DISTRICT GROUND WATER INFORMATION BOOKLET

FLUORIDE CONTAMINATION

AND

REMEDIATION

CHHINDWARA DISTRICT
MADHYA PRADESH

जल वर्ष 2007 Water Year 2007

स्वच्छ सुरक्षित जल – सुन्दर खुशहाल कल

CONSERVE WATER - SAVE LIFE

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

JULY, 2007

CHHINDWARA DISTRICT AT A GLANCE

S. No	ITEMS	STATISTICS	
1.	**GENERAL INFORMATION**		
	i) Geographical area	**11,815** Sq. Km	
	ii) Administrative Divisions (As on 31.03.2006) Number of Tahsil Block Number of Panchayat Number of Villages	 = 09 = 11 (4-Tribal) =808 =1984	
	iii) Population (As on 2001 Census)	18,48,882	
	iv) Average Annual Rainfall	1087.2 mm	
2.	**GEOMORPHOLOGY**		
	Major Physiographic units	1. Northern hilly region 2. Central high plateau region 3. Southern low grounds 4. Upland trough of *Jam & Kanhan* rivers	
	Major Drainages	Narmada and Godavari basins	
3.	**LAND USE**		
	a) Forest area:	2,002.44 Sq. Km	
	b) Net area sown:	6,093.67 Sq. Km	
	c) Cultivable area:	6,218.12 Sq. Km	
4.	**MAJOR SOIL TYPES**	Black cotton soil, Sandy loam and Clayey loam soil	
5.	**AREA UNDER PRINCIPAL CROPS (As on18.10.2006)**	6,093.67 Sq. Km	
6.	**IRRIGATION BY DIFFERENT SOURCES**	**Area irrigated**	**Number of Structures**
	Dug wells	814.26 Sq. Km	71415
	Tube wells/ Bore wells	211.68 Sq. Km	5029
	Tanks/ ponds	18.94 Sq. Km	45
	Canals	101.27 Sq. Km	61
	Others sources	66.30 Sq. Km	-
	Net irrigated area	1216.45 Sq. Km	-
	Gross irrigated area	1310.20 Sq. Km	-
7.	**NUMBER OF GROUND WATER MONITORING WELLS OF CGWB (As on 31- 3- 2007)**	No of Dug Wells=36 No of Piezometers =12	

8.	**PREDOMINANT GEOLOGICAL FORMATIONS**	Recent Alluvium, Deccan Traps Gondwanas and Archaeans (Sausar series)
9.	**HYDROGEOLOGY**	
	➢ **Major water bearing formation**	Archaeans (Gneisses, Schist, Granites& Pegmatite), Gondwanas, Deccan traps and Alluvium
	➢ **Pre- monsoon depth to water level range during 2006**	Min.= 3.65m, Max. =15.75m
	➢ **Post- monsoon depth to water level range during 2006**	Min.= 0.60m, Max. =15.00m
	➢ **Long term water level trend range in 10 yrs (1997- 2006) in m/yr**	Rising trend= 0.096 to 0.417m /year (Post monsoon) Declining trend= 0.007 to 0.524m /year (Pre monsoon)
10.	**GROUND WATER EXPLORATION BY CGWB (As on 31- 03- 2007)**	
	No of wells drilled (EW, OW, PZ, Total)	Exploratory Wells =31 Observation Wells = 08 Piezometers (H.P) =12 **Total = 51**
	Depth range (m)	35.60-201.30 m **(EW)**
	Discharge (liters per second)	0.10-10.00 lps
	Storativity (S)	-
	Transmissivity range	4.78 –32.00 m^2/ day
11.	**GROUND WATER QUALITY**	
	Presence of Chemical constituent more than permissible limit	Ground water in phreatic aquifer is potable but higher concentration of **fluoride** (1.60-**20.00** Mg/l) is noticed in deeper aquifers
	Type of water for irrigation purpose	C_3-$S_1$and C_3-S_2 Type (**Suitable for irrigation**)
12.	**DYNAMIC GROUND WATER RESOURCES (YEAR-2004)**	
	Annual Replenishable Ground Water Resources	1159.58 MCM
	Net Annual Ground Water Draft	558.96 MCM
	Projected Demand for Domestic and industrial Uses for next 25 years	59.13 MCM
	Stage of Ground water Development	51%
13.	**EFFORTS OF ARTIFICIAL RECHARGE & RAINWATER HARVESTING**	Recommended construction of artificial recharge structures in fluoride –affected areas
14.	**GROUND WATER CONTROL AND REGULATION**	
	Number of Semi-Critical Blocks	**1 - Chhindwara**
15.	**Major Ground water problems**	**Fluoride –affected District**

1.0 INTRODUCTION

Chhindwara district was formed on 1_{st} November 1956. It is located on the Southwest region of 'Satpura Range of Mountains'. The district is spread over an area of 11,850 Sq. km and is located at the southern boundary of the state, laying between North Latitudes 21^0 28' and 22^0 50' and East longitudes 78^0 15' and 79^0 25' falls under the Survey of India Topo Sheet No. 55 J, K, N, & O. The district is bounded by Narsinghpur and Hoshangabad district in the north, Seoni district in the east, Betul district in the west and by Maharashtra state in the south (Plate-1).

The District is divided into 9 Tahsils (Chhindwara, Tamia, Parasia, Jamai, Chourai, Amarwara, Sausar, Bichhua and Pandhurna) and 11 Development Blocks (Chhindwara, Mohkhed, Tamia, Parasia, Jamai, Amarwara, Harrai, Chourai, Sausar Bichhua, and Pandhurna). There are 1984 villages in the district, out of which 1903 villages are habitated (Table.1)

As per Census 2001, the total population of the district is 18, 48,882 out of which 76.90% belong to rural areas. The Scheduled Caste and Scheduled Tribes population is 2, 14,201 and 6, 41,421 respectively.

Table 1. Administrative units of Chhindwara district.

S. No.	Tahsils	Blocks	Area in Sq. km.
1	Chhindwara	Chhindwara	683
		Mohkhed	775
2	Tamia	Tamia	1538
3	Parasia	Parasia	787
4	Jamai	Jamai	1458
5	Chourai	Chourai	1172
6	Amarwara	Amarwara	1022
		Harrai	2107
7	Sausar	Sausar	808
8	Bichhua	Bichhua	528
9	Pandhurna	Pandhurna	972
		Total Area	**11850**

The district lies in parts of the Narmada and the Godavari basin, Wainganga sub basins. The total catchments areas of the Narmada & the Wainganga rivers falling in the district are 3,555 and 8,295 Sq. km respectively. The major tributaries of the Godavari River are Kanhan, Pench and Wardha, while Sakkar, Sitarewa, Dudh are tributaries of Narmada River

Crops: Paddy, Barley, Maize, Tuar, Urad, Soyabean, Sugarcane, Groundnut, Cotton (KHARIF) and Wheat, Gram & Vegetables (RABI) are the main crops. The total irrigated area is 1310.60 Sq. km., of which 101.27 Sq. km.was irrigated by canals, 211.68 Sq. km. by tube wells and 814.26 Sq. km. by open wells

Activities carried out by CGWB

The Scientists of Central Ground Water Board carried out Systematic Hydro geological Surveys during various Field Season Programmes:

- Sh. L.M. Mothghare during1978-79, 1979-80, &1984-85;Sh. P. Srinivasan during 1987-88; Sh. J.N. Rao, during 1978-79; Sh. A.B. Deshmukh & Seraj Khan, during 1987-88).

- Reappraisal Hydrogeolgoical Surveys were carried out by Sh. C. Paul Prabhakar Scientist-B, in Mohkhed, Chhindwara & Chourai blocks of Chhindwara district during Annual Action Plan 1991-1992.

- Ground water management studies were carried out by G. Bhaskara Rao, Scientist-C, in Mohkhed, Chhindwara & Chourai blocks of Chhindwara district during Annual Action Plan 1999-2000.

- Ground water management studies were carried out by G. Bhaskara Rao, Scientist-C, in Amarwara and Harrai blocks of Chhindwara district during Annual Action Plan 2000-2001.

- Ground water management studies were carried out by G. Bhaskara Rao, Scientist-C, in Tamia, Parasia, and Jamai blocks of Chhindwara district during Annual Action Plan 2001-2002.

- Ground water management studies were carried out by G. Bhaskara Rao, Scientist-C, in Bichhua, Sausar and Pandhurna blocks of Chhindwara district during Annual Action Plan 2002-2003.

- Exploratory drilling operations were carried out by the CGWB during AAP 1999-2000, 2000-2001and 2001-2002 in the entire district area (S/Shri D.K.Rai, A.K.Jain and S.K Shrivastava, Hydrogeologists attended drilling operations).

2.0 RAINFALL AND CLIMATE

A hot summer and general dryness characterize the climate of the area, except during the southwest monsoon season. The year may be divided into four seasons. The cold season, December to February is followed by the hot season from March to about the middle of June. The period from the middle of June to September is the south-west monsoon season. October and November form the post monsoon or transition period.

The normal annual rainfall of Chhindwara district is 1087.2 mm. The district receives maximum rainfall during south-west monsoon period i.e. June to September. About 85.7 % of the annual rainfall falls during monsoon season. Only 14.3 % of the annual rainfall takes place between Octobers to May period. Thus, surplus water for ground water recharge is available only during the southwest monsoon period.

The normal maximum temperature noticed during the month of May is 39.4^0 C and minimum during the month of December 9.8^0 C The normal annual mean minimum and maximum temperatures has been worked out as 18.2^0 C and 30.6^0 C respectively.

During the south-west monsoon season, the relative humidity generally exceeds 87% (August month) and the rest of the year is drier. The driest part of the year is the summer season, when relative humidity is less than 33%. May 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, 9.5 km/hr observed during the month of June and minimum, 3.3 km/hr during the month of November. The average annual wind velocity in is 5.4 km/hr.

3.0 GEOMORPHOLOGY AND SOIL TYPES

Physiographically the district has been divided broadly in to two main geomorphic units - one is Satpura plateau and other is Nagpur plateau. The hill ranges lying in the northern part of the district belong to the ***Mahadeo*** hill ranges of the Satpura mountains stretching nearly east-west. These hills form the water divide. The district can be further divided in to four parts. I) Northern hilly region II). Central high plateau region III). Southern low grounds IV). Upland trough of ***Jam*** and ***Kanhan*** rivers. Presence of fluvial units showing occurrences of alluvium in the flood plains of all major streams and rivers, buried pediplains showing denudational hills of sandstone as seen in western part of the district. Similarly structural hills, covered by Gondwanas, are seen in northern part, denudational hills in southern part and dissected Deccan plateau in eastern and northeastern parts of the district.

The soils in the district are generally of three types Viz., black cotton soil, sandy loam soil and clayey loam soils. The black cotton soils occur mainly in Sausar Tahsil while sandy loam soil is found in Chhindwara Tahsil. The clayey loam is predominant in Amarwara Tahsil. The northern hilly region covered by loamy soils, are very shallow, somewhat excessively drained, developed by moderately steep slopes and are marked by severe erosion.

4.0 GROUND WATER SCENARIO

4.1 Hydrogeology

i) Aquifer System

The major part of the district is occupied by Deccan Trap, consisting of different lava flows whose thickness ranges between 7 to 21 m. The recent alluvium deposits are found at places along the ***Pench*** and the ***Kanhan*** rivers with thickness varying from 5.00 to 20.00 m. Alluvium comprises clayey material with intercalated layers of sand and gravels. Archaeans are exposed in parts of Sausar, Bichhua, Chhindwara, Jamai and Mohkhed blocks whereas the Coal bearing lower Gondwanas in parts of Jamai, Parasia and Jamai blocks. The upper Gondwanas occupy parts of Harrai and Tamia blocks.

Ground water occurs under phreatic and semi-confined to confined conditions. Alluvium, weathered granites/gneisses, lower Gondwana sandstones, weathered, fractured and jointed massive basalts and vesicular basalts form the major phreatic aquifers; and weathered, fractured granites are noticed as main water-bearing zones at deeper levels. It is observed that the discharge of dug wells tapping alluvium and vesicular basalt ranges between 80 and 235 m3/day respectively and jointed massive basalts and weathered gneisses range from 44 to 177 m^3/day and from 61 to 77 m^3/day respectively. Hydrogeological details of some of CGWB exploratory bore wells are given in Table 2. Water bearing fractured zones is encountered between the depths of 71.00 and 176.00 m bgl at deeper levels. The discharge in weathered, fractured granite at deeper levels ranges from 0.2 to 10.00 l/s (Plate-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 34 monitoring wells of Chhindwara district, Pre and Post monsoon depth to water level maps are reproduced.

iii) Pre- monsoon (May 2006)

Pre monsoon depth to water levels in the year 2006 range from 3.65 to 15.75 m bgl. Shallow water levels (< 5.00m) occur south of Jamai block. Water levels between 5.00-10.00 m noticed in major part of the area and water levels between 10.00-15.00 m is observed south western part, where intense agricultural activities are noticed. The deepest water level of 15.75 m bgl was recorded in the well at Sarangbheri. The long-term water level trend (1997 to 2006) shows declining trend ranges from 0.007 to 0.524 m/year (Pre- monsoon). Water level fall is noticed particularly in Sausar and Pandhurna block areas where a large-scale withdrawal of ground water for irrigation purpose is observed (Plate-3).

iv) Post- monsoon (May 2006)

During post monsoon period, water levels ranges from 0 .60 to 15.00 m bgl. Shallow water level (< 5.00 m) occurs in north, while deep water levels (>10.00m) observed in southern part. The deepest water level of 15.00 m bgl was also recorded in the well at Sarangbheri and Water level fluctuation between pre and post monsoon period ranges from 0.30-to7.60 m. (Plate-4).

Table 2. Hydrogeological details of CGWB exploratory bore wells.

S. No.		Depth Drilled (m bgl)	Depth of Well constructed (m bgl)	Zones tapped (m bgl)	Aquifer material	Static water level (m bgl)	Discharge (lps)	Drawdown (m)	Remarks/ Fluoride
1	Jhiilmili	127.10	127.10	82-90; 115-126	Fractured granite	58.90	4.07	8.72	2.5
2	Rajakhodhana	103.70	103.70	88.5-103.7	Fractured granite	20.98	10.0	38.45	20.00
3	Khakra Chaurai	137.20	137.20	82-84; 122-137	Fractured granite	19.22	5.04	67.45	15.00
4	Panjara	138.30	138.30	82-92.5; 135. 5-138.3	Fractured granite	52.88	3.41	-	
5	Loniamaru	167.70	167.70	71-82;97.5-107;140-146	Fractured granite	48.48	4.07	13.16	10.00
6	Khedi Bhutai	183.00	183.00	-	Basalt	80.00	Meager	-	
7	Atarwara	134.20	130.00-133.00	130-134	Fractured granite	71.72	4.5	26.28	9.00
8	Sarra	183.00	43.00	9-15.5; 18.00-27.00; 30.50-36.50	Fractured granite	6.50	1.1	22.37	1.95
9	Sahapura	183.00		Abandoned	Fractured granite	9.84	0.40	67.06	0.49
10	Ubhegaon	152.50	152.50	-	Basalt & Fractured granite				Abandoned
11	Datla	183.00	183.00	30-45 (basalt)	Basalt & Fractured granite	27.30	1.0	-	Abandoned
12	Bichhbi	201.30		115.90 – 128.10	Basalt & Fractured granite				Abandoned
13	Bisapur	183.00	183.00		Basalt & Fractured granite				Abandoned
14	Datla	183.00	183.00	30.00 – 45.00	Basalt & Fractured granite	27.30	1.00	-	
15	Gangiwara	183.00			Fractured granite	15.81	0.84	-	
16	Goreghat	183.00	-	-	Basalt & Fractured granite	9.58	-	-	Abandoned
17	Jatama	173.80	-	-	Fractured granite	88.55	1.00	-	9.00 Abandoned
18	Khunajhir Khurd	113.90	113.90	14.00 – 20.00	Basalt & Fractured granite	17.30	1.85		8.50 Abandoned
19	Lawagogri	183.00	-	-	Fractured granite	3.25	Poor		Abandoned
20	Rajara	125.00	125.00	-	Basalt & Fractured granite	80.93	3.38	-	
21	Ridhora Mal	183.00	183.00	-	Fractured granite	72.50	1.60	-	1.75
22	Salimeta	201.30	-	39.00 – 42.00	Basalt & Fractured granite	Dry	-	-	Abandoned
23	Umret	183.00	-		Fractured granite	25.28	3.00	72.27	1.30
24	Chhinda	118.90	-	18.00 – 70.00	Basalt	-	-	-	Abandoned

4.2 GROUND WATER RESOURCES

The entire district, command and Non Command areas, falls under Safe Category, except Chhindwara block (Plate-5) which is falling under Semi -Critical category where stage of ground water development is 89.42%.

The net annual ground water availability in the district is 1101.50 MCM and draft from all uses is 558.96 MCM. Net ground water available for future irrigation use is 513.06 MCM (Table 3)

Table 3. Ground water availability and stage of development

Assessment Unit/ District	Command/ non-Command/ Total	Net Annual Ground water Availability MCM	Existing Gross Groundwater Draft for Irrigation MCM	Existing Gross Groundwater Draft for Domestic & Industrial water Supply MCM	Existing Gross Groundwater Draft for All uses MCM	Allocation for domestic & industrial requirement supply up to next 5years MCM	Net Ground Water Availability for future irrigation development MCM	Stage of Ground Water Development %
Chhindwara								
	Non-Command	93.25	80.41	2.98	83.39	9.56	3.27	89
	Block Total	**93.25**	**80.41**	**2.98**	**83.39**	**9.56**	**3.27**	**89**
Mohkhed	Command	19.87	1.99	2.9	2.29	5.7	17.30	12
	Non-Command	112.13	81.10	2.85	83.95	5.55	25.48	75
	Block Total	**13.00**	**83.10**	**3.14**	**86.24**	**6.12**	**42.79**	**65**
Sausar	Command	5.66	2.15	.3	2.38	2.8	3.23	42
	Non-Command	87.24	33.14	2.35	35.49	2.82	5128	41
	Block Total	**92.90**	**35.30**	**2.58**	**37.88**	**3.10**	**5.50**	**41**
Pandhurna	Non-Command	144.16	80.78	3.00	83.78	4.97	58.41	58
	Block Total	**144.16**	**80.78**	**3.00**	**83.78**	**4.97**	**5.41**	**58**
Bichhua	Non-Command	45.60	23.40	1.62	25.02	4.57	17.63	55
	Block Total	**45.60**	**23.40**	**1.62**	**25.02**	**4.57**	**17.63**	**55**
Chourai	Non-Command	126.72	76.28	3.24	79.52	5.96	44.48	63
	Block Total	**126.72**	**76.28**	**3.24**	**79.52**	**5.96**	**44.48**	**63**
Amarwara	Non-Command	102.70	47.91	2.52	50.43	5.16	49.63	49
	Block Total	**10.70**	**47.91**	**2.52**	**50.43**	**5.16**	**49.63**	**49**
Harrai	Non-Command	97.95	13.48	2.04	15.51	4.16	80.32	16
	Block Total	**97.95**	**13.48**	**2.04**	**15.51**	**4.16**	**80.32**	**16**
Parasia	Non-Command	93.22	60.32	3.35	63.67	5.30	27.60	68
	Block Total	**93.22**	**60.32**	**3.35**	**63.67**	**530**	**27.60**	**68**
Tamia	Non-Command	47.51	4.77	1.89	6.65	5.59	37.15	14
	Block Total	**47.51**	**4.77**	**1.89**	**6.65**	**5.59**	**37.15**	**14**
Jamai	Non-Command	125.49	23.58	3.30	26.88	4.64	97.27	22
	Block Total	**125.49**	**23.58**	**3.30**	**26.88**	**4.64**	97.27	**22**
	District Total	**1101.50**	**529.32**	**29.65**	**558.96**	**59.13**	**513.06**	**51**

4.3 GROUND WATER QUALITY

Ground water quality in the district is assessed annually by CGWB on the basis of analysis of ground water samples collected from 36 Groundwater monitoring stations in the district. Based on examination of the water quality analysis data for the year 2006 (Table 4), the following inference derived.

The pH value of water samples of 26 stations ranges between 7.35 and 7.93) did not show significant variations since all the values were of alkaline in nature and within permissible limit (6.5 to 8.5) as set by BIS (1991). The electrical conductivity (EC) values were found to be in the range of 332 and 1722 µS/cm. The EC values exceeding limit, 1000 µS/cm, were noticed at three villages, Viz., Chhindi (1005 µS/cm), Silwani (highest 1722 µS/cm) and Chhindwara (1132 µS/cm). The high EC values of these villages may be attributed to the primary minerals of earth's crust dissolved in water samples. The analytical results show that the well of Silwani village had highest and abnormal concentration of chloride as 257 mg/l against the desirable limit of 250 mg/l with corresponding higher sodium concentration of 90 mg/l indicating water is moderately saline in nature. The nitrate concentration represents the localized pollution effect on ground water quality of the region. The concentrations of NO_3 exceeding 45 mg/l were reported in 70.83 % wells with highest as 254 mg/l of Silwani village. The higher concentration of NO_3 can be expected from the other sources and is an indicative of man made pollution. High fluoride concentration is found at Damua (1.95 ppm) and Rajna villages (3.96 ppm).

The analytical results plotted on Piper diagram show that the maximum number of wells, (at Goni, Singhori, Amarwara Surla, Khapa, Kundali, Borgoan, Ramakona, Piplianarayanwar, Pandhurna, Bangoan, Mohi, Saranbheri, Jamai, Parasia, Lahgudna, Tamia, and Delakhari villages) were found to be of Alkaline earth - bicarbonate type which means these waters had temporary hardness since the concentration of calcium and magnesium ions exceed over sodium and potassium ions and simultaneously the concentrations of carbonate and bicarbonate ions together were reported to be high as compared to sulphate and chloride ions together. The well at Silwani was found to have calcium chloride type of water whereas the wells at Linga Railway Station and Rajna had sodium chloride type of waters. The remaining three samples, at Chhindwara, Damua and Chhindi did not show any type of domination of either ions and hence was considered to be of mixed type of waters.

The parameters such as sodium adsorption ratio (SAR), percent sodium (% Na), and residual sodium carbonate (RSC) are used to classify the water quality 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 U.S. Salinity Laboratory suggested a diagram for classifying waters for irrigation purpose in 1954.

The chemical analysis data of all the water samples were plotted on U.S. Salinity Laboratory diagram, and from the diagram it is evident that nearly 79% wells namely Goni, Amarwara, Surla, Khapa, Kundali, Borgaon, Ramakona, Piplianarayanwar, Pandhurna, Bangaon, Mohi, Saranbheri, Linga Railway Station, Jamai, Parasia, Damua, Lahgudna, Tamia, and Delakhari were found under C_2-S_1 Class (Medium Salinity & Low Sodium) which means that these waters can be used for irrigation purpose without causing adverse effect on the crops

with no chances of development of soil salinity. The ground waters representing the wells of Singhori, Silwani, Chhindwara and Chhindi were grouped under C_3-S_1 (High Salinity & Low Sodium) class, and can be used on soils with restricted drainage. The only isolated well at Rajna village was grouped as C_3-S_2 (High Salinity & Medium Sodium). It may be concluded that with few exceptions, the sodium concentrations are low in all the samples hence the study area do not pose any problem of Sodium hazard. The quality of water in phreatic aquifer, by and large, good and suitable for both drinking and irrigation purposes.

Table 4. Chemical analysis data of Groundwater monitoring wells (Mg/l)

S.No.	Village	pH	EC µS/cm at 25^0 C	CO_3^{--2}	HCO_3^-	Cl^-	SO_4^{-2}	NO_3^-	F^-	PO_4^{-3}	TH	Ca^{++}	Mg^{++}	Na^+	K^+
1	**Renikhera**	7.44	390	0	183	18	25	5	0.44	0.4	175	50	12	13	2.2
2	**Delakhari**	7.8	777	0	427	28	5	11	1.27	0.06	235	40	33	80	0.5
3	**Tamia**	7.83	709	0	299	39	25	50	0.38	0.08	295	86	19	33	2.2
4	**Lahgudna**	7.86	779	0	268	60	45	57	0.27	0	315	102	15	42	0.9
5	**Chhindi**	7.84	1005	0	275	85	75	98	0.31	0.05	420	130	23	45	0.3
6	**Damua**	7.97	389	0	128	43	22	12	1.95	0	65	10	10	61	0.7
7	**Parasia**	7.85	467	0	183	25	20	28	0.65	0	200	62	11	18	2.8
8	**Jamai**	7.81	332	0	104	21	15	38	0.89	0	140	38	11	14	0.5
9	**Chhindwara**	7.38	1132	0	275	113	105	92	0.3	0	410	104	36	74	6.9
10	**Linga Rly Stn.**	7.6	643	0	146	82	56	56	1.31	0	155	38	15	84	0.6
11	**Sarangbheri**	7.66	431	0	207	25	10	5	0.59	0.22	150	48	7	35	0.4
12	**Silwani**	7.35	1722	0	226	287	66	254	0.39	0	680	194	47	90	2
13	**Mohi**	7.56	563	0	226	25	35	25	0.82	0	210	54	18	37	2.8
14	**Bangaon**	7.66	748	0	397	18	4	28	0.28	0	265	52	34	52	1.2
15	**Pandhurna**	7.83	446	0	207	18	12	10	0.36	0	150	46	9	39	1
16	**Piplianarayanwar**	7.52	640	0	195	43	44	59	0.26	0	260	84	12	32	0.1
17	**Rajna**	7.69	951	0	146	202	50	35	3.96	0	100	36	2.4	178	1.6
18	**Ramakona**	7.75	767	0	390	18	8	27	0.61	0	275	50	36	53	1.2
19	**Sausar**	7.76	663	0	262	39	45	16	0.62	0	290	70	28	24	1.4
20	**Borgaon**	7.82	366	0	140	14	46	3	0.34	0	165	48	11	12	2.1
21	**Kundali**	7.73	700	0	305	38	42	30	0.61	0	315	90	22	25	0.4
22	**Khapa**	7.74	587	0	214	43	50	22	0.47	0	260	72	19	23	1.5
23	**Surla**	7.53	678	0	244	43	42	30	0.85	0	295	84	21	25	0.4
24	Amarwara	7.93	653	0	293	28	35	21	0.88	0.17	290	66	30	25	1.3
25	Singhori	7.93	933	0	329	50	35	103	0.37	0	440	148	17	16	2.3
26	Goni	7.91	559	0	256	14	45	5	0.73	0	150	42	11	64	3.2

4.4 STATUS OF GROUND WATER DEVELOPMENT

i) Rural and 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. A total number of 10,326 shallow tube wells fitted with hand pumps are operational to provide drinking water to as many as 4482 inhabited villages. There are 1863 problem villages identified and water being supplied through hand pumps, and in 620 villages Piped water supply schemes are operational.

ii) Ground Water Development for Irrigation

Ground water development for irrigation is through Dug wells, Dug-cum-bored wells and shallow bore wells. There are 71,451 dug wells, dug-cum-bored wells and 5,029 shallow bore wells existing in the area to irrigate 29,314 Ha. The depth of irrigation open wells ranges from 6.00 to 22.000 m bgl and yield ranges from 44 to 235 m^3 /day. The diameter of wells ranges from 3.00 to10.00m. Farmers generally use Jet pumps with 3.00 and 5.00 H.P on dug wells and Submersible pumps on bore well to lift water for irrigation purpose. Rocks of Archaeans, Deccan Traps and upper Gondwanas mainly occupy the district area. By looking into the characteristics of rock formation, it is felt the suitable rig for the area is DTH rig, preferably having rotary/DTH system. The available DTH/LMP rig (having capacity 200/216/165/152 mm) dia up to a depth of 300 metres in hard rock formation was utilized to carry out exploratory drilling of CGWB. In the basaltic terrain suitable well -assembly should be lowered to prevent collapsing of clays and highly weathered formations.

5.0 GROUND WATER MANAGEMENT STRATEGY

Although, all the blocks of district area, except Chhindwara block, categorized as ‘Safe’, irrigation by ground water is developing fast in the recent decades. Farmers are seen constructing wells for irrigation purpose without much consideration of well spacing, resulting in adverse impact on the ground water regime in some of the watersheds, which has caused the water levels to deplete. Declining trend of water levels is noticed in the south and southwestern part of the area. As the phreatic aquifers started yielding less, farmers started to dig the wells down to deeper levels where high fluoride concentration is also found in ground water. As per PHED, a total number of 255 villages were affected by excessive fluoride (>1.50 Mg/l) in deep ground water. Some vegetable crops also are reported affected by high fluoride ground water. Hence, artificial recharge of ground water is felt necessary to tackle these twin problems.

To combat these problems watershed wise artificial recharge studies are recommended to take up to increase ground water potential and improvement of its quality. Micro level studies for artificial recharge to ground water are recommended to take up in Chhindwara block and other areas wherever declining of water levels is noticed. There is a possibility of clays likely to be encountered at various depths in the area, hence it is recommended to construct gravel pack well with proper well assembly. Construction of deep bore wells may be discouraged for drinking water purpose where excessive fluoride is observed at deeper levels. Scientific study at the end of every 3- 5 years period may be taken up to know the impact of ground water development on the ground water regime. Impact of high fluoride concentration on vegetables and crops need to be established.

6.0 HIGH FLUORIDE GROUND WATER

Water is known as a universal solvent, because it has the ability to dissolve at least some amount of almost all substances; that comes in its contact. The concentration of fluoride between 0.6 to 1.2 mg/l is essential in potable water to protect teeth decay while higher concentration (beyond 1.5 mg/l) can cause teeth mottling and still higher concentration of fluoride may lead to skeleton fluorosis. Water and food, mainly agricultural crops are contaminated with fluoride as the earth crust in India is heavily loaded with fluoride containing minerals such as Fluoride, Topaz, Apatite and Phosphatic nodules etc. As a result of the rich minerals content, fluoride leaches out and contaminate the water and earth /soil in general and ground water in particular

In Chhindwara district the incidence of excess fluoride in ground water was first suspected in 1997, when complaints of arthritic pain received from residents of Soya bean Plant premises at Palatwada village in Chourai block. The Public Health Engineering Department swing into action immediately and by January 1998, the Department completed testing of water samples of 6226 hand pump/ tube well sources, located in 1680 villages of 11 blocks of the district. The analysis of findings has indicated presence of fluoride in higher concentration in **418** hand pumps/ tube wells located in **254** villages (Table 6&7), which is alarming situation and needs immediate remedial measures. The PHED has referred this problem to Central Ground Water Board for its remedial measure, which incorporated in its Annual Action Plan 1999-2000 to 2001-2002. The Central Ground Water Board has carried out hydro geological surveys followed by exploratory drilling operations. The findings are as follows.

i) Distribution of Fluoride Concentration in Surface Water:

A water sample was collected from Pench River near Rajakhodana village in the month of May 2000, and chemically analyzed. The fluoride content in the river water sample found to be 0.54 mg/l, which is with in permissible recommended value for drinking purpose.

ii) Distribution of Fluoride Concentration in Shallow Ground Water:

Out of 26 water samples collected from Ground water monitoring wells during May 2006, 10 water samples of dug wells; the fluoride ion is below the recommended value of 0.5 mg/l., in 2-water samples concentration is above 1.5 mg/l (Max. 3.96 in Rajna well).

iii) Distribution of Fluoride Concentration in Deep Ground Water:

To know the fluoride ion concentration at deeper levels and its variation with depth, water samples from exploratory boreholes of CGWB were collected from different depths and found that concentration of fluoride is increasing with depth (Max.20.00 mg/l). The details of depths drilled and fluoride concentration of ground water samples are given in the Table 5.

Table 5. Fluoride concentration at deeper levels in exploratory boreholes of CGWB

S. No.	Exploratory well	Depth drilled (m)	F concentration (Mg/l)
1	Jhilimili	127.10	4.75
2	Panjra	138.30	9.07
3	Nonia Mau	167.70	14.20
4	Kakra Chourai	137.20	18.75
5	Rajakhodana	103.70	20.00
6	Sarra	183.00	1.95
7	Gangiwada	183.00	3.78
8	Rajada	125.00	14.70
9	Khunajhir khurd	113.90	11.30
10	Atarwada	133.00	9.25

Perusal of the analytical results of ground water samples collected by the Public Health Engineering Department, Chhindwara and CGWB indicates that the concentration of fluoride ion is higher in deeper levels and appears increasing with depth and also from recharge areas to discharge areas as revealed by the fact that the number of villages with high fluoride concentration is located on either side of Pench river. The number of villages with high fluoride concentration (> 5.00 mg/l) is also high (163 villages). The high value of fluoride ion, 20.00 mg/l, has been recorded in deep ground water in C G W B exploratory borehole drilled at **Rajakhodana** village (Topo Sheet .No 55N/4, 1A).

Occurrence of high fluoride is mainly found in parts of Jamai, Chhindwara, Chourai, Bichhua and Pandhurna blocks. It is also noticed that the comparatively high fluoride concentration is found in the hand pumps/tube wells located near and intersection of lineaments e.g. Sevajpani village (13.7 mg/l), Singhori (16.5 mg/l), Rajola (10.00 mg/l), Ghat Piparia (7.0 mg/l), Lohara (11.4 mg/l) Ghat Parasia, (13.00 mg/l), Noniamaru (11.9 mg/l), Siregaon (10.3 mg/l) etc (Plate -6) The cause of high concentration of fluoride may be due to availability of ground water and its contact period with fluoride bearing minerals present in the rocks is more in deeper levels and due to ground water circulation.

Table 6. Fluoride Concentration in affected Villages (Source: PHED, Chhindwara)

S. No	Name of village (PC No.)	F^- concentration in ppm	S. No	Name of village (PC No.)	F^- concentration in ppm
	1. CHHINDWARA BLOCK				
1	Sankh (117)	7.1-8.00		2. PANDHURNA BLOCK	
2	Jatama (117)	7.18	1	Lavhana (17)	1.84-2.32
3	Sunheri Mohgaon (116)	4.5	2	Hardoli	2.32
4	Kuhiya (115)	7.25	3	Morghat (80)	2.32-4.35
5	Saliya (115)	7.18-8.6	4	Belgaon	5.05
6	Seoniparamoti (99)	4.8-7.08	5	Bamla	1.82
7	Anjaniya (99)	6.4	6	Jamghat	1.75
8	Nawegaon (110)	5.1-5.4	7	Rajdongri	3.85
9	Bohna (108)	3.3-4.85	8	Siratha	10.00
10	Khajari (95)	4.10	9	Bhajipani	2.19-4.70
11	Noniyamaru (107)	3.3-11.9	10	Ambada	1.60
12	Ghat Parasia (110)	10.8-13.0	11	Rajoasa (28)	2.65
13	Umariya Usra (109)	2.10-11.00	12	Birolipar (29)	7.00
14	Bhandi (109)	7.50	13	Pither Raiyt (174)	5.85-10.4
15	Bangaon (103)	9.00	14	Khedidhan Bhoyar (25)	2.45
16	Lakaadi Jamhodi (98)	2.30	15	Pithermal (3)	3.50
17	Sarra (94)	4.5-6.4	16	Gujerkheri (19)	4.70
18	Imalikheda (94)	6.7-7.0	17	Neelkanth (24)	3.50
19	Thuniya Bhand (94)	6.5	18	Salai (2)	9.10
20	Thawari Teka (106)	2.3-8.13	19	Sonpathai (1)	3.3
21	Bhula (106)	3.9-10.80	20	Mordongri	1.64
22	Rajakho (104)	14.0-18.90	21	Bhatewari	1.56-2.15
23	Keolari (97)	7.8	22	Pardi	1.92
24	Megha Seoni (98)	3.08	23	Karwai	2.15
25	Chhabadi (98)	7.80	24	Khairipaika	2.00
26	Khairi Lachhu (108)	1.90-4.18	25	Umarikalan	5.50
27	Dungaria (79)	4.70	26	Hiwaraprathyt	4.10
28	Sarna (99)	6.0	27	Bangaon	5.2-5.5
29	Chargaon Prahlad (98)	2.40	28	Khedikalan(12)	3.3
30	Jamunia (103)	1.60-2.36	29	Marud (11)	1.51
31	Jhiri (104)	1.58-1.80	30	Chiklimukara	2.15
32	Karaghat (105)	8.00	31	Bad Chicholi (44)	2.8-5.0
33	Khairi bhutai (102)	2.90	32	Bothiya (45)	2.05-2.30
34	Panjra (102)	2.30-5.70	33	Khapa Razadi (22)	2.18-3.56
35	Chaniyakhurd (102)	3.45-6.90	34	Seoni (23)	4.20
36	Mendkital (102)	3.4	35	Sawajpani (29)	2.7-13.70
37	Manegaon (105)	8.79	36	Mundidana(2_	5.7-11.80
38	Rohnakhurd (96)	1.70	37	Markawada (25)	1.85-4.30
39	Jhirlinga (96)	2.7-3.13	38	Dholankhapa (1)	2.8-3.2
40	Piparia bisala (104)	1.64-1.80	39	Narsala (2)	1.76
41	Nagjhir (104)	2.66-7.00	40	Kaudia (1)	2.70
42	Bhandehi (113)	2.37	41	Lendagondi (6)	2.6-2.75
43	Imaliya Bhota (101)	5.70	42	Buchankhapa (28)	1.66-2.02
44	Boriya (100)	3.7-4.2	43	Malapur (6)	1.99-2.12
45	Rohnakala (92)	5.25	44	Biroli	4.50
46	Pakchadiya (101)	4.50		3. CHOURAI BLOCK	
47	Kudwari (96)	2.80	1	Rampuri (95)	3.14
48	Marai (110)	8.25	2	Dawazir (95)	5.45
49	Ghogra (110)	9.80	3	Meghdown (95)	3.60

50	Khutiya Jhajhariya (109)	2.70-10.70	4	Patloan (95)	2.90
51	Kokai (108)	5.50	5	Mandariya (103)	2.04-3.10
52	Jatlapur (1020	10.70	6	Siregaon (72)	7.60-10.30
53	Sihora (105)	2.60	7	Hathani (73)	3.4-7.00
54	Sonpur (111)	1.70-2.28	8	Kamthi (73)	2.8
55	Saraswara (100)	1.80-3.40	9	Bichhwa (73)	11.40
56	Surgi (102)	3.50-6.00	10	Karaboh (73)	4.35
57	Chargaon (117)	3.10-5.70	11	Sitapar (80)	2.24
58	Madanpur (117)	7.80	12	Hasanpur (81)	1.75-6.75
59	Kaparwari (97)	3.40	13	Kukarai (100)	3.40
60	Dagawani Pipariya (106)	5.70	14	Karlai (100)	4.60
61	Mohgaon (105)	8.50	15	Markahandi (83)	6.40
62	Khapa Mittekhan (96)	5.05-8.50	16	Chorgaon (84)	9.13-9.70
63	Bhaisadand (91)	2.50	17	Jhilmili (83)	3.90-4.20
64	Partalai (79)	1.70	18	Sihoramal (84)	11.20-12.20
65	Loniya (95)	2.0-2.60	19	Umariya (83)	7.80
66	Pathkheda (108)	11.00	20	Amta (83)	3.20
67	Gangiwara (77)	2.16-3.25	21	Mahagora (73)	4.30-8.50
68	Kotalbardi (113)	5.80	22	Palhari (85)	3.64-8.05
69	Doulpur (113)	6.20	23	Chichgaon (71)	2.70-9.00
70	Malanwada (111)	1.50	24	Moari (83)	8.10-9.00
	4.0 MOHKHED BLOCK		25	Madhewani (83)	10.0
1	Sawari (46)	3.80	26	Badiwada (87)	5.7-6.5
2	Linga (199)	8.90	27	Ziriya (87)	2.2-3.0
3	Sikarpur (112)	6.70	28	Kairiya (87)	3.5-6.90
4	Khunajhir kalan (119)	6.80	29	Parsoli (99)	3.70-5.65
5	Gadarwara (118)	7.70	30	Lonikalan (98)	5.8-8.50
6	Chikalikalan (121)	4.20	31	Mohgaonkalan (86)	2.3-7.6
7	Gubrel (46)	7.80	32	Panjara (98)	5.8-6.0
8	Arjunwadi (112)	4.25	33	Chand (89)	2.35-3.3
9	Bisapurkalan (129)	3.80	34	Deemarmetas (89)	4.6-5.0
10	Turkikhapa (128)	4.60	35	Khairirani (88)	4.2
11	Majewarmal (44)	2.00	36	Bikala (88)	3.10
12	Lawagogri (45)	4.15	37	Bhand Piparia (88)	3.40-4.50
13	Nawegaonudasi (123)	3.40	38	Chikhali Khurd (89)	6.60
14	Rimariya Dalel (122)	2.47	39	Harnakhedi (88)	3.60
15	Ajni (122)	1.90	40	Titari (94)	5.60
16	Rajoli (122)	1.70	41	Badgaon (94)	4.55-4.80
17	Jamuniamadh (130)	1.95	42	Chandangaon (94)	4.05
18	Devardha (119)	1.80	43	Lalgaon (94)	3.25
19	Hourakhapa (129)	1.90	44	Jamunia (95)	4.30
20	Rahep (24)	1.75	45	Pakhadiha(92)	2.15
	5 AMARWARA BLOCK		46	Pathara Janglimal (91)	1.74
1	Badela (58)	4.2-6.5	47	Binjawada (44)	6.00
2	Sainghodi (47)	4.7-16.50	48	Samaswada (77)	7.14
3	Khakra Chourai (61)	10.6-13.00	49	Siddap (79)	4.5-6.4
4	Gurraiya (61)	1.6-3.6	50	Gadkhapa (78)	3.5-6.70
5	Mahendrawada (61)	4.6-5.2	51	Jurtara (64)	13.80
6	Gara Chhota (45)	4.4	52	Kedarpurkalan (66)	4.6
7	Rajola (47)	10.00	53	Mehgora (69)	2.32-8.90
8	Mohali (44)	8.0-17.70	54	Chorbatri (91)	2.05
9	Bandra (59)	2.08-5.20	55	Lohara (69)	11.40
10	Manegaon (60)	7.00-8.00	56	Hiwarakalan (69)	4.10-12.00
11	Zilmili (56)	3.20	57	Lungsi (72)	6.00
12	Saliwadasani (44)	8.10	58	Barabariyari (70)	5.40
13	Kohliya (40)	5.30	59	Keolari Sambha (63)	13.75-15.70
14	Bank mukasa (46)	4.3-4.60	60	Bamhanwada (70)	3.35
15	Ghat Piparia (48)	7.0	61	Mowar (63)	4.90
16	Sahkari (55)	3.5-4.4	62	Hiwarkhedi (62)	3.0-15.70

17	Hathoda (49)	3.1-5.1	63	Pindrai Saraf (62)	15.70
18	Dighawani (26)	2.08-3.4	64	Dhanola (70)	5.45
19	Banki (43)	1.50	65	Maduwadhana (62)	16.05
20	Sajawa (26)	2.50	66	Khatkar (72)	10.4
	6 PARASIA BLOCK		67	Chourai (82)	6.50
1	Kundalikalan (80)	2.16	68	Nawegaon makariya(82)	4.35
2	Sonapipri (75)	2.6-8.5		7 JAMAI BLOCK	
3	Rawanwada (70)	1.5-3.90	1	Kalimati (36)	2.80
4	Sirgora (73)	2.85	2	Richeda (53)	4.20
5	Bijakwada (49)	1.90	3	Keolari (53)	6.80
6	Sirgorikalan (67)	4.90-8.00	4	Latkheda	4.30
7	Haranbhata (73)	2.26-9.90	5	Bhawaikhurd (13)	1.90
8	Sethiya (72)	2.70	6	Ramnagari (13)	14.90
9	Maniyakhapa (81)	2.20-2.70	7	Telibat (31)	10.00
10	Kundalikhurd (81)	1.94-3.78	8	Chhindikamath (30)	13.00
11	Masul (77)	3.10	9	Khairwani (38)	2.2-2.40
12	Barrangakhurd (77)	2.85-3.70	10	Junnardeobisala (36)	2.40
13	Jaithari (78)	3.07-4.40	11	Panara (31)	2.70
14	Munga (77)	1.78-2.90	12	Datlawadi (38)	2.79
15	Patha (75)	3.07			
16	Chhabadikalan (78)	2.30			
17	Palatwada (72)	6.75			
18	Jurremal (67)	1.80			
19	Baghbardiya (67)	1.50			
20	Urdhan (66)	1.50			

Table 7. Range of fluoride ion concentration in ground water

S. No	Block	Total inhabited village surveyed	No. of villages found excessive fluoride	No of H.P/T.W found excessive fluoride	No of water samples having fluoride ion in range of (mg/l)		
					1.5 – 3	3 –5	> 5.0
1	Chhindwara	132	70	123	33	34	59
2	Mohkhed	179	20	20	08	07	05
3	Amarwara	147	20	42	11	12	19
4	Chourai	179	68	111	15	37	59
5	Pandhurna	158	44	68	37	19	12
6	Parasia	194	20	41	26	10	05
7	Jamai	262	12	13	07	02	04
	TOTAL	1251	254	418	137	118	163

7.0 RECOMMENDATIONS

The following recommendations are made for the development of ground water in the district on the basis of hydrogeological studies. The areas recommended for ground water development are described below and shown in Plate-7.

Alluvium: The river alluvium deposits are occurring along the riverbanks in Tamia, Chourai and Sausar blocks are suitable for shallow tube wells.

Deccan Trap: In Deccan Traps the areas of ground water flow convergence; weathered zones, fractured, jointed and massive basalts and weathered vesicular basalts are observed suitable for ground water development. These areas are recommended for dug wells having depth of 12-15 m and 8-10 m diameter. Horizontal boring is recommended in the dug wells constructed in valley portions to enhance the yields of the wells. In some of the micro watershed areas, wells were constructed in large numbers causing water level decline and dwindling of well yields. Hence it is recommended to identify such areas and artificial recharge structures may be constructed after detailed surveys, to increase the ground water potential.

Lower Gondwanas: The areas occupied by coal bearing lower Gondwana sandstones are recommended for construction of dug wells and tube wells. Due to coal mining, at places it is found that ground water levels are seen declining near by villages. Micro level studies are recommended to take up in Pench-Kanhan coalfield area to study the impact of mining activities on ground water regime and possibility of artificial recharge

Archaeans: The areas occupied by weathered granites, and gneisses belonging to Archaeans in the district are suitable for dug wells and bore wells. The water bearing fractured zones are encountered between the depths of 71.00 and 176.00 m bgl at deeper levels.

High fluoride concentration ground water can be improved through de-fluoridation as described below. De-fluoridation at domestic level can be carried out in a container (bucket) of 60 liters capacity with a tap 3-5 cm above bottom of the container for withdrawal of treated water after precipitation and settling. The raw water taken in the container is mixed with adequate amount of aluminum sulphate solution (alum), lime or sodium carbonate and bleaching powder depending upon its alkalinity and fluoride content. Alum solution is added first and mixed well with water. Lime or sodium carbonate solution then added and the water stirred slowly for 20 minutes and allowed to settle for nearly one hour and is withdrawn.

The supernatant, which contains permissible amount of fluoride, is withdrawn through the tap for consumption. The settled sludge is discarded. Approximate volumes of alum solutions for defluoridation of 40 liters of water are given below. (Table-8)

Table 8. Domestic Defluoridation: **Approximate volume of alum solution (milli litre) required to be added in 40 litre of test water, to obtain acceptable limit (1.0 mg /l) of fluoride in water at various alkalinity**.

Test Water Fluoride Mg/l	Test water Alkalinity as Ca, CO3, Mg/l							
	125	200	300	400	500	600	800	1000
2	60	90	110	125	140	160	190	210
3	90	120	140	160	205	210	235	310
4		160	165	190	225	240	275	375
5			205	240	275	290	355	405
6			245	285	315	375	425	485
8					395	45	520	570
10							605	675

Artificial recharge structures may be constructed to enhance the yield potential in the phreatic aquifer where the problem of excessive fluoride is noticed and groundwater structures (shallow wells), may be constructed at the locations demarcated by the CGWB in it's Annual Action Plan 2000-2001 report (Ground water management studies in Amarwara and Harrai blocks of Chhindwara district, M.P) and construction of deep bore wells for drinking purpose may be stopped. During surveys it is observed that at many villages people are still using excessive fluoride water for drinking purpose. Hence, it is recommended to abandon immediately all the existing wells yielding high fluoride water.

In the hilly region especially in Harrai block wells may be constructed along lineament zones and other hydrogeological favorable locations for solving the rural water supply problem particularly remotely located villages.

Stop dams are recommended across the stream sections near villages in the hilly, tribal pockets so that the stored water can be used for domestic purposes

Springs are an important source of water supply especially in the hilly, tribal areas from which the villagers fetch water for drinking and other domestic purposes, but left unnoticed by state authorities. There are number of springs noticed in the area. Hence, it is recommended to develop the springs exist at Mohi, Ghatpiparia, Zilmili, Dhigawani villages etc.