1566/OTH/2007

जल वर्ष 2007 Water Year 2007

स्वच्छ सुरक्षित जल – सुन्दर खुशहाल कल

CONSERVE WATER - SAVE LIFE

भारत सरकार जल संसाधन मंत्रालय
केंद्रीय भूजल बोर्ड

GOVT OF INDIA
MINISTRY OF WATER RESOURCES
CENTRAL GROUND WATER BOARD

भूजल जानकारी
वर्धा जिला महाराष्ट्र

GROUND WATER INFORMATION
WARDHA DISTRICT
MAHARASHTRA

मध्यवर्ती क्षेत्र
नागपुर
CENTRAL REGION
NAGPUR
2007

WARDHA DISTRICT AT A GLANCE

1.	**GENERAL INFORMATION**		
	Geographical Area	:	6310 sq. km.
	Administrative Divisions (As on 31/03/2007)	:	Taluka-8; Wardha, Deoli, Selu, Arvi, Ashti, Karanja, Hinganghat, Samudrapur.
	Villages	:	1361
	Population	:	12,30,640
	Normal Annual Rainfall		985 mm to 1100 mm
2.	**GEOMORPHOLOGY**		
	Major Physiographic unit	:	Two; Northern Hills and Southern Plains
	Major Drainage	:	One; Wardha
3.	**LAND USE** (2000-01)		
	Forest Area	:	769 sq. km.
	Net Area Sown	:	3876 sq. km.
	Cultivable Area	:	4484 sq. km.
4.	**SOIL TYPE**		
	Black or Dark Brown soil viz., Kali, Morand, Khardi and Bardi.		
5.	**PRINCIPAL CROPS** (1998-99)		
	Wheat		194 sq. km.
	Jowar		591 sq. km.
	Cotton		1487 sq. km
	Total Pulses	:	668 sq. km
	Soya bean	:	1313 sq. km
6.	**IRRIGATION BY DIFFERENT SOURCES** (2000-01) - **Nos./Potential Created (ha)**		
	Dugwells	:	35237/90674
	Borewells	:	116/707
	Tanks/Ponds	:	209/12656
	Other Minor Surface Sources	:	241/7103
	Net Irrigated Area	:	54615 ha
7.	**GROUND WATER MONITORING WELLS** (As on 31/05/2007)		
	Dugwells	:	46
	Piezometers	:	2
8.	**GEOLOGY**		
	Recent	:	Alluvium
	Upper Cretaceous-Lower Eocene:		Basalt (Deccan Trap)
	Middle Cretaceous	:	Infra-trappean beds
9.	**HYDROGEOLOGY**		
	Water Bearing Formation	:	Basalt- weathered/fractured/ jointed vesicular/massive, under phreatic and semi-confined to confined conditions.
	Premonsoon Depth to Water Level (May-2006)	:	2.65 to 14.70 m bgl
	Postmonsoon Depth to Water Level (Nov.-2006)	:	0.77 to 12.46 m bgl
	Premonsoon Water Level Trend (1997-2006)	:	Rise: Negligible to 0.46 m/year Fall: 0.02 to 0.72 m/year

Postmonsoon water level trend (1997-2006)	:	Rise: 0.02 to 0.41 m/year Fall: Negligible to 0.50 m/year

10. GROUND WATER EXPLORATION (As on 31/03/07)

Wells Drilled	:	EW-39, OW-13, Pz- 3
Depth Range	:	30.00 to 201.00 m bgl
Discharge	:	Traces- 14.88 lps
Storativity	:	4.38×10^{-4} to 1.3×10^{-2}
Transmissivity	:	5.27 to 293.36 m^2/day

11. GROUND WATER QUALITY

Good and suitable for drinking and irrigation purpose, however localized nitrate contamination is observed.

Type of Water	:	Ca-Cl and Ca-HCO3

12. DYNAMIC GROUND WATER RESOURCES- (As on 31/03/2004)

Annual Replenishable GW Resources	:	943.85 MCM
Total Draft (Irrigation + Domestic)	:	264.48 MCM
Projected Demand (Domestic + Industrial)	:	33.41 MCM
Stage of Ground Water Development	:	28.02%

13. AWARENESS AND TRAINING ACTIVITY

Mass Awareness Programme	:	Two
a. Date	:	08/03/02 & 22/12/06
b. Place	:	Selu & Wardha
c. Participants	:	200 each
Water Management Training Programme	:	One
a. Date	:	04 to 05/01/07
b. Place	:	Wardha
c. Participants	:	25

14. ARTIFICIAL RECHARGE & RAINWATER HARVESTING

Projects Completed	:	Nil
Projects under Technical Guidance:	:	Nil

15. GROUND WATER CONTROL & REGULATION

Over Exploited Taluka	:	None
Critical Taluka	:	None
Notified Taluka	:	None

16. MAJOR GROUND WATER PROBLEMS AND ISSUES

The moderate drought area has been observed in the north western parts of the district i.e., in major parts of Ashti, Karanja and Arvi talukas. Ground water quality is adversely affected by nitrate contamination.

Ground Water Information
Wardha District

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Ground Water Information
Wardha District

1.0 Introduction

Wardha is one the 11 districts of Vidarbha. It has a geographical area of 6310 km^2, which is about 2.0% of the area of the State. It is bounded by north latitudes 20"08' and 21°22' and east longitudes 78" 30' and 79"15. and falls in parts of Survey of India degree sheets 55 K, 55 L and 55 P.

The district headquarters is located at Wardha town. For administrative convenience, the district has been divided into eight talukas, i.e., Arvi, Ashti, Deoli, Hinganghat, Karanja, Samudrapur, Seloo and Wardha. There are 1361 villages and 6 towns in the district. The total population of the district as per 2001 census is 12,30,640 and the density of population is 195 persons/sq. km. The district forms part of Godavari basin. Wardha River is the main river flowing through the district.

Central Ground Water Board has taken up several studies in the district. A list of studies conducted in the district is presented in **Table-1**.

Table 1: Studies undertaken by CGWB.

S. No.	Officer	AAP	Type of Survey/Study
1.	Ramanna, K.	1968-69	Systematic Hydrogeological Survey
2.	Mani, V.V.S	1970-71 1971-72	-do-
3.	Sharma, S.K.	1973-74	-do-
4.	Subramaniam, P.R.	1983-84	Reappraisal Hydrogeological Survey
5.	Bansal, S.K	1994-95	-do-
6.	Jain, S.K., Sahoo, K.B.	1999-2001	Feasibility of Artificial Recharge in Seloo Block.
7.	Warke, B.N. & Davthuraj, J.	2001-02	Reappraisal Hydrogeological Survey

In addition to the above studies, a report on Hydrogeology of the Wardha district (Romani, Salim) was issued in 1982 and the Report on Ground Water Resources and Development Potential of Wardha District (Murthy, K.N.) was compiled during 1995.

Ground water exploration has been taken up in the district in different phases. The first exploration was taken up between 1974 and 1976 when 20 wells were drilled in Yashoda basin. Subsequently later on exploration was also taken up in other parts of the district and so far 55 wells (EW-39, OW-13, Pz-03) have been drilled. The taluka wise salient features of ground water exploration are given in **Table-2**.

Table 2: Salient Features of Ground Water Exploration.

S. No.	Taluka	Wells			Depth (mbgl)	SWL (mbgl)	Dis-charge (lps)	Draw-Down (m)	Zones (mbgl)
		EW	OW	PZ					
1.	Arvi	3	1	0	99-201	9.00 -30.20	1.37 -14.88	10.37-10.55	25-93
2.	Ashti	2	0	1	30-180	8.44–25.55	Traces-4.43	-	34.00
3.	Deoli	11	1	0	51-200	1.05-10.84	0.05-7.30	5.88-12.10	1.25-70.00
4.	Hinganghat	5	3	0	48-158	1.29-11.5	0.43-13.50	0.73-21.95	5.20-103.00
5.	Karanja	3	1	1	30-201	4.75-24.09	0.07-9.84	1.20-33.43	16.00-149.40
6.	Samudra-pur	3	1	0	112-195	5.92-8.00	Traces-8.60	1.74-14.73	-
7.	Selu	3	1	0	140-201	1.87-16.00	0.38-4.43	0.26-11.25	15.00-138.00
8.	Wardha	9	5	1	30-86	2.60-6.51	0.19-8.60	4.31-22.78	GL-80.50
	Total	**39**	**13**	**3**	**30-201**	**1.05-30.20**	**Traces-14.88**	**0.26-33.43**	**1.25-149.40**

The depth of the wells drilled ranged from 30.00 to 201 metres below ground level (m bgl). The discharge from these wells varied from traces to 14.88 litres per second (lps) and 21 wells, i.e., 38% of wells were found to be high yielding with discharge of more than 3 lps. Static water levels ranged from 1.05 to 30.20 m bgl. Except for the exploratory wells at Karanja, Chhoti Arvi, Durgawadi and Jhadsi water levels were shallow in other wells. Deeper aquifer zones have been encountered in most of the wells beyond 50 m depth, the deepest being at 149.40 m at Sawli exploratory well.

A map of the district showing the taluka boundaries, taluka headquarters, physical features and location of exploratory and monitoring wells is presented as **Figure-1**.

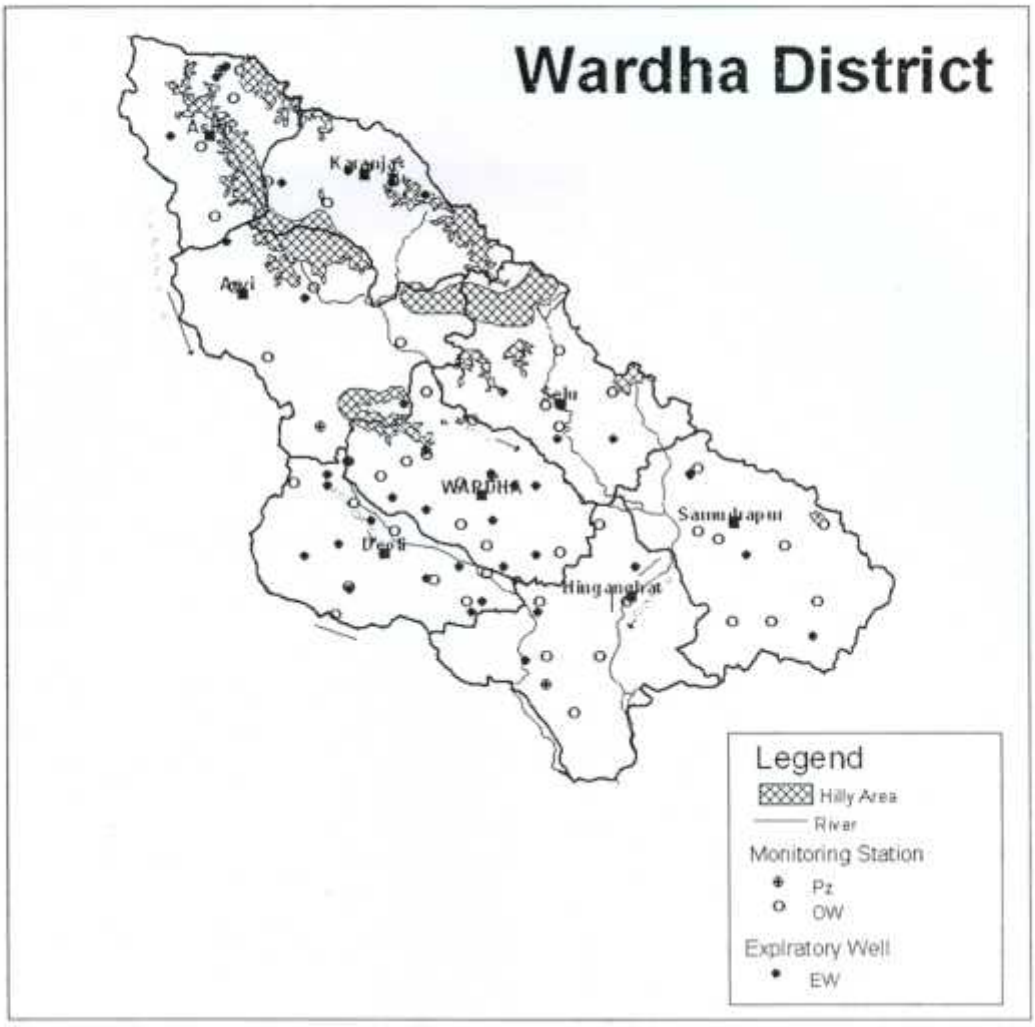

Figure-1: Location

2.0 Climate and Rainfall

The climate of the district is characterized by a hot summer and general dryness throughout the year except during the south-west monsoon season i.e., June to September. The mean minimum temperature is 12.1℃ and mean maximum temperature is 42.8℃.

The normal annual rainfall varies from 985 mm to 1100 mm and the rainfall progressively increases from north western to south eastern part. The average annual rainfall of last ten years in the district varies from 832.40 mm (Ashti) to 1131.48 mm (Seloo) and the same is presented in **Table-3**.

Table 3: Annual Rainfall Data (1996-2005). (mm)

Taluka	1997	1998	1999	2000	2001	2002	2003	2004	2005	Average
Wardha	1099.8	1007.9	1154.4	984.6	928.5	864.6	951.1	885.4	1121	999.70
Seloo	1099.8	1018.8	1318.2	976	1023	1279.5	968	1105	1395	1131.48
Deoli	1099.8	879.2	1099	884.2	748	941.7	967	739.6	1165	947.06
Hinganghat	1132.7	1156.1	1024.6	1210.5	938.2	988.2	1048.2	956.9	1246.9	1078.03
Samudrapur	1132.7	1043.1	1240.7	1206.4	1042.2	1074	1112	882.8	1281.2	1112.79
Arvi	979.2	816.6	1192.7	696.6	979.9	793.9	863.7	789.5	1216.7	925.42
Ashti	979.2	969.6	1096.2	619	641.2	760.6	706.8	699	1020	832.40
Karanja	979.2	861.2	987.1	917.7	906.8	876	910.5	879.5	1051.3	929.92
Average	**1062.8**	**969.06**	**1139.1**	**936.88**	**900.98**	**947.31**	**940.91**	**867.21**	**1187.1**	**994.60**

The average annual rainfall for the last ten years when compared with the normal annual rainfall, it is observed that the average rainfall is much less than the normal annual rainfall, except during 1999 and 2005 when it has exceeded the normal annual rainfall. Thus the rainfall has definitely decreased in the district over the period of time.

3.0 Geomorphology and Soil Types

The area is physiographically divided in two parts, the north and north eastern parts forming into a hilly spur projecting south and south eastwards from the Satpuras. While the southern part forms in to an undulating plain with average elevation ranging between 300 and 500 metre above mean sea level (m amsl) The general slope is southwards and gentle towards Wardha River, but tends to become steeper in the northern uplands. The entire district is mainly drained by Wardha River and its tributaries viz., Yashoda, Wunna and Bakli. Based on geomorphological setting and drainage pattern, the district is divided into 39 watersheds.

The soil of the district is basically derived form Deccan Trap Basalt and almost entire district consists of black or dark brown soil over a sheet of Deccan Trap Basalt. The soil varies in depth from few centimetres to 3 m with average thickness being about 0.75 m. The soils of the district can be grouped under four main local categories viz., Kali, Morand, Khardi and Bardi, with major part of the district being occupied by Kali soil.

4.0 Ground Water Scenario

4.1 Hydrogeology

The major part of the district is underlain by Deccan lava flows of Upper Cretaceous to Eocene age, whereas Alluvium is restricted along the banks of Wardha River and Yashoda River. A map depicting the hydrogeological features is shown in **Figure-2**.

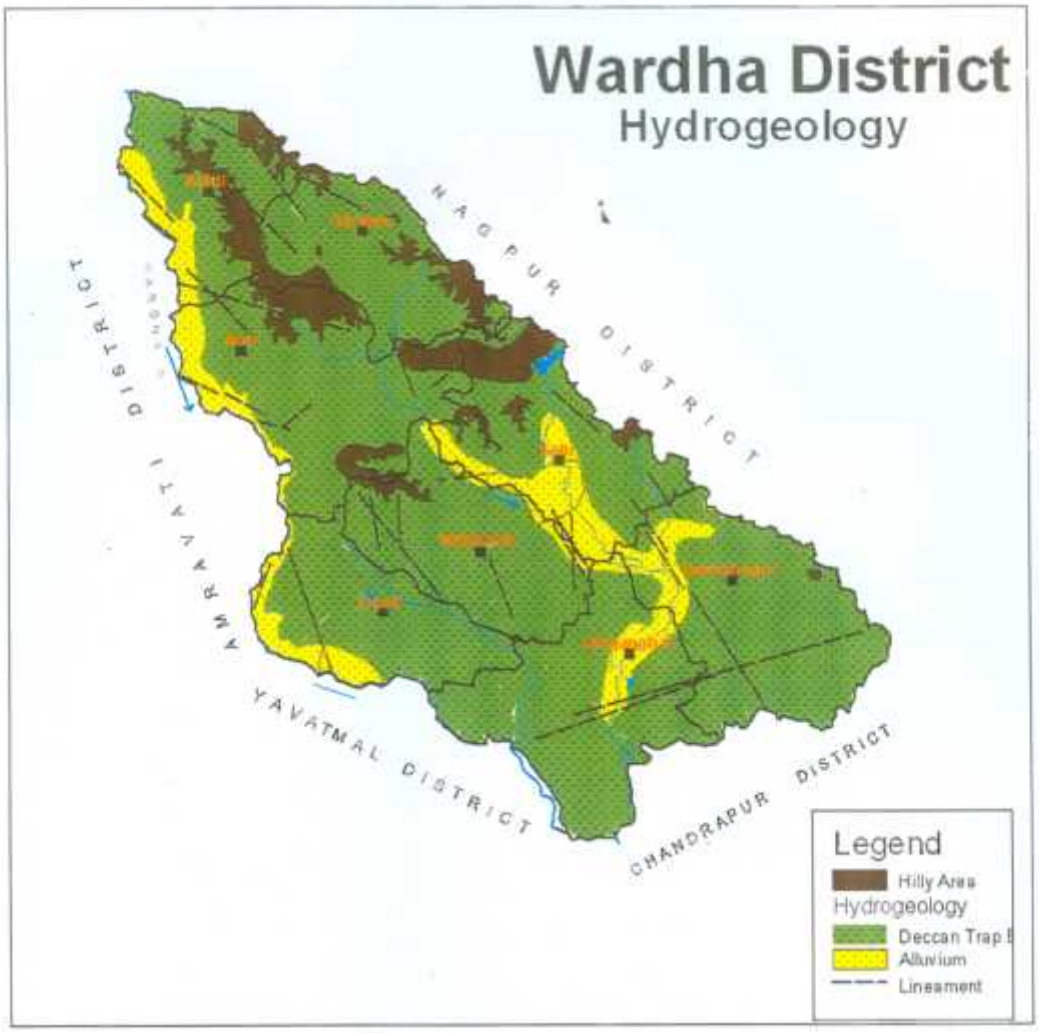

Figure-2: Hydrogeology

4.1.1 Deccan Trap Basalt

Deccan Trap Basalt represents a thick pile of nearly horizontal flows, within these thick piles seven flows have been deciphered down to a depth of 120 m. The porosity and permeability has been found to change in an individual flow, from flow to flow and from place to place.

Ground water in the near-surface strata generally occurs under unconfined conditions but at deeper levels it usually occurs under semi-confined state, the confining layers being red boles and dense massive part of Basalt. Deeper confined aquifers are less productive than shallow semi-confined and phreatic aquifers, unless they have interconnected fracture system, which is being recharged. Weathering of Basalt both in massive and vesicular unit have given rise to good phreatic aquifers even down to a depth of 20 m and these shallow aquifers are extensive and homogeneous. The palaeo-weathering which has taken place during the time intervals between two eruptions has given rise to stratified aquifer systems. Ground water is under semi-confined conditions in these aquifers, which get recharged mainly from downward recharge through shallow aquifers and from major surface

water bodies. Broadly speaking, three distinct aquifer systems are available in the Basalts in areas underlain by Deccan Traps, Wardha district being one such area.

1. Shallow water table or phreatic aquifer down to 20 m depth.

2. Semi-confined aquifers at slightly deeper levels overlain by massive Basalt and red boles from 20 to 40 m depth.

3. Confined aquifers, which are noticed at still deeper levels in flows not exposed and available from about 40 m to about 120 m.

4.1.2 Alluvium

The Alluvial deposits are restricted along the banks of Wardha River and Yashoda River and have limited areal extent. They comprise of upper layer of silt material underlain by a coarse detrital material like sand and gravel with admixture of clay. Coarse detrital material occurring as lenses form good aquifers, whereas finer silt and clayey material are poorly permeable and act as aquiclude. The maximum thickness of Alluvium is about 18 m near Pulgaon, which is situated along the bank of Wardha River elsewhere it is very shallow.

4.1.3 Water Level Scenario

Central Ground Water Board periodically monitors 48 National Hydrograph Network Stations (NHNS) stations in the Wardha district, four times a year i.e. in January, May (Premonsoon), August and November (Postmonsoon). The data on premonsoon and postmonsoon water levels along with fluctuation during 2006 and long term water level trends (1997-06) is given in **Table- 4**.

Table 4: Water Level Data (2006) with Long Term Trend (1997-06).

S. No.	Location	Pre monsoon Water Level (m bgl)	Post monsoon Water Level (m bgl)	Fluctuation (m)	Pre monsoon Trend		Post monsoon Trend	
					Rise (m/yr)	Fall (m/yr)	Rise (m/yr)	Fall (m/yr)
1	2	3	4	5	6	7	8	9
1	Adegaon	10.70	3.88	6.82	0.30		0.34	
2	Ajda	4.75	3.34	1.41		0.07		0.05
3	Alipur	11.65	3.18	8.47		0.11	0.33	
4	Anji	-	-	-		0.02		0.03
5	Arvi	9.05	2.37	6.68		0.19	0.04	
6	Ashti	3.82	1.88	1.94	0.13			0.00
7	Bhidi	-	1.98	-		0.33	0.15	
8	Dahegaon	11.30	3.23	8.07		0.04		0.20
9	Dahigaon	5.85	3.21	2.64		0.13		0.0061
10	Daroda	4.75	2.43	2.32		0.04		0.0092
11	Deoli	4.37	2.14	2.23		0.03	0.04	
12	Dhadi	11.30	6.60	4.70		0.24		0.02
13	Dhondgaon	7.05	3.01	4.04		0.19		0.02
14	Girad	5.35	2.72	2.63	0.11		0.08	
15	Giroli	6.35	3.03	3.32	0.16		0.31	

1	2	3	4	5	6	7	8	9
17	Hingni	9.00	6.22	2.78		0.30		0.15
18	Junapani	3.95	3.89	0.06		0.17		0.07
19	Keljhar	12.30	7.58	4.72		0.21		0.16
20	Khandali	5.70	3.75	1.95	0.46		0.38	
21	Kharangana	5.70	4.05	1.65		0.07		0.03
22	Kurjhadi (Fort)	7.50	2.35	5.15		0.47		0.21
23	Madni (New)	7.05	5.05	2.00		0.10		0.07
24	Muradgaon (Balsare)-1	9.67	8.51	1.16		0.15		0.26
25	Nagalwadi	10.25	3.73	6.52		0.08	0.04	
26	Nandori	-	1.35	-		0.29		0.11
27	Paragothan	8.15	8.15	0.00		0.29		0.18
28	Pipri	6.45	3.65	2.80	0.26			0.15
29	Pulgaon	7.50	5.98	1.52		0.72		0.50
30	Sahur	5.60	3.08	2.52	0.03		0.32	
31	Sakhra	7.00	2.47	4.53	0.0085		0.02	
32	Samudrapur	6.80	2.71	4.09	0.0043			0.0007
33	Sarul	7.95	7.81	0.14	0.24		0.29	
34	Sawangi	2.65	2.94	-0.29	0.12			0.12
35	Selu	10.88	-	-		0.03	0.05	
36	Sirasgaon	6.65	1.44	5.21		0.31		0.10
37	Sirpur	12.55	8.49	4.06		0.02	0.28	
38	Sonegaon	7.90	2.51	5.39	0.09		0.04	
39	Sukli	12.58	12.46	0.12	0.10			0.33
40	Talegaon	5.60	5.08	0.52	0.16			0.04
41	Thanegaon	-	-	-	-	0.25	0.14	
42	Tigaon	5.40	2.55	2.85		0.05		0.02
43	Vadad	6.35	6.48	-0.13	0.01		0.17	
44	Vaygaon	5.95	2.23	3.72	0.10		0.12	
45	Virul	6.90	3.07	3.83		0.14		0.13
46	Wadhona	14.70	3.98	10.72		0.44		0.09
47	Wasi	5.90	1.62	4.28	0.34		0.41	
48	Yelakeli	12.55	10.90	1.65		0.35		0.23

4.1.3.1 Depth to Water Level – Premonsoon (May-2006)

The depth to water level in the district during premonsoon ranges between 2.65 m bgl (Sawangi) and 14.70 m bgl (Wadhona). Depth to water level during premonsoon has been depicted in **Figure-3**. Deeper water levels, i.e., in the range of 10-20 m bgl are seen in isolated patches in parts of Seloo, Deoli, Ashti talukas and extreme northern part of Arvi taluka. The water levels in major part of the district covering entire southern, central and northern parts are shallow in the range of 5-10 m bgl.

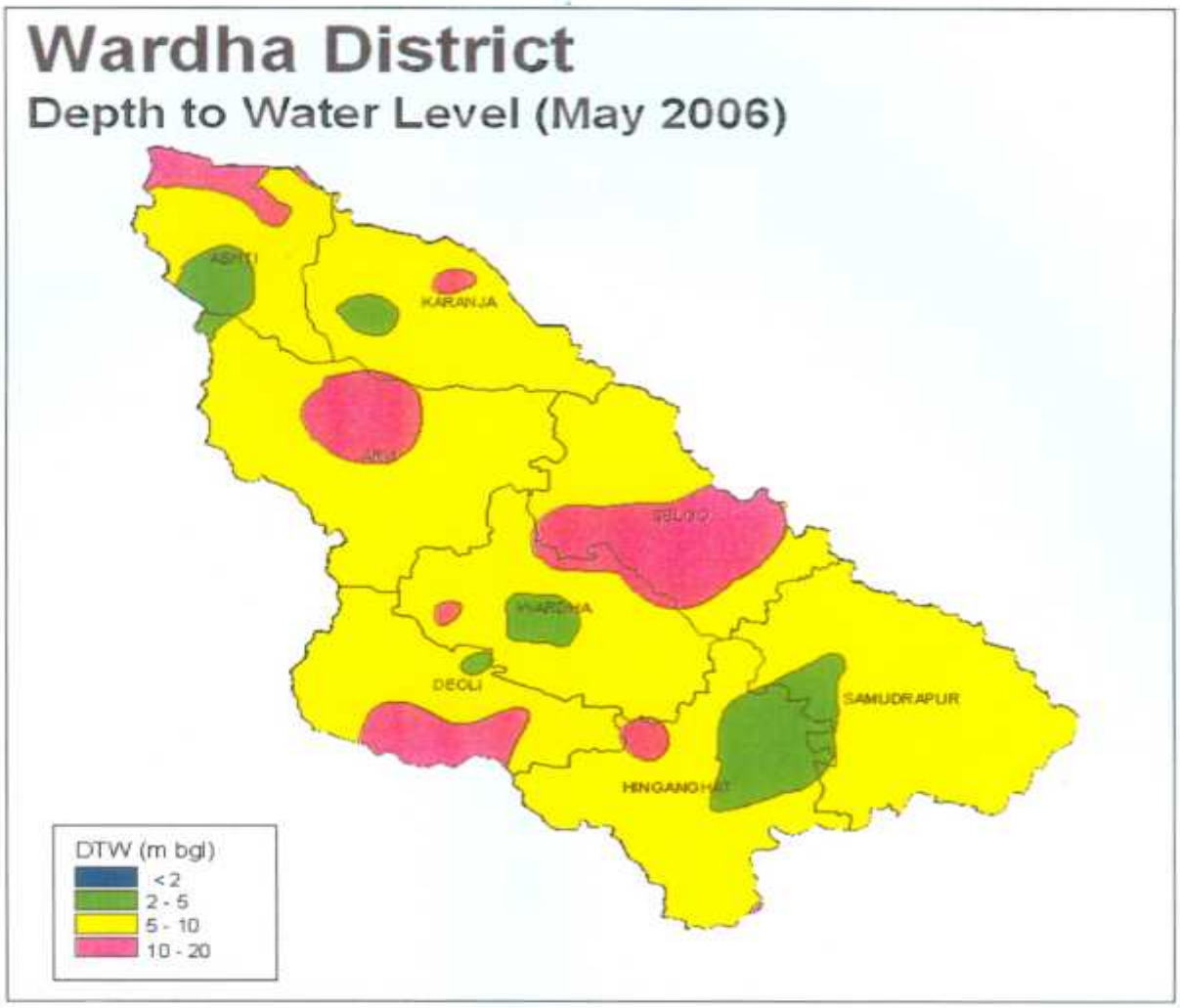

Figure-3: Depth to Water Level (Premonsoon-May 2006)

4.1.4 Depth to Water Level – Postmonsoon (Nov.-2006)

The depth to water level during postmonsoon ranges between 0.77 m bgl (Hinganghat) and 12.46 m bgl (Sukli). Spatial variation in postmonsoon depth to water level is shown in **Figure-4**. Deeper water levels in the range of 10-20 m bgl are observed in isolated patch in southern part of Seloo taluka. The water levels in major part of the district are shallow within 10 mbgl, with water level range of 2-5 m bgl being the most dominant occupying entire stretch from north to south.

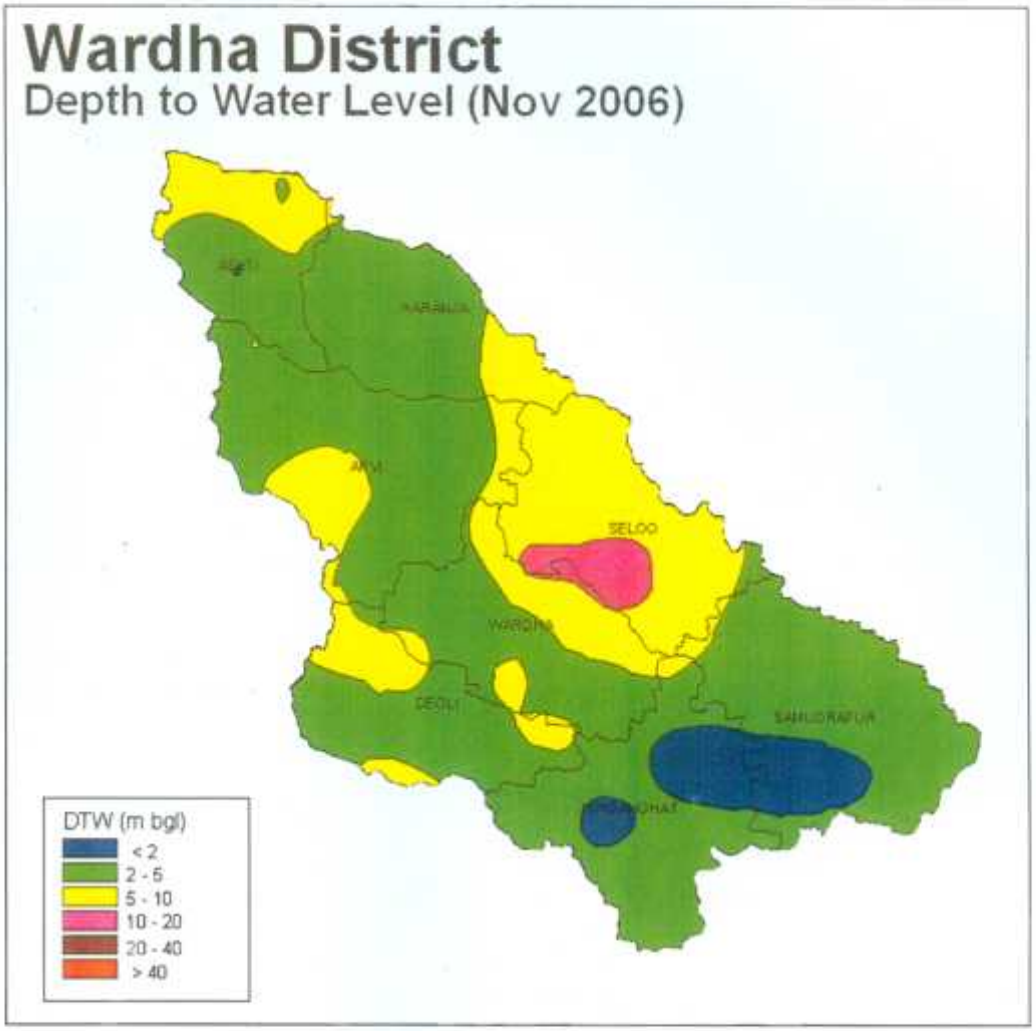

Figure-4: Depth to Water Level (Postmonsoon- Nov. 2006)

4.1.5 Seasonal Water Level Fluctuation– (May-Nov. 2006)

In major part of the district rise in water levels in the range of 0.06 m (Juna Pani) to 10.72 m (Wadhona) is observed, however fall in water levels have also been observed at two places i.e., at Sawangi (0.29m) and Vadad (0.13 m), whereas water level has been maintained at one place i.e., Paragothan. In major part of the district rise in water levels in the range of 0 to > 4 m has been observed in entire south, central and northern parts and rise in the range of 2-4 m is most dominant. Whereas fall in water level is observed in restricted central part of Wardha taluka in the range of 0-2 m.

4.1.6 Water Level Trend (1997-2006)

Trend of water levels for premonsoon and postmonsoon periods for last ten years (1997-2006) have been computed for 48 NHNS and are given in **Table-4**.

Analysis of trend indicates that during premonsoon period, rise in water level has been recorded at 17 stations and it ranges between negligible at few stations and 0.46 m/year (Khandali). Fall in water levels has been observed at 31 stations in the range of 0.02 m/year (Sirpur) to 0.72 m/year (Pulgaon). During postmonsoon period, rise in water levels has been recorded at 20

stations and it ranges from 0.02 m/year (Sakhra) to 0.41 m/year (Wasi), whereas at 28 stations, fall in water level ranging between negligible at few stations and 0.50 m/year (Pulgaon) is observed. Thus in major parts of the district, both during pre and postmonsoon periods declining trend of water levels has been observed.

4.1.7 Aquifer Parameters

Pumping tests conducted on wells piercing Alluvium and Deccan Trap Basalt in the district have revealed that transmissivity for Alluvial formation range from 10.08 to 14.8 m^2/day and permeability from 2.25 to 8.22 m/day.

Pumping tests conducted on exploratory wells piercing Deccan Trap Basalt have revealed that transmissivity varies from 5.27 to 293.30 m^2/day whereas storativity ranges from $4.3x10^{-4}$ to $1.3x10^{-2}$.

4.2 Ground Water Resources

Central Ground Water Board and Groundwater Survey and Development Agency (GSDA) have jointly estimated the ground water resources of Wardha district based on GEC-97 methodology. The same is presented in **Table-5**. Ground Water Resources estimation was carried out for 5340.14 sq. km. area of which 820.25 sq. km is under command and 4519.90 sq. km is non-command. Taluka wise ground water resources are shown in **Figure-5.**

As per the estimation the total annual ground water recharge is 996.80 MCM with the natural discharge of 52.95 MCM, thus the net annual ground water availability comes to be 943.85 MCM. The gross draft for all uses is estimated at 264.48 MCM with irrigation sector being the major consumer having a draft of 247.67 MCM. The domestic and industrial water requirements are worked at 33.41 MCM. The net ground water availability for future irrigation is estimated at 646.69 MCM. Stage of ground water development varies from 15.79% (Ashti) to 67.50% (Karanja). The overall stage of ground water development for the district is 28.02%. In general, the level of ground water development in the district is quite low and all the talukas fall in "Safe" Category. Out of the total 39 watersheds, only 1 watershed (WRJ-4) falls under "Over-Exploited" category; 2 watersheds (WRJ-1 and WRK-2) fall under "Semi-Critical" category; while remaining 36 watersheds fall under "Safe" Category.

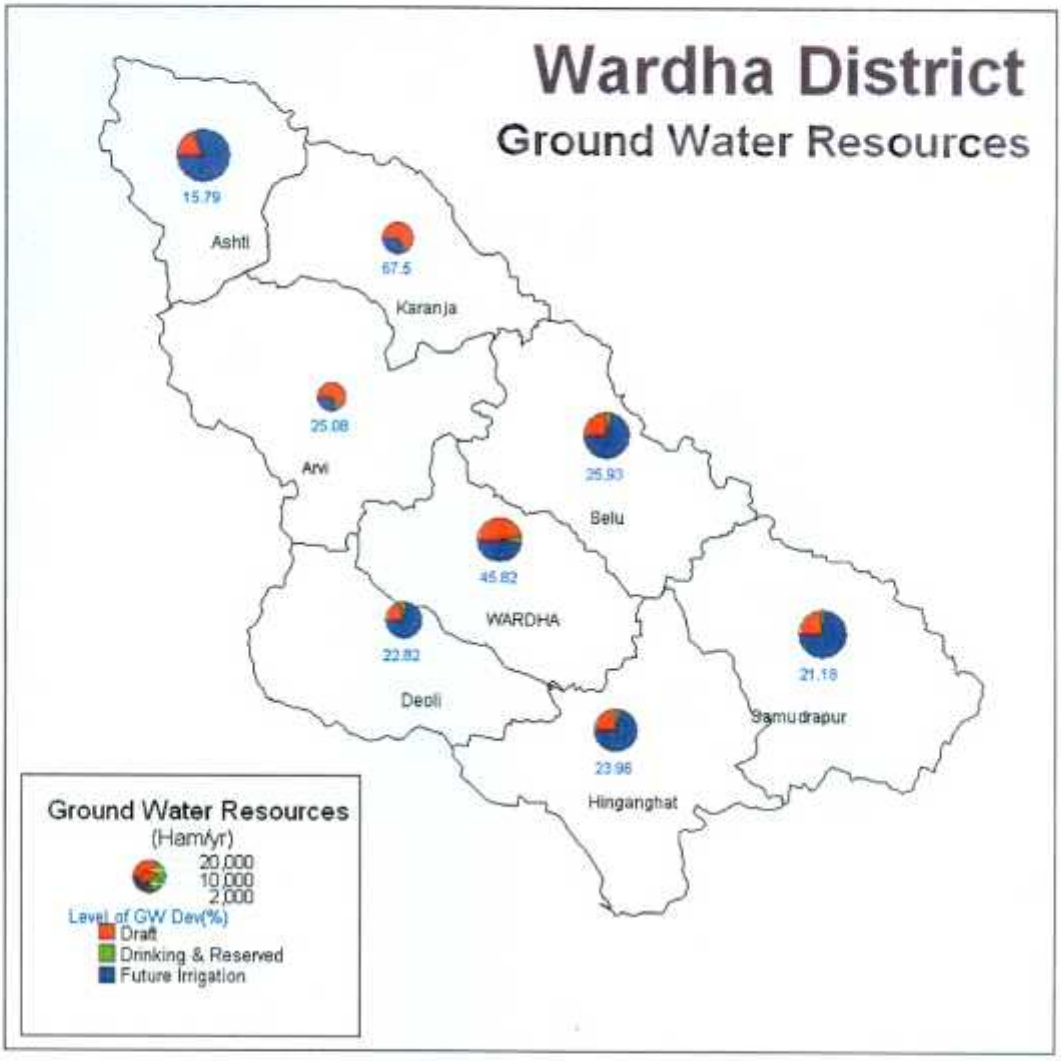

Figure-5: Ground Water Resources

Table-5: Taluka wise Ground Water Resources (March 2004).

Taluka	Area Type	Net Annual Ground Water Availability (ham/yr)	Existing Gross Ground water Draft for Irrigation (ham/yr)	Existing Gross Ground Water Draft for Domestic & Industrial water Supply (ham/yr)	Existing Gross Ground Water Draft for All uses (ham/yr)	Allocation for domestic & industrial requirement supply up to next 25 years (ham/yr)	Net Ground Water Availability for future irrigation development (ham/yr)	Stage of Ground Water Development (%)
WARDHA	COMMAND	2643.93	781.33	48.97	830.30	98.86	769.13	31.40
	NON COMMAND	9179.04	4316.92	270.57	4587.49	540.41	4795.84	49.98
	TOTAL	**11822.97**	**5098.25**	**319.53**	**5417.79**	**639.27**	**5564.97**	**45.82**
SELOO	COMMAND	6660.07	1235.97	96.50	1332.47	150.23	3138.96	20.01
	NON COMMAND	4843.13	1476.21	174.45	1650.65	391.68	5860.55	34.08
	TOTAL	**11503.20**	**2712.18**	**270.95**	**2983.13**	**541.90**	**8999.50**	**25.93**
DEOLI	NON COMMAND	8187.45	1652.81	215.58	1868.40	431.16	5887.90	22.82
HINGANGHAT	COMMAND	164.95	18.20	1.72	19.92	3.03	112.18	12.08
	NON COMMAND	11040.88	2453.16	211.74	2664.90	423.85	7978.90	24.14
	TOTAL	**11205.83**	**2471.36**	**213.46**	**2684.82**	**426.88**	**8091.08**	**23.96**
SAMUDRAPUR	COMMAND	5314.20	732.74	55.10	787.84	109.08	3314.03	14.83
	NON COMMAND	9081.13	2122.06	138.91	2260.97	276.79	6772.29	24.90
	TOTAL	**14395.33**	**2854.79**	**194.01**	**3048.81**	**385.87**	**10086.33**	**21.18**
ARVI	COMMAND	8785.80	720.27	51.28	771.55	104.10	6435.28	8.78
	NON COMMAND	5567.21	2700.86	127.26	2828.12	254.07	5209.91	50.80
	TOTAL	**14353.01**	**3421.13**	**178.54**	**3599.67**	**358.18**	**11645.19**	**25.08**
KARANJA	COMMAND	149.02	31.18	1.58	32.76	3.21	68.11	21.98
	NON COMMAND	6092.25	4034.76	145.32	4180.08	270.52	1932.25	68.61
	TOTAL	**6241.27**	**4065.94**	**146.90**	**4212.84**	**273.72**	**2000.35**	**67.50**
ASHTI	COMMAND	14303.51	769.99	77.85	847.84	159.91	11316.95	5.93
	NON COMMAND	2372.75	1720.61	64.54	1785.15	125.05	1076.47	75.24
	TOTAL	**16676.26**	**2490.60**	**142.39**	**2632.98**	**284.96**	**12393.42**	**15.79**
TOTAL	**COMMAND**	**38021.48**	**4289.69**	**332.98**	**4622.67**	**628.41**	**25154.63**	**12.16**
	NON COMMAND	**56363.84**	**20477.38**	**1348.38**	**21825.76**	**2713.53**	**39514.11**	**38.72**
	TOTAL	**94385.32**	**24767.07**	**1681.36**	**26448.43**	**3341.95**	**64668.73**	**28.02**

4.3 Ground Water Quality

In the district, 28 water samples were collected during May 2006. The geochemical classification of ground water samples is given in **Table-6**.

Table 6: Geochemical Classification of Ground Water Samples.

Sr. No.	Classification	Type	No. of Sample	% of Sample
1	Alkaline earths (Ca+Mg > 50%) exceeds alkali metals and weak acids (CO_3+HCO_3 > 50%) exceeds strong acids	Ca-HCO_3	9	32
2	Alkali metal (Na+K > 50%) exceeds alkaline earths and weak acids (CO_3+HCO_3 > 50%) exceeds strong acids.	Na-HCO_3	2	7
3	Alkaline earths (Ca+Mg > 50%) exceeds alkali metals and strong acids (Cl+SO_4+NO_3 > 50%) exceeds weak acids	Ca-Cl	15	54
4	Alkali metal (Na+K > 50%) exceeds alkaline earths and strong acids (Cl+SO_4+NO_3 > 50%) exceeds weak acids	Na-Cl	2	7
		Total	**28**	**100**

Out of the 28 samples collected for analysis, 26 were representing Deccan Trap Basalt while 2 samples were from Alluvium formation. It is clear from the **Table-6** that 54% and 32% of ground water samples in the district are of Ca-Cl and Ca-HCO_3 type respectively while 7% of samples are each of Na-HCO_3 and Na-Cl type. The previous studies have shown that the ground water in Deccan Trap Basalt formation under natural condition is of Ca-HCO_3 type. However it is observed that 54% of samples have changed from Ca-HCO_3 type to Ca-Cl type. This change in type of water may be due to the percolation of waste and wastewater containing high concentration of strong acids ions (Cl+SO_4+NO_3) to ground water.

4.3.1 Suitability of Ground Water for Drinking Purpose

The suitability of ground water for drinking purpose is determined keeping in view the effects of various chemical constituents in water on the biological system of human being. Though many ions are very essential for the growth of human, but when present in excess, have an adverse effect on human body. The standards proposed by the Bureau of Indian Standards (BIS) for drinking water (IS-10500-91, Revised 2003) were used to decide the suitability of ground water. The classification of ground water samples was carried out based on the desirable and maximum permissible limits for the parameters viz., TDS, TH, Ca, Mg, Cl, SO_4 and NO_3 prescribed in the standards and is given in **Table-7**.

Table-7 Classification of Ground Water Samples based on BIS Drinking Water Standards (IS-10500-91, Revised 2003)

Parameters	DL	MPL	Samples with conc. < DL	Samples with conc. in DL-MPL	Samples with conc. >MPL
TDS (mg/L)	500	2000	6	21	1
TH (mg/L)	300	600	8	15	5
Ca (mg/L)	75	200	11	16	1
Mg (mg/L)	30	100	4	23	1
Cl (mg/L)	250	1000	26	2	0
SO_4 (mg/L)	200	400	26	2	0
NO_3 (mg/L)	45	No relaxation	5	--	23
F (mg/L)	1.0	1.5	28	0	0

(Here, DL- Desirable Limit, MPL- Maximum Permissible Limit.)

The **Table-7** shows that out of the 28 ground water samples, 23 samples (82%) have NO_3 concentration more than MPL (>45 mg/L) while the concentration of all the other parameters is less than MPL. This indicates that the potability of ground water is mainly affected due to NO_3. The potability of ground water in few samples have also been affected due to high TDS, TH and concentration of Ca and Mg ions.

4.3.2 Suitability of Ground Water for Irrigation Purpose

The water used for irrigation is an important factor in productivity of crop, its yield and quality of irrigated crops. The quality of irrigation water depends primarily on the presence of dissolved salts and their concentrations. Sodium Absorption Ratio (SAR) and Residual Sodium Carbonate (RSC) are the most important quality criteria, which influence the water quality and its suitability for irrigation.

4.3.2.1 Sodium Absorption Ratio (SAR)

Sodium Absorption Ratio (SAR) is an expression pertaining to cation make up of water and soil solution and is used for characterizing the sodium hazard of irrigation water.

SAR value is used to calculate the degree to which irrigation water tends to enter into cation exchange section in the soil. The main problem with high sodium concentration is its effect on soil permeability. Sodium also contributes directly to the total salinity of the water and may be toxic to sensitive crops such as fruit trees. The higher value of SAR indicates soil structure damage.

4.3.2.2 Residual Sodium Carbonate (RSC)

Residual Sodium Carbonate (RSC) is considered to be superior to SAR as a measure of sodicity particularly at low salinity levels.The classification of ground water samples based on SAR and RSC values for its suitability for irrigation purpose is shown below in **Table-8**.

Table-8 Classification of Ground Water for Irrigation based on SAR and RSC.

SAR	**<10**		**10-18**		**18-26**		**>26**	
Category	**Good**		**Good to Permissible**		**Doubtful**		**Unsuitable**	
Total Samples	No. of Samples	%	No. of Samples	%	No. of Samples	%	No. of Samples	%
28	27	96	1	4	Nil	Nil	Nil	Nil
RSC	**<1.25**		**1.25-2.50**		**>2.50**			
Category	**Good**		**Doubtful**		**Unsuitable**			
Total Samples	No. of Samples	%	No. of Samples	%	No. of Samples	%		
28	25	89	1	4	2	7		

The **Table-8** shows that SAR and RSC values of majority of ground water samples are less than 10 and 1.25 respectively indicating ground water is good for irrigation purposes. However, the RSC values of ground water samples collected from the wells located at Sukli and Sarul is more than 2.50 suggesting that the ground water from these wells is unsuitable for irrigation purposes. Overall, the ground water quality in the wells monitored is good for irrigation purpose and there is a less possibility of developing sodium hazard.

4.4 Status of Ground Water Development

Ground water development depends on many factors viz., availability, crop water requirement, socio-economic fabric and on the yield of the aquifers existing in that area. The yields of wells are functions of the permeability and transmissivity of aquifer encountered and varies with location, diameter and depth etc. Ground water in the area is being developed by two type of abstraction structures i.e., borewells and dugwells. However dugwells are the main ground water abstraction structures in the district. The yield of dugwells in Deccan Trap Basalt varies from 13.5 to 90.0 m^3/day, whereas those of borewells range from 20 to 440 m^3/day. This variation of yields in the single type of aquifer is due to lateral/spatial variation in permeability of the formation/aquifer material. The yield of dugwells in Alluvium (restricted along river banks) range from 68 to 260 m^3/day

Ground water is predominantly used for irrigation, as it is the major ground water utilising sector. As per 2000-01 data, area irrigated by ground water is 358.80 sq.km., whereas surface water accounts for 187.35 sq.km. and the net irrigated area is 546.15 sq.km. Thus it is clear that ground water is the major source of irrigation as it accounts for about 66% of net irrigated area. There are about 35237 dugwells in the district which create an irrigation potential of 906.74 sq.km., out of which 506.25 sq.km. of irrigation potential is utilised. In addition to this irrigation potential of 2.23 sq.km. is utilised through 116 borewells/tubewells during 2000-01.

State Government has drilled large number of borewells fitted with hand pumps and electric motors for rural drinking water purposes in the district. In all till March 2003, GSDA, Government of Maharashtra was successfully operating 3052 borewells for rural water supply under various schemes in the district, out of which 216 are fitted with electric pumps and the rest with hand pumps.

5.0 Ground Water Management Strategy

Ground water has special significance for agricultural development in the State of Maharashtra. The ground water development in some parts of the State has reached a critical stage resulting in decline in ground water levels. There is thus a need to adopt an integrated approach of development of ground water resources dovetailed with ground water augmentation to provide sustainability to ground water development.

5.1 Ground Water Development

Almost entire district is underlain by the Deccan Trap Basalt formation. Isolated areas in the northern and central part of the district are hilly and have poor ground water development potential. The ground water development potential is low in the northern part, along the hills, in parts of Ashti, Arvi and Karanja talukas. Deccan Trap Basalt areas with low development potential are also seen in Deoli, Wardha and Samudarpur talukas. Major part of the district spread over all the talukas has medium ground water development potential. Areas with high development potential are located in parts of Deoli, Wardha, Hinganghat and Samudrapur talukas. The ground water in areas underlain by Deccan Trap Basalt may be developed through dugwells and dug-cum-bored wells (DCB). Borewells may be suitable at locations where fractured Basalt or inter-low zones form the deeper aquifer, particularly the area with high development potential. However, the sites for borewells may be located after proper scientific investigations.

The yield of the dugwells in the Deccan Traps may be expected between 10 and 70 m^3/day depending on the location and season. The wells tapping vesicular basalt and inter-flow zones may have higher yields, up to 90 m^3/day.

Alluvial aquifers in the district are restricted to small areas along the rivers and do not form significant aquifer. The ground water in these areas may be developed through dugwells and shallow tubewells and the yields are expected to be between 50 and 250 m^3/day. The nature and yield potential of the aquifers occurring in different areas is given below in **Table-9**, whereas the map is presented as **Figure-6**.

Table-9: Nature and Yield Potential of Aquifers

Sr. No.	Taluka	Main Aquifer	Yield Potential	Type of Wells Suitable
1.	Arvi	Basalt	Low to Medium	Dugwell DCB
2.	Ashti	Basalt	Low to Medium	Dugwell DCB
3.	Deoli	Basalt	Low to High	Dugwell DCB Borewell
4.	Hinganghat	Basalt	Medium to High	Dugwell DCB Borewell
5.	Karanja	Basalt	Low to Medium	Dugwell DCB

Sr. No.	Taluka	Main Aquifer	Yield Potential	Type of Wells Suitable
6.	Samudrapur	Basalt	Low to Medium	Dugwell DCB
7.	Seloo (South Western part- along Dham River)	Alluvium	Medium to High	Dugwell DCB Tubewell
7a	Seloo (Eastern Part)	Basalt	Medium	Dugwell DCB
8.	Wardha	Basalt	Medium to High	Dugwell DCB Borewell

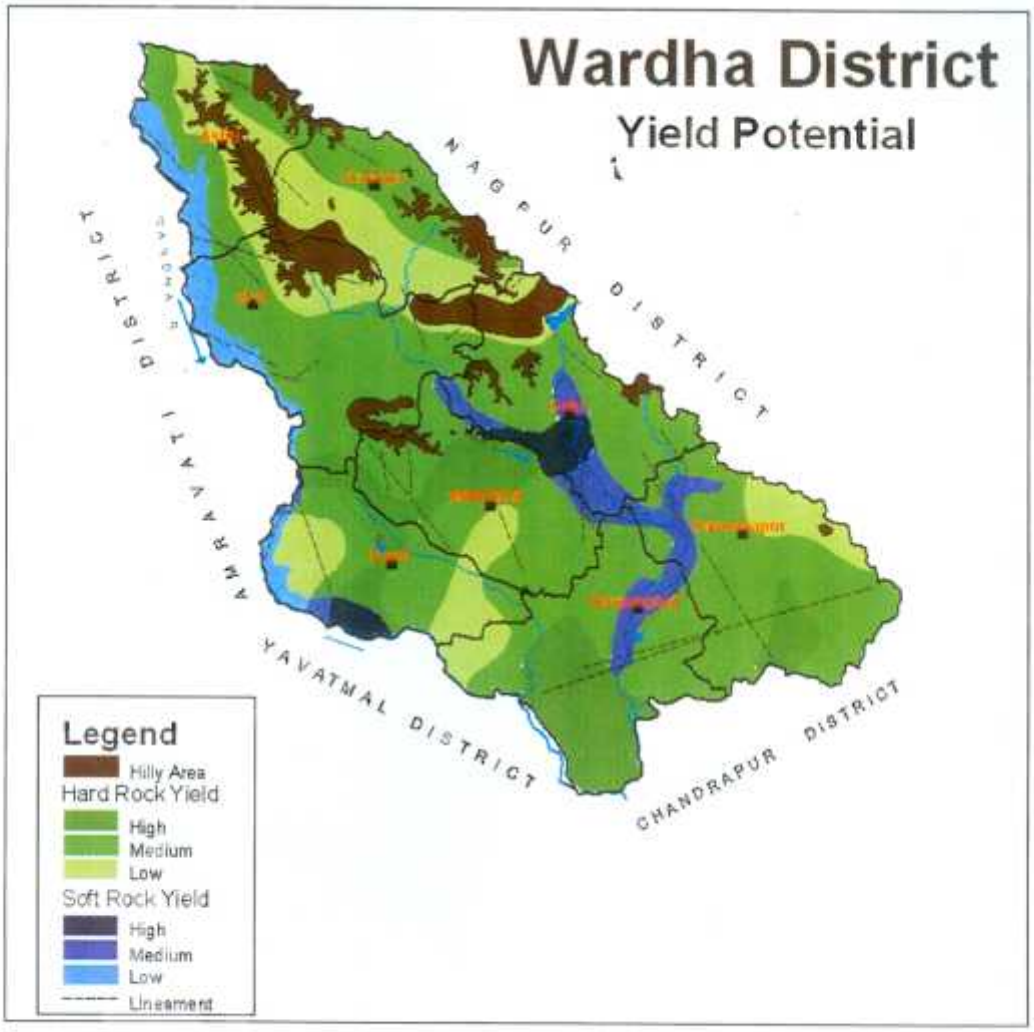

Figure-6: Yield Potential

5.2 Water Conservation and Artificial Recharge

In Basaltic area, the artificial recharge structures feasible are check dams, gully plugs, percolation tanks, nalla bunds, etc. The structures like gully

plugs, contour bunds are most favourable in hilly areas, particularly in parts of Arvi, Ashti, Karanja and Seloo talukas. Existing dugwells can also be used for artificial recharge, however, the source water should be properly filtered before being put in the wells. The most feasible artificial recharge structure suitable for Alluvial areas restricted along the banks of Wardha River and its tributaries, are shallow recharge wells on the river bed of the tributaries. Percolation tanks are also suitable, wherever source water availability is there.

The sites for artificial recharge structures need to be located where the hydrogeological conditions are favourable, i.e., where sufficient thickness of de-saturated/unsaturated aquifer exists and water levels are more than 5 m deep.

6.0 Ground Water Related Issues and Problems

The moderate drought area has been observed in the north western part of the district i.e., in major part of Ashti, Karanja and Arvi talukas. The average annual rainfall during 1997-2005 is also minimum in this part. Thus future water conservation and artificial recharge structures in the district may be prioritised in this part of the district. Ground water quality is adversely affected by nitrate contamination in 82% of the samples collected in May 2006. Continues intake of high nitrate concentration water causes infant methaemoglobinamea, popularly known as Blue Babies disease. Thus all the wells used for water supply should be first analysed for nitrate contents and if the nitrate content is found beyond permissible limit the ground water may be used for other purposes than drinking. Adequate sanitary protection to the wells may be provided to control the nitrate contamination.

7.0 Mass Awareness and Training Activities

7.1 M.A.P. and W.M.T.P.

Till March 2007, 2 MAP and 1 WMTP had been organised in the district. The details are given in **Table-10**.

Table-10: Status of MAP and WMTP.

S. No.	Item	AAP	Venue	Date	No of Persons Attended
1.	MAP	2001-02	Selu	08/03/02	200
2.	MAP	2006-07	Wardha	22/12/06	200
3.	WMTP	2006-07	Wardha	04&05/01/07	25

7.2 Participation in Exhibition, Mela, Fair etc.

During the MAP and WMTP at Wardha, an exhibition depicting rainwater harvesting model, various ground water related posters, leaflets, literature and technical reports were displayed along with maps of Wardha district. The models, maps, posters were explained to the visitors in details.

8.0 Areas Notified by CGWA/SGWA

As per ground water resource estimation all the talukas fall under "Safe" category, hence till March 2007 the area has not been notified either by CGWA or SGWA.

9.0 Recommendations

1 The major part of the district is underlain by Deccan Trap Basalt, where dugwells are the most feasible structures for ground water development. The sites for borewells need to be selected only after proper scientific investigation.

2 Borewells generally tap deeper fractures and inter flow zones, which may not be sustainable. Besides, the borewells should only be used for drinking water supply and not for irrigation.

3 Ground water quality is adversely affected by nitrate contamination in 82% of the samples collected in May 2006. Thus all the wells used for water supply should be first analysed for nitrate contents and if the nitrate content is found beyond permissible limit the ground water may be used for other purposes than drinking. Adequate sanitary protection to the wells may be provided to control the nitrate contamination.

4 The overall stage of ground water development for the district is only 28%, thus a lot of scope for further development exists.

5 The level of ground water development in Karanja has already reached 67%, therefore further development should be done with caution. Out of the total 39 watersheds, only 1 watershed (WRJ-4) falls under "Over-Exploited" category, here also further ground water development is not recommended. Whereas dual approach of development coupled with artificial recharge measures needs to be adopted in 2 watersheds (WRJ-1 and WRK-2) falling under "Semi-Critical" category. Thus future water conservation and artificial recharge structures needs to prioritised in these parts as well as in the drought area i.e., in parts of Ashti, Karanja and Arvi talukas.

6 The scope exists for construction of suitable artificial recharge structures in the district. The structures recommended for the hilly-Basaltic area in the northern part are: contour bunds, gully plugs, nala bunds and check dams. For other Basaltic areas, the nala bunds, check dams and KT weirs are suggested. The existing dugwells may also be used for artificial recharge of ground water provided source water is free of silt and dissolved impurities.

7 The most feasible artificial recharge structure suitable for Alluvial areas restricted along the banks of Wardha River and its tributaries, are shallow recharge wells on the river bed of the tributaries. Percolation tanks are also suitable, wherever source water availability is there.

8 The existing village ponds need to be rejuvenated to act both as water conservation and artificial recharge structures.