.25
LAUNDI	Chandla	-	0.19	-	0.21
GAURJHAR	Sarwai	-	0.12	-	0.13

Table-3 : Depth to Water Level

BLOCK	VILLAGE	DEPTH TO WATER LEVCL (m.b.g.lj)				DECADAL AVERAGE OF WATER LEVEL (m.b.g.L) (1996-2005)			
		May'06	Aug'06	Nov'06	Jan'06	May'06	Aug'06	Nov'06	Jan'06
BADA MALHARA	Ghuara	9.38	3.25	7.85	8.87	8.77	2.91	4.25	6.07
BADA MALHARA	Sadwa	6.13	2.90	3.98	4.91	6.13	3.94	3.94	4.04
BADA MALHARA	Sendpa	8	0.40	4.34	6.10	8.81	1.57	3.82	6.00
BAKSWAHA	Buxwaha	13.2	2.42	9.52	12.00	12.45	3.21	7.80	10.07
BIJAWAR	Bijawar	9.44	7.40	8.94	11.40	7.90	4.48	5.26	6.57
BIJAWAR	Gulganj	9.6	4.62	7.78	9.36	9.24	3.15	3.86	6.14
BIJAWAR	Khair kalan	14.57	9.98	11.83	14.88	14.76	8.97	9.47	11.58
BIJAWAR	Raipura	4.5	0.58	2.57	3.25	5.75	-	2.95	3.61
BIJAWAR	Tapra	7.89	6.52	8.57	9.22	8.12	5.56	7.50	8.20
ESHANAGAR	Chhatarpur	-	7.72	-	8.73	-	4.18	-	7.14
ESHANAGAR	Issa Nagar	10.51	8.60	10.32	11.08	8.47	5.44	6.04	7.25
ESHANAGAR	Maharajpur	13.25	12.15	12.55	13.90	10.93	7.00	6.15	8.05
ESHANAGAR	Mankari	6.3	5.98	7.15	9.90	5.14	3.54	3.94	5.96
ESHANAGAR	Matgwan	10.45	9.05	10.35	12.35	9.45	5.49	6.08	7.89
GAURIHAR	Niwari	14.70	1.63	5.25	7.20	7.16	2.25	2.84	4.96
GAURIHAR	Gaurihar	4.98	7.58	9.22	10.80	7.60	-	4.17	4.77
LAUNDI	Sarwai	4.8	1.20	3.12	5.80	5.33	1.29	1.87	4.25
LAUNDI	Chandla	7.45	5.65	6.72	7.60	6.69	2.79	3.28	4.25
NOWGAON	Laundi	11.5	8.20	9.85	10.10	0.00	-	-	-
NOWGAON	Kukrel	9.6	5.00	9.60	9.60	7.19	4.07	5.44	6.76
NOWGAON	Nowgaon	11.03	8.45	9.10	8.87	8.61	6.04	5.32	6.46
NOWGAON	Putaria	9.65	6.85	8.78	9.78	8.59	5.84	6.88	7.94
NOWGAON	Tatampur	11.53	7.70	7.80	11.53	9.22	4.56	4.31	6.12
RAJNAGAR	Chandra Nagar	8.15	4.78	6.97	5.20	8.55	2.73	4.55	6.88
RAJNAGAR	Ganj	11.42	9.93	10.05	11.90	9.76	5.27	5.48	7.43
RAJNAGAR	Kurri	6.83	3.89	5.21	6.14	6.31	3.49	4.21	5.41

