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भारत सरकार

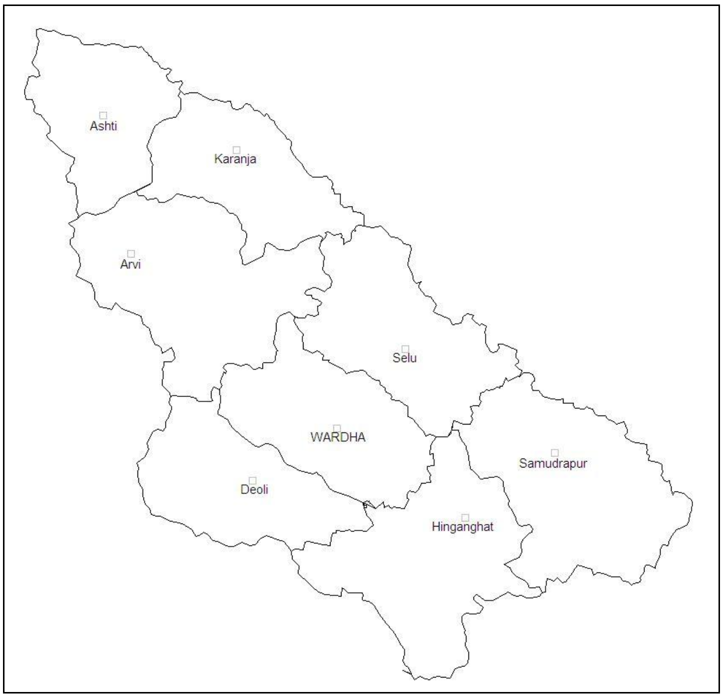
जल संसाधन मंत्रालय

केंद्रीय भूजल बोर्ड

GOVERNMENT OF INDIA
MINISTRY OF WATER RESOURCES
CENTRAL GROUND WATER BOARD

महाराष्ट्र राज्य के अंतर्गत वर्धा जिले की भूजल विज्ञान जानकारी

GROUND WATER INFORMATION WARDHA DISTRICT, MAHARASHTRA



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मध्य क्षेत्र, नागपुर

CENTRAL REGION
NAGPUR
2013

WARDHA DISTRICT AT A GLANCE

1.	**GENERAL INFORMATION**		
	Geographical Area	:	6310 sq. km.
	Administrative Divisions	:	Taluka-8; Wardha, Deoli, Selu, Arvi, Ashti, Karanja, Hinganghat, Samudrapur.
	Villages	:	1361
	Population (2001 Census)	:	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** (2008-09)		
	Forest Area	:	590.13 sq. km.
	Net Area Sown	:	187.00 sq. km.
	Cultivable Area	:	2568.41 sq. km.
4.	**SOIL TYPE**		
	Black or Dark Brown soil viz., Kali, Morand, Khardi and Bardi.		
5.	**PRINCIPAL CROPS** (2008-09)		
	Wheat		106.56 sq. km.
	Jowar		224.53 sq. km.
	Cotton		845.26 sq. km
	Total Pulses	:	341.61 sq. km
6.	**IRRIGATION BY DIFFERENT SOURCES** (2006-07 MI CENSUS) **- Nos./Potential Created (ha)**		
	Dugwells	:	47294/99920
	Borewells	:	70/176
	Surface Flow Schemes	:	607/1702
	Surface Lift Schemes	:	1184/3339
	Net Potential Created	:	105137 ha
7.	**GROUND WATER MONITORING WELLS** (As on Nov 2012)		
	Dugwells	:	38
	Piezometers	:	17
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-2011)	:	3.45 to 22.50 m bgl
	Postmonsoon Depth to Water Level (Nov.-2012)	:	1.50 to 10.3 m bgl
	Premonsoon Water Level Trend (2001-10)	:	Rise: 0.007 to 0.39 m/year Fall: 0.0084 to 0.71 m/year

Postmonsoon water level trend (2001-10)	:	Rise: 0.003 to 0.51 m/year Fall: 0.02 to 0.093 m/year

10. GROUND WATER EXPLORATION (As on 31/03/12)

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 31/03/2009)

Net Annual GW availability	:	1018.56 MCM
Total Draft (Irrigation + Domestic)	:	333.83 MCM
Projected Demand (Domestic + Industrial)	:	71.47 MCM
Stage of Ground Water Development	:	32.77%

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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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.	K. Dongre, Sc-C	2009-10	Ground Water Management Studies in 5 Farmer’s Districts

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**.

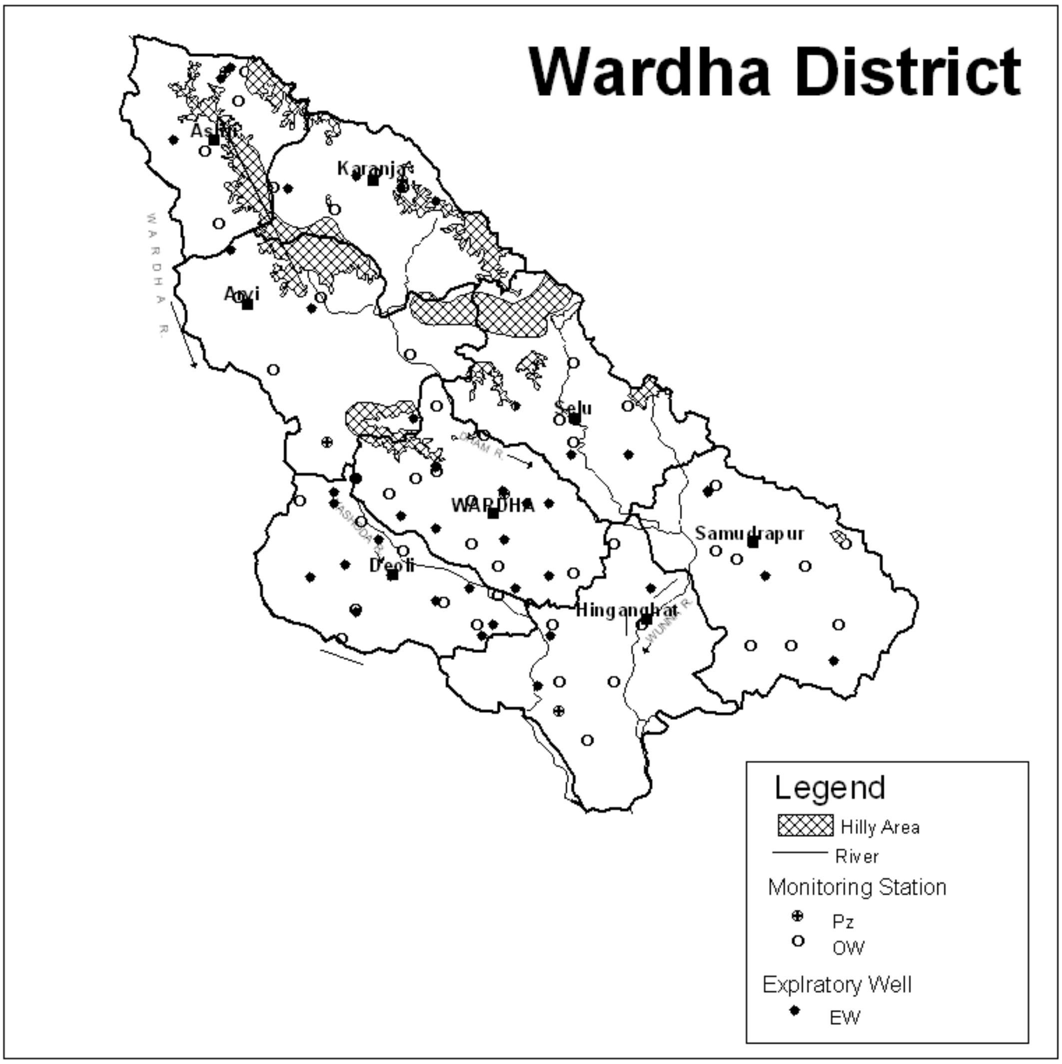

Figure-1: Location

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°C and mean maximum temperature is 42.8°C.

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 807.6 mm (Ashti) to 1152.5 mm (Seloo) and the same is presented in **Table-3**.

Table 3: Annual Rainfall Data (2002-2011). (mm)

Taluka	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Average
Wardha	864.6	951.1	885.4	1121	940.3	1152.9	**892.7**	617.3	1393.4	927.9	**974.7**
Seloo	1279.5	968	1105	1395	1084.3	1643.1	**986.1**	758.3	1329.5	976	**1152.5**
Deoli	941.7	967	739.6	1165			682.3	581	1242.6	1013.8	**916.6**
Hinganghat	988.2	1048.2	956.9	1246.9			1011	769.3	1513.6	941.4	**1059.4**
Samudrapur	1074	1112	882.8	1281.2			733.9	772.9	1440.2	1108.5	**1050.7**
Arvi	793.9	863.7	789.5	1216.7	1146	1132	**977.6**	605	1147.1	1109.9	**978.1**
Ashti	760.6	706.8	699	1020	843.7	1203.3	**578.8**	569.4	873.6	820.4	**807.6**
Karanja	876	910.5	879.5	1051.3	958.7	1061.6	705.2	702.2	1253	924	**932.2**
Average	**947.3**	**940.9**	**867.2**	**1187.1**	**994.6**	**1238.6**	**821.0**	**671.9**	**1274.1**	**977.7**	

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 2005, 2006 and 2010 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**.

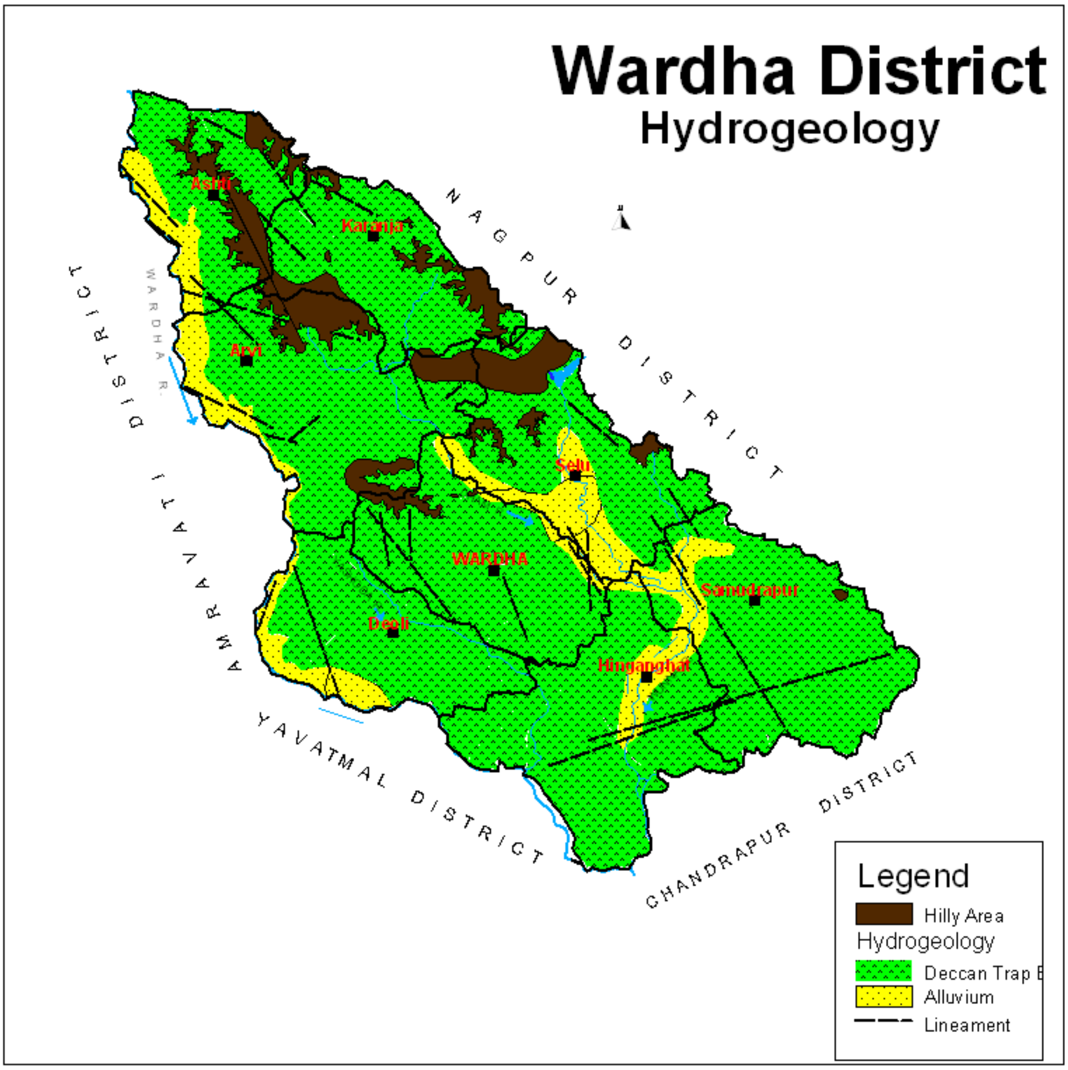

Figure-2: Hydrogeology

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 55 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 2011 and long term water level trends (2001-2010) is given in **Table- 4**.

Table 4: Water Level Data (2011) with Long Term Trend (2001-2010).

Sl No	Location	Premonsoon DTW (mbgl)	Post monsoon DTW (mbgl)	Fluctuation (m)	Pre monsoon Trend (m/Yr)		Post monsoon Trend (m/Yr)	
					Rise	Fall	Rise	Fall
1	Adegaon_pz		5.2		0.27		0.51	
2	Ajda	4.3	3.6	0.7		0.17		0.03
3	Alipur	7.85	3.7	4.15		0.03	0.01	
4	Anji	7.65	6.5	1.15		0.01		0.08
5	Arvi_Pz		5.1		0.007		0.14	
6	Ashti	3.7	1.6	2.1	0.02		0.02	
7	Ashti_Pz		4.6					
8	Bhidi	5.9	2.8	3.1		0.01	0.11	
9	Dahegaon		3.8			0.0420	0.34	
10	Dahigaon	5.35	3	2.35		0.0151	0.06	
11	Daroda	4.4	2.9	1.5		0.0631	0.03	
12	Deoli	7.1	1.6	5.5		0.7111		0.09
13	Dhadi	10.9	9.7	1.2	0.32		0.3	
14	Dhondgaon		3.9		0.16			
15	Girad	6.5	2.9	3.6	0.0210		0.13	
16	Giroli	6.5	3.7	2.8	0.0801			0.02
17	Hinganghat	2.4	5.9	-3.5		0.13	0.05	
18	Hingni	7.41		7.41	0.0544		0.11	

19	Junapani	3.8	2.1	1.7	0.1245			0.02
20	Junapani_Pz		2.5					
21	Keljhar	9.63	6.9	2.73	0.08			0.09
22	Khandali		4.9			0.08	0.27	
23	Kharangana	6.3	4	2.3	0.21		0.03	
24	Madni (New)		6.7			0.18	0.11	
25	Muradgaon (Balsare)1	5.1	2.5	2.6		0.2	0.51	
26	Nagalwadi	9.7	3.9	5.8		0.1		
27	Nandgaon Borgaon_Pz		2.4					
28	Nandori_Pz		6.4			0.15	0.09	
29	Paragothan	3.5	2.4	1.1	0.07		0.33	
30	Pipri	7.1	4.3	2.8		0.12	0.08	
31	Pulgaon	7.9	5.2	2.7		0.52		0.38
32	Sahur	7.8	4.5	3.3	0.07		0.21	
33	Sakhra	7	6.7	0.3		0.23	0.23	
34	Samudrapur	7.2	3	4.2		0.14	0.13	
35	Sarul		6.1			0.15		0.17
36	Sarul_Pz		6.2					
37	Sawangi	4.7	3	1.7	0.07		0.11	
38	Selu_Pz		7					
39	Selu	9.4		9.4		0.08		
40	Sirasgaon2	7.75	4	3.75			0.08	
41	Sirasgaon_Pz		4.1					
42	Sirpur	10.7	7.9	2.8		0.08	0.04	
43	Sonegaon	8.3	2.9	5.4		0.08	0.17	
44	Sukli		11.7			0.37	0.46	
45	Thanegaon2		4.1				0.21	
46	Tigaon	4.7	2.3	2.4	0.09		0.1	
47	Vadad	8.4		8.4	0.25		0.15	
48	Virul		3.3			0.01	0.15	
49	Wadhona	8			0.27			0
50	Wardha	5.65						
51	Wasi	6.2			0.06		0.13	
52	Yelakeli	10.9	9.7	1.2			0.12	

4.1.3.1 Depth to Water Level – Premonsoon (May-2011)

The depth to water level in the district during premonsoon ranges between 2.40 m bgl (Hinganghat) and 10.9 m bgl (Yelakeli). 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 small patch in parts of Seloo, 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. Shallow water level of 2-5m are observed in small patches in parts of Asti, Karanja, Alvi, Wardha, Samudrapur and Hinganghat Taluks.

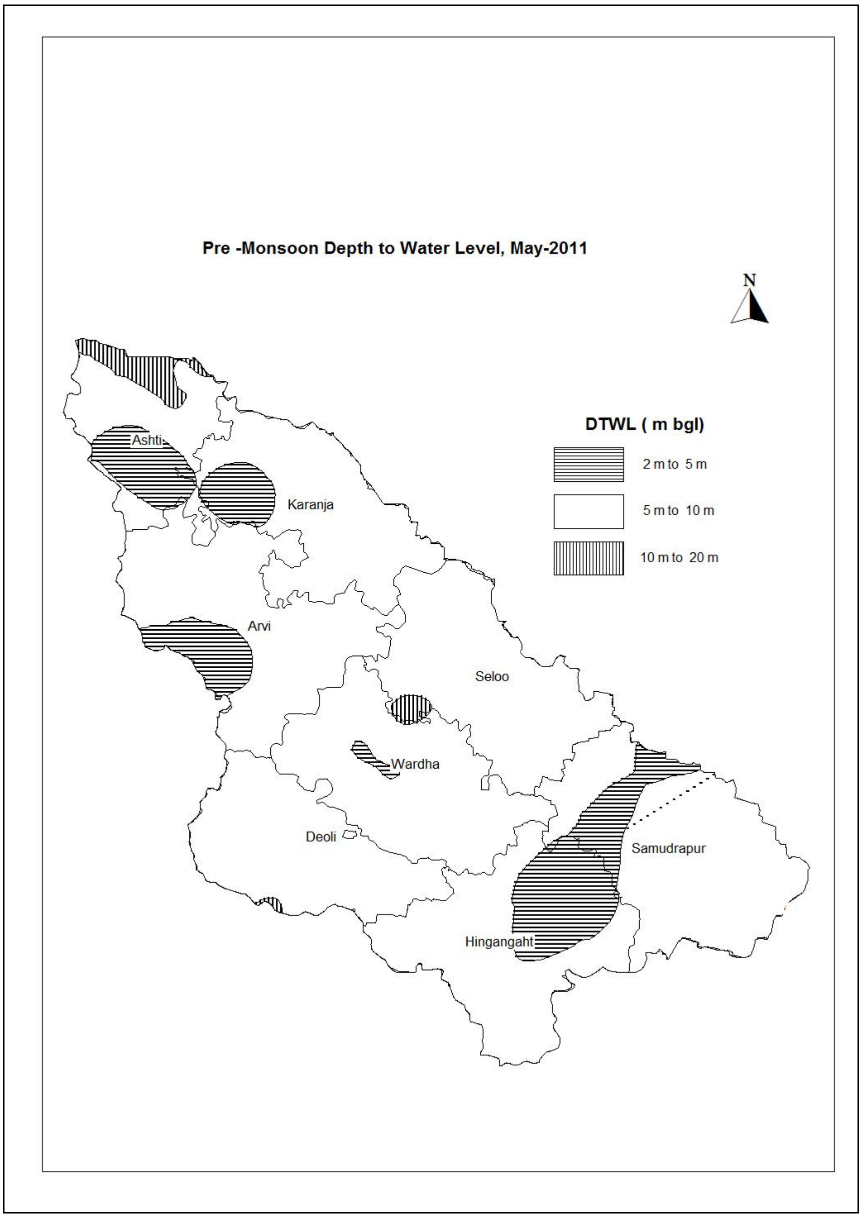

Figure-3: Depth to Water Level (Premonsoon-May 2011)

4.1.4 Depth to Water Level – Postmonsoon (Nov.-2011)

The depth to water level during postmonsoon ranges between 1.6 m bgl (Ashti) and 11.7 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 small patch in southern part of Seloo taluka. The water levels in the range of 5-10 mbgl are observed in parts of Asti. Karanja, Samudrapur, Hinganghat, Deoli, Wardha and in Major part of Deoli. The with water level range of 2-5 m bgl being the most dominant occupying entire stretch from north to south.

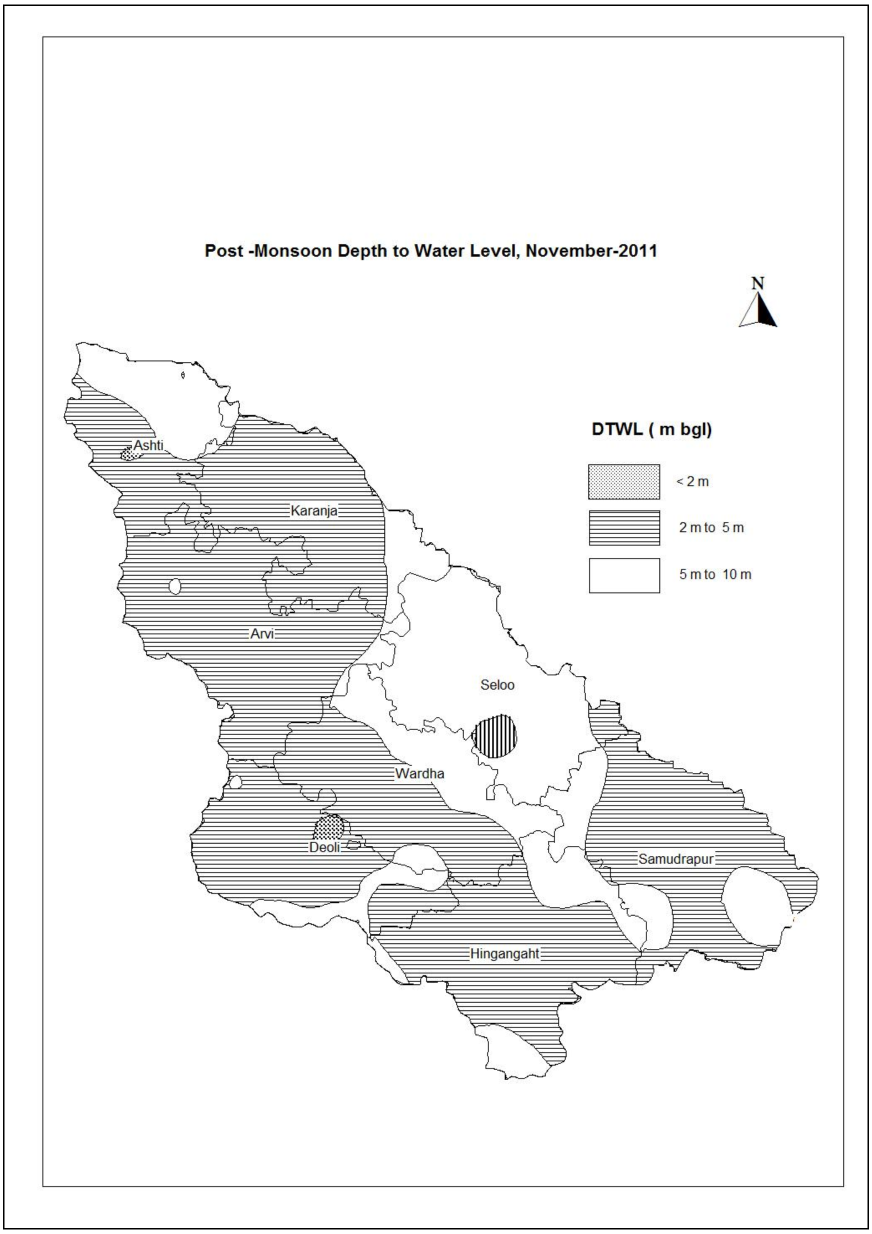

Figure-4: Depth to Water Level (Postmonsoon- Nov. 2011)

4.1.5 Seasonal Water Level Fluctuation– (May-Nov. 2011)

10 Wells have recoded rise of water level in the range of 0.3 to 2m, where as 13 wells have recorded rise in the range of 2-4m. 9 wells have recorded rise of 4-9m. Only one well at Hingaghat has recorded fall of 3.5 m. Major part of the district has recorded rise of water level. The range of 2-4 m is most dominant. Whereas fall in water level is observed in restricted part of Hinganghat taluka.

4.1.6 Water Level Trend (2001-10)

Trend of water levels for premonsoon and postmonsoon periods for last ten years (2001-10) have been computed for 52 NHNS and are given in **Table-4**.

Analysis of trend indicates that during premonsoon period, rise in water level has been recorded at 18 stations and it ranges between 0.02 (Ashti) and and 0.32 m/year (Dhadi). Fall in water levels has been observed at 24 stations in the range of 0.01 m/year (Bhidi) to 0.71 m/year (Deoli).

During postmonsoon period, rise in water levels has been recorded at 33 stations and it ranges from 0.01 m/year (Alipur) to 0.51 m/year (Muradgaon), whereas at 8 stations, fall in water level ranging between negligible at few stations and 0.38 m/year (Pulgaon) is 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 as on 2009. 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 1075.67 MCM with the natural discharge of 57.10 MCM, thus the net annual ground water availability comes to be 1018.56 MCM. The gross draft for all uses is estimated at 333.83 MCM with irrigation sector being the major consumer having a draft of 298.09 MCM. The domestic and industrial water requirements are worked at 71.47 MCM. The net ground water availability for future irrigation is estimated at 648.99 MCM. Stage of ground water development varies from 15.26% (Ashti) to 62.29% (Karanja). The overall stage of ground water development for the district is 32.77%. In general, the level of ground water development in the district is quite low and all the talukas fall in "Safe" Category. .

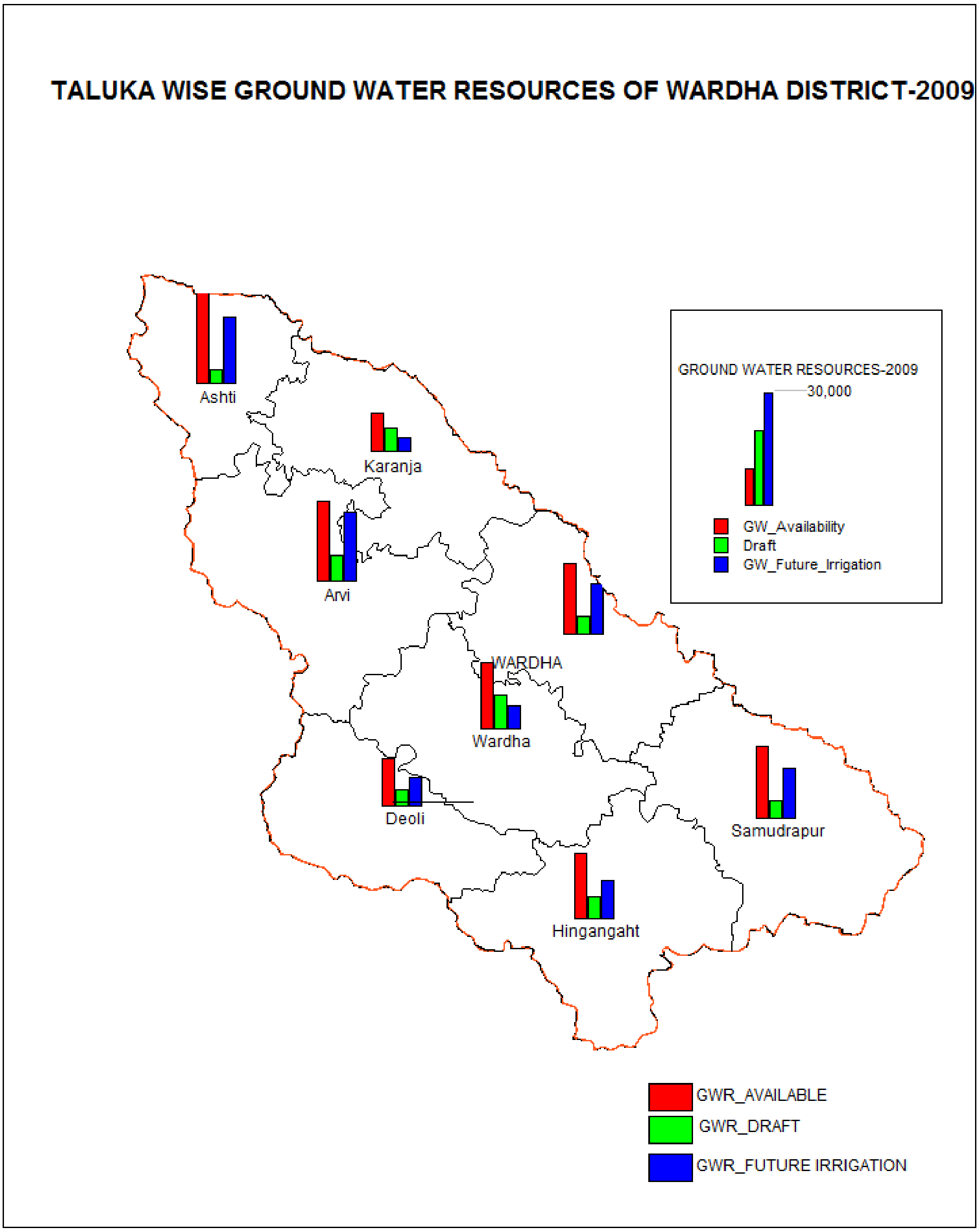

Figure-5: Ground Water Resources

Table-5: Taluka wise Ground Water Resources (March 2009).

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	3225.13	971.13	79.28	1050.41			
	NON COMMAND	9234.48	5017.92	544.55	5562.47			
	TOTAL	**12459.62**	**5989.05**	**623.83**	**6612.88**	**1241.71**	**4619.86**	**53.07**
SELOO	COMMAND	9987.54	1145.46	155.92	10301.37			
	NON COMMAND	3263.64	1874.38	272.01	2146.38			
	TOTAL	**13251.17**	**3019.83**	**427.92**	**3447.76**	**842.49**	**9515.30**	**26.02**
DEOLI	NON COMMAND	9169.93	2729.36	353.24	3082.60	706.47	5734.10	33.62
HINGANGHAT	COMMAND	1806.49	522.43	58.24	580.67			
	NON COMMAND	10267.39	3132.17	554.40	3686.57			
	TOTAL	**12073.88**	**3654.60**	**612.64**	**4267.24**	**1223.85**	**7189.43**	**35.34**
SAMUDRAPUR	COMMAND	5856.67	952.49	113.71	1066.19			
	NON COMMAND	7592.40	2336.10	217.62	2553.73			
	TOTAL	**13449.07**	**3288.59**	**331.33**	**3619.92**	**681.08**	**9413.63**	**26.92**
ARVI	COMMAND	6679.77	378.49	42.27	420.76			
	NON COMMAND	8371.23	3804.08	617.92	4422.00			
	TOTAL	**15050.99**	**4182.57**	**660.20**	**4842.76**	**1178.12**	**12930.46**	**32.18**
KARANJA	COMMAND	98.78	8.52	0.81	9.33			
	NON COMMAND	7304.07	4328.84	272.90	4601.74			
	TOTAL	**7402.85**	**4337.36**	**273.72**	**4611.08**	**530.07**	**2953.07**	**62.29**
ASHTI	COMMAND	15910.58	859.33	97.46	956.78			
	NON COMMAND	3088.38	1749.06	193.32	1942.38			
	TOTAL	**18998.97**	**2608.39**	**290.77**	**2899.16**	**743.50**	**12543.59**	**15.26**
TOTAL	**COMMAND**	**43564.96**	**4837.85**	**547.69**	**5385.54**			
	NON COMMAND	**58291.52**	**24971.91**	**3025.96**	**27997.87**			
	TOTAL	**101856.5**	**29809.76**	**3573.65**	**33383.41**	**7147.29**	**64899.44**	**32.77**

4.3 Ground Water Quality

CGWB is monitoring the ground water quality of the Nagpur district since the last four decades through its established monitoring wells. The objectives behind the monitoring are to develop an overall picture of the ground water quality of the district. During the year 2011, the Board has carried out the ground water quality monitoring

Of 23 monitoring wells. These wells mainly consist of the dug wells representing the shallow aquifer. The sampling of ground water from these wells was carried out in the month of May 2011 (pre-monsoon period). The water samples after collection were immediately subjected for the analysis of various parameters in the Regional Chemical Laboratory of the Board at Nagpur. The parameters analyzed, include pH, Electrical Conductivity (EC), Total Alkalinity (TA), Total Hardness (TH), Nitrate (NO_3) and Fluoride (F). The sample collection, preservation, storage, transportation and analysis were carried out as per the standard methods given in the manual of American Public Health Association for the Examination of Water and Wastewater (APHA, 1998). The ground water quality data thus generated was first checked for completeness and then the validation of data was carried out using standard checks. Subsequently, the interpretation of data was carried out to develop the overall picture of ground water quality in the district in the year 2011.

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., TA, TH, NO_3 and F prescribed in the standards and is given in **Table-6**.

Table-6: Classification of Ground Water Samples for Drinking 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
TA (mg/L)	200	600	11	12	-
TH (mg/L)	300	600	7	12	4
NO_3 (mg/L)	45	No relaxation	4	-	19
F (mg/L)	1.0	1.5	23	-	-

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

The perusal of **Table-6** shows that the concentrations of all the parameters except nitrate in most of the samples are above the maximum permissible limit of the BIS standards. It is also seen from the **Table-6** that the potability of ground water in the wells is mainly affected due to the Nitrate (NO_3) as its concentration exceeds more than MPL in 83% of samples. Overall, it can be concluded that the ground water quality in the wells monitored in the district is affected because of high NO_3 concentrations.

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. Electrical Conductivity (EC) and Residual Sodium Carbonate (RSC) are the most important quality criteria, which influence the water quality and its suitability for irrigation.

Electrical Conductivity (EC)

The amount of dissolved ions in the water is best represented by the parameter electrical conductivity. The classification of water for irrigation based on the EC values is as follows.

Low Salinity Water (EC: 100-250 µS/cm): This water can be used for irrigation with most crops on most soils with little likelihood that salinity will develop.

Medium Salinity Water (EC: 250 – 750 µS/cm): This water can be used if moderate amount of leaching occurs. Plants with moderate salt tolerance can be grown in most cases without special practices for salinity control.

High Salinity Water (EC: 750 – 2250 µS/cm): This water cannot be used on soils with restricted drainage. Even with adequate drainage, special management for salinity control may be required and plants with good salt tolerance should be selected.

Very High Salinity Water (EC: >2250 µS/cm): This water is not suitable for irrigation under ordinary condition. The soils must be permeable, drainage must be adequate, irrigation water must be applied in excess to provide considerable leaching and very salt tolerant crops should be selected.

The classification of ground water samples collected from monitoring wells for irrigation purpose was carried out and given below in **Table-7**.

It is clear from the **Table-7** that maximum number of samples (61%) falls under the category of high salinity water while nearly 3% of samples fall in very high salinity water category. This shows that the ground water in the pre-monsoon season from shallow aquifer in the district should be used for irrigation with proper soil and crop management practices..

Table-7: Classification of Ground Water for Irrigation based on EC.

Type	EC (µS/cm)	No. of Samples	% of Samples
Low Salinity Water	<250	Nil	Nil
Medium Salinity Water	250-750	6	26
High Salinity Water	750-2250	14	61
Very High Salinity Water	>2250	3	13
Total		**23**	**100.0**

Residual Sodium Carbonate (RSC)

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

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

Type	RSC	No. of Samples	% of Samples
Good	<1.25	23	100
Doubtful	1.25-2.50	-	-
Unsuitable	>2.50	-	-
Total		**23**	**100**

The perusal of **Table-8** shows that the RSC values of ground water samples collected from the wells is less than 1.25 in about 100% of wells, which reflects that the overall quality of ground water in the monitoring wells is good for irrigation purpose.

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
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, Tubewell

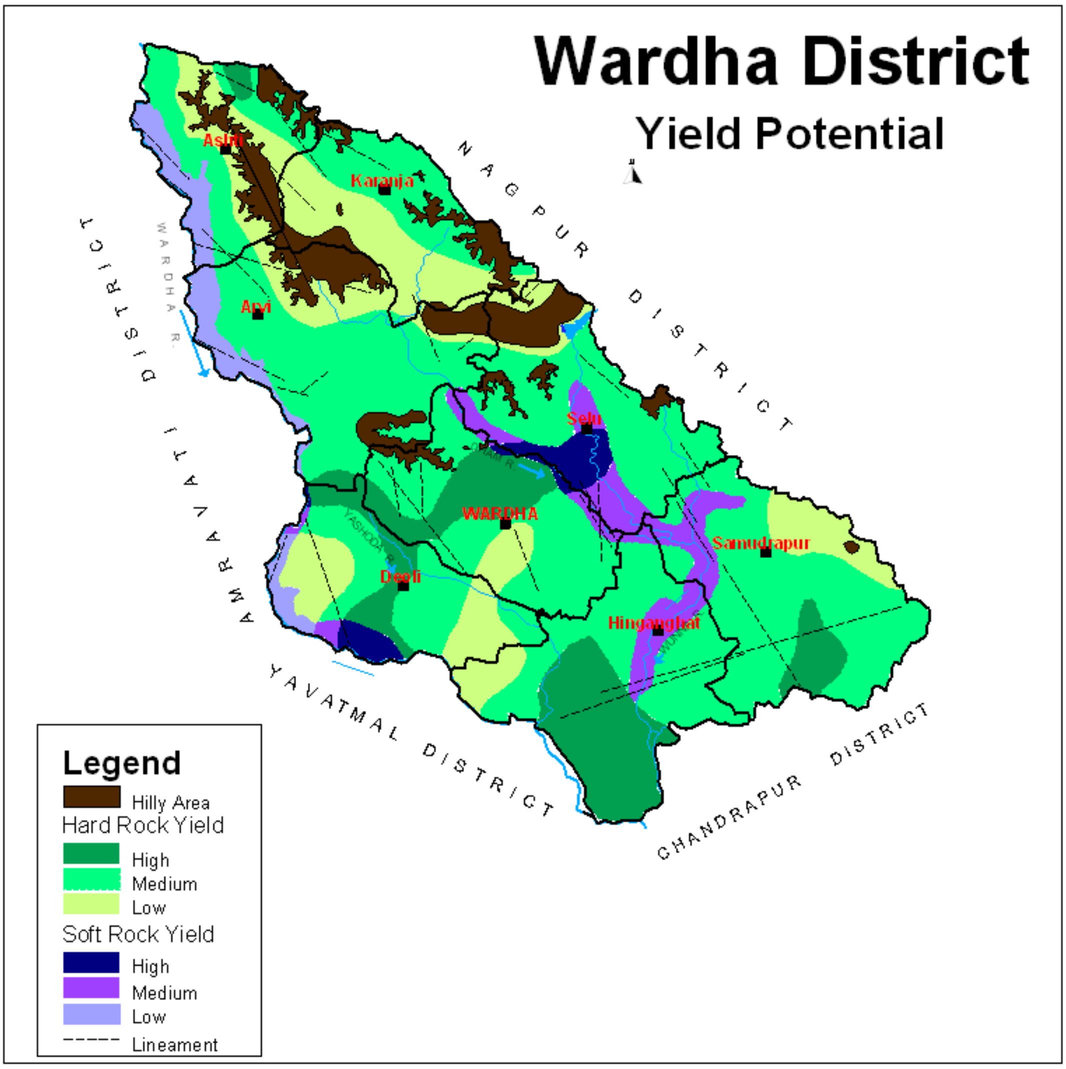

Figure-6: Yield Potential

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 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 57% of the samples collected in May 2011. 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 2012, 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 2009 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 57% of the samples collected in May 2011. 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 32.77, thus a lot of scope for further development exists.

5 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.

6 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.

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