1776/DBR/2013

भारत सरकार
जल संसाधन मंत्रालय
केंद्रीय भूमिजल बोर्ड

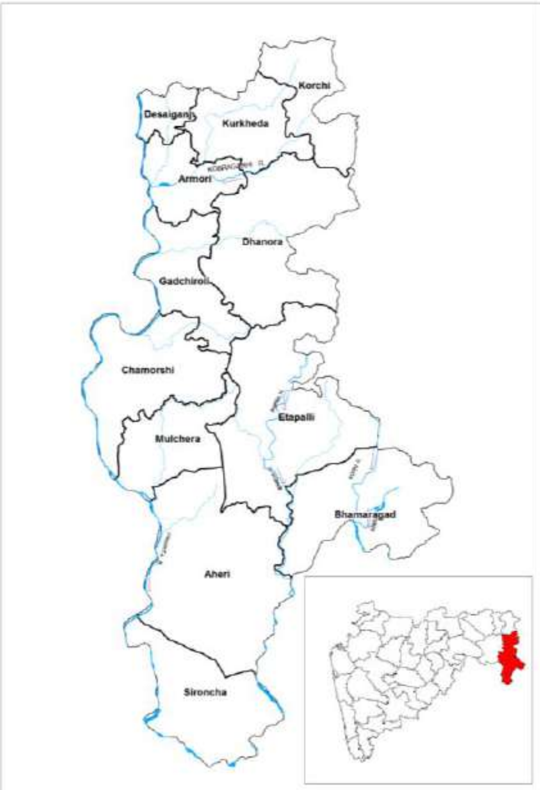
GOVT OF INDIA

MINISTRY OF WATER RESOURCES

CENTRAL GROUND WATER BOARD

महाराष्ट्र राज्य के अंतर्गत गडचिरोली जिले की भूजल विज्ञान जानकारी

GROUND WATER INFORMATION GADCHIROLI DISTRICT MAHARASHTRA



By

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द्वारा

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मध्य क्षेत्र, नागपुर

CENTRAL REGION
NAGPUR

GARHCHIROLI DISTRICT AT A GLANCE

1. GENERAL INFORMATION

Geographical Area		14915.54 sq. km.
Administrative Divisions (As on 31/03/2011)	:	Taluka-12; Desaiganj, Armori, Kurkheda, Korchi, Dhanora, Garhchiroli, Chamorshi, Mulchera, Etapalli, Bhamragad, Aheri, and Sironcha.
Villages	:	1688
Population (2011)	:	10,71,795
Normal Annual Rainfall	:	1300 to 1750 mm

2. GEOMORPHOLOGY

Major Physiographic unit	:	2; Hilly and Plains
Major Drainage	:	3; Wainganga, Indravati and Pranhita all tributaries of Godavari River.

3. LAND USE (2002-03)

Forest Area	:	11328.60 sq. km.
Cultivable Area	:	2637.31 sq. km.
Net Area Sown	:	1423.67 sq. km.

4. PRINCIPAL CROPS (2004-05)

Cereals	:	1560 sq. km.
Pulses	:	300 sq. km.
Oil Seeds	:	70 sq. km.

5. IRRIGATION BY DIFFERENT SOURCES (2006-07)**-**
Nos./Potential Created (ha)/Potential Utilised (ha)

Dugwells	:	13124/21227/15191
Tubewells & Borewells	:	93/407/317
Surface Flow Schemes	:	2890/22964/21701
Surface Lift Schemes	:	174/36/354
Net Irrigated Area	:	37563 ha

6. GROUND WATER MONITORING WELLS (As on 31/03/2011)

Dugwells	:	52
Piezometers	:	3

7. GEOLOGY

Recent	:	Alluvium, Soil and Laterite
Upper Gondwana	:	Chikiala Stage: Grey to Black, ferruginous Sandstone, ferruginous Conglomerate and Sandstone.
	:	Kota Stage: Ferruginous Conglomerate and Sandstone. Calcareous Sandstone and Limestones.
Lower Gondwana	:	Kamthi Stage: Friable, ferruginous, medium to coarse grained Sandstone and ferruginous conglomerate.
Pakhal series of Cuddapahs System (Precambrian)	:	Limestone with intercalated Shale, ferruginous Shale, Conglomerates, Breccia, Quartzite and Sandstone.
Archean	:	Basic intrusive and Quartz Pegmatite veins, Granite and Pyroxene Gneisses, Pyroxenite banded Magmatite, Quartzite and other unclassified metamorphics

8. HYDROGEOLOGY

Water Bearing Formation	:	Soft Rock- Sandstone and Conglomerates of Gondwana, Limestone of Pakhals, coarse grained sand and colluvium of Alluvium. Hard Rock- Weathered and Fractured Granite, Schist and Gneisses.
Premonsoon Depth to Water Level (May 2011)	:	4.10 to 15.30 m bgl
Postmonsoon Depth to Water Level (Nov. 2011)	:	1.35 to 14.50 m bgl
Premonsoon Water Level Trend (2002-2011)	:	Rise: Negligible to 0.61 m/year Fall: 0.01 to 0.65 m/year
Postmonsoon Water Level Trend (2002-2011)	:	Rise: Negligible to 0.80 m/year Fall: Negligible to 0.28 m/year

9. GROUND WATER EXPLORATION (As on 31/03/11)

Wells Drilled	:	EW-8, OW-3, Pz-5
Depth Range	:	80.00 to 300.11 m bgl
Discharge	:	1.30 to 15.00 lps

10. GROUND WATER QUALITY

Type of Water	:	Suitable for irrigation. Nitrate contamination.

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

Net Annual Ground Water Availability	:	1280.70 MCM
Annual Ground Water Draft (Irrigation+Domestic)	:	184.23 MCM
Allocation for Domestic and Industrial requirement up to next 25 years	:	43.06 MCM
Stage of Ground Water Development	:	17 %

12. MAJOR GROUND WATER PROBLEMS AND ISSUES

The water levels are showing declining trends in soft rock formations occurring in southern part of the district occupying parts of Sironcha taluka The falling trend is also observed in north western and southern-central parts of the district occupying almost entire Desaiganj (Wadsa), Chamorshi and Mulchera talukas and parts of Armori, Gadchiroli, Dhanora, Etapalli and Aheri talukas.. In the district, about 50% samples have nitrate concentration more than MPL of 45 mg/L. This indicates that the potability of ground water is mainly affected due to nitrate.

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Garhchiroli District

1.0 Introduction

Garhchiroli district is one of the eleven districts of Vidarbha region of Maharashtra. The district is bounded on the east by Chattishgarh State, on the south Andhra Pradesh State, on the north as Gondia district, and on the west by Chandrapur district. Garhchiroli district was created on August 26, 1982 by bifurcating Chandrapur district. It lies between north latitudes 18°08' and 20°50' and east longitude 79°45' and 80°54' and falls in parts of Survey of India degree sheets 55 P, 56 M, 56 N, 64 D, 65 A and 65 B. The district has a geographical area of 14915.54 sq. km.

The district headquarters is located at Garhchiroli Town. For administrative convenience, the district is divided in 12 talukas viz., Desaiganj, Armori, Kurkheda, Korchi, Dhanora, Garhchiroli, Chamorshi, Mulchera, Etapalli, Bhamragad, Aheri and Sironcha. As per 2011 census it has a population of 10,71,795. The district has 1688 villages, 467 Gram Panchayats, and 2 Municipal Councils. There are three major rivers flowing in the district i.e., Wainganga, Indravati and Pranhita and all are tributaries of Godavari River.

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 (March 2011).

S. No.	Officer (S/Shri)	AAP	Type of Survey/Study	Areal Covered
1.	Sudarshana	1976-77	SHS	56 N/13, 65 B/1 & 56 B/2
2.	Nagarjan R.	1977-78	SHS	56 M/16, 65 A/4 & 65 A/8.
3.	MurthyK.N.	1986-87	SHS	56 M/13, & M/14
4.	Sudarshan G.	1988-89	SHS	56 M/15, 65 A/3, 65 A/7, 65 A/11, 65 A/14 & 65 A/15.
5.	Marwaha S.	1988-89	SHS	65 A/1, 65 A/2, 65 A/5, 65 A/6, 65 A/9 & 65 A/10.
6.	Arumugam K.	1988-89	SHS	64 D/4, 64 D/7, 64 D/8, 64 D/11 & 64 D/12.
7.	Jain P.K & Bhattacharya	1990-91	SHS	55 P/14
8.	Naik P.K.	1990-91	SHS	55P/15 & 55P/16.
9.	Binoy Ranjan	1993-94	RHS	Chamorshi and Ashti talukas
10.	Binoy Ranjan	2005-06	RHS	-

Here, SHS- Systematic Hydrogeological Survey, RHS- Reappraisal Hydrogeological Study.

In addition to the above studies, a report entitled "Ground Water Resources and Development Potential of Garhchiroli District, M.S." was compiled by Shri. L.M. Motghare, Scientist- C, in 1993-94 and by Shri D.K. Jain, Scientist-D in 2009-10. A map of the district showing taluka boundaries, taluka headquarters, physical features and locations of monitoring wells, exploratory wells and Piezometers is presented in **Figure-1**.

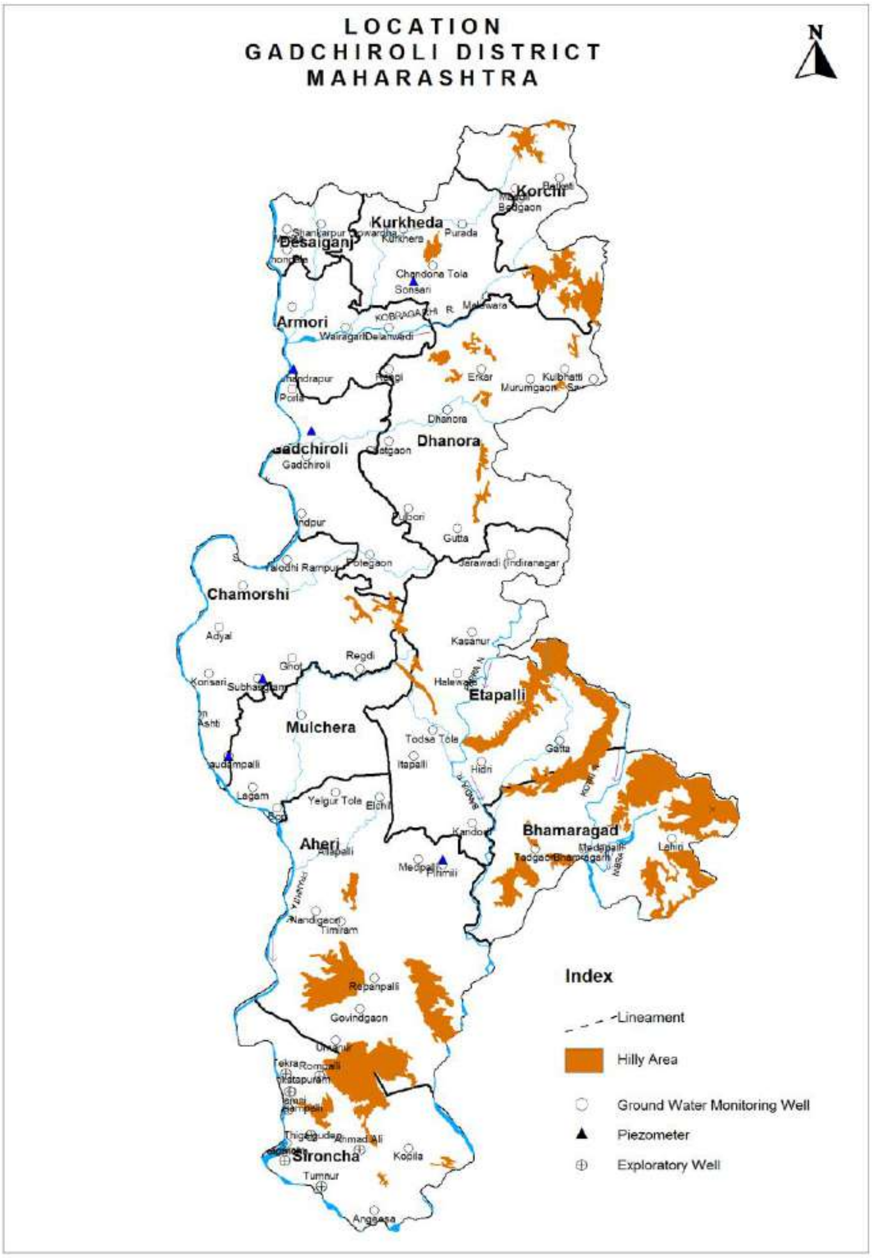

Figure-1: Location.

The ground water exploration in the district has been taken up in 1984. The ground water exploration has been done in Gondwana Sandstone. A total of 8 EW and 3 OW have been constructed till March 2011 under exploration programme. Apart from these, 5 piezoemeters have been drilled under Hydrology Project-I.

Table 2: Salient Features of Ground Water Exploration (March 2011).

Taluka	Total Wells	Wells			Depth (m bgl)	Casing (m bgl)	SWL (m bgl)	Dis-charge (lps)	Draw-down (m)	Zones (m bgl)
		EW	OW	PZ						
Sironcha	11	8	3	-	80.00-300.15	30.00-178.00	1.65-19.10	1.30-15.00	10.00-29.05	5.30-276.52

In Gondwana Sandstone 8 exploratory wells and 3 observation wells were drilled and their depth ranged from 80.00 to 300.15 metres below ground level (m bgl). The discharge from these wells varied from 1.30 to 15.00 litres per second (lps), for a drawdown of 10.00 to 29.05 m. Static water levels ranged from 1.65 to 19.10 m bgl. The potential aquifer zones have been encountered from 5.30 to 276.52 m depth. These wells tap Kota and Chikiala, Sandstones of upper Gondwana and lower Gondwana sediments. Two main aquifer zones were encountered viz., one between 30 and 100 m bgl and another between 160 and 230 m bgl. The exploration results reveal that the depth to basement ranges from 123 to 176 m bgl in the central and north-western parts of Sironcha taluka, whereas it is more that 300 m in the western and southern parts. The results of the exploration indicate the scope for development of ground water by means of tubewells mainly for irrigation purposes. The depth of tubewells should be between 80 and 120 m bgl.

2.0 Climate and Rainfall

The climate of the district is characterized by a hot summer, a well distributed rainfall during the southwest monsoon and general dryness except during rainy season. The winter is from December to February followed by summer from March to May. The southwest monsoon season is from June to September. October and November constitute the post-monsoon. The mean minimum temperature is 14.6°C and mean maximum temperature is 42.1°C.

The normal annual rainfall over the district varies from about 1300 mm to 1750 mm. The average annual rainfall for the period 2002-2011 ranges from 921.83 mm (Chamorshi) to 1643.43 mm (Kurkheda), whereas year wise data suggests that minimum rainfall was in 2002 (962.20 mm) and maximum was in 2010 (1852.54 mm). It is noticed that the average annual rainfall has decreased during the last 10 years period as compared to the normal annual rainfall. The overall average annual rainfall for last 10 years is 1345.19 mm and is presented in **Table-3.**

Table 3: Annual Rainfall Data (2002-2007) (mm).

Taluka	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Aheri	818.00	1520.00	854.00	1326.00	1258.40	1542.70	1391.00	893.50	2150.70	965.20
Armori	963.80	1184.80	733.40	1349.80	1598.40	1551.40	955.00	999.20	1764.60	1240.30
Bhamragad	1169.3	2222.50	1179.90	2037.00	1151.60	2118.40	1312.40	1082.90	2297.00	1420.80
Chamorshi	601.50	808.50	768.50	1039.00	1054.00	807.00	785.00	550.80	1812.00	992.00
Dhanora	1285.1	1740.70	1315.00	1682.80	1564.90	1874.90	1349.70	1054.10	1857.60	1243.30
Etapalli	790.00	1514.00	1102.40	1592.30	1481.40	1427.80	1239.60	1054.00	1930.80	1019.80
Garhchiroli	1022.4	1286.10	1200.20	1490.60	1421.00	1619.00	1225.60	884.70	1852.90	1323.20
Korchi	972.20	1344.00	1713.20	2920.70	1554.00	1623.00	796.00	725.00	1360.40	1517.20
Kurkheda	1199.6	1120.80	1116.20	2228.60	1694.00	3070.50	1234.90	1287.00	1846.10	1636.60
Mulchera	756.20	1564.40	1316.00	1518.60	1368.00	1377.20	1457.80	971.90	1879.80	1179.00
Sironcha	932.20	1201.00	546.90	1225.20	1701.60	1141.20	1566.30	788.70	1621.40	778.00
Wadsa	1036.8	1416.40	911.00	1513.80	1494.80	2298.80	1203.30	942.40	1875.20	1162.20

(Source- www.mahaagri.gov.in)

3.0 Geomorphology

Topographically, the major part of the district is undulating. The area around Godavari River and the Pranhita is the plain. The area towards the south of the Godavari is low lying having an elevation of about 160 m amsl. Central part of the district is also low lying having an elevation of around 250 m amsl. The elevation in the district ranges from 160-935 m amsl. The hill ranges of the district comprises of Sirkheda, Bhamragarh, Aheri, and Dandakaranya. Sirkoda hill range is about 25 km wide and extends over a distance of about 70 km.

There are three major rivers flowing in the district i.e., Wainganga, Indravati and Pranhita, all are tributaries of Godavari River.

4.0 Ground Water Scenario

4.1 Hydrogeology

The district is unique in Maharashtra in the sense that the entire area of the district is mainly occupied by metamorphic and igneous rocks along with sedimentary rocks in southern part. The district is underlain by various types of rock formations from the oldest Granites and Gneiss of the Precambrian to the Recent Alluvium. A map depicting the hydrogeological features is shown in **Figure-2**.

The occurrence and movement of ground water depends upon the rock formation of the area. It is generally influenced by the following factors.

- Inter-granular primary porosity and permeability.
- Thickness and extent of weathered zones.
- Topographic setting of an area.
- Surface water bodies influencing ground water recharge.
- Development of joints, fractures, lineaments constituting secondary porosity and permeability.

Formation wise water bearing properties and its potential in Garhchiroli district is described as follows.

4.1.1 Hard Rock Formation

4.1.1.1 Archeans

Archeans consisting of granite gneisses, schist, etc. occupies a major part of the district. These un-weathered rocks do not have inter granular porosity and permeability. Occurrence of ground water in this formation is controlled by the degree of weathering, jointing and fracturing. These rocks cover an area of about 12470 sq.km. i.e., about 81% of the total area of the district in the entire northern, eastern, western and central parts. These crystalline rocks due to prolonged weathering has produced layer of unconsolidated saprolite material which forms favourable and important source of ground water. The thickness of weathering varies considerably and at times it is more than 20 m. The weathering in coarse grained hard rocks imparts good porosity and permeability and the ground water structures constructed in these rocks give good yields. Laterite is commonly found as capping the weathered rocks at some places. These Laterites have generally low permeability and tends to impede infiltration. The ground water abstraction structures constructed in these rocks have poor yields.

Un-weathered rock underlained by the weathered zones, jointed and fractured zones forms good aquifers. The ground water storage relies entirely on secondary porosity and permeability in these rocks. High yields are generally associated with the presence of fractured and other secondary openings. Ground water occurs in unconfined and confined conditions in this formation.

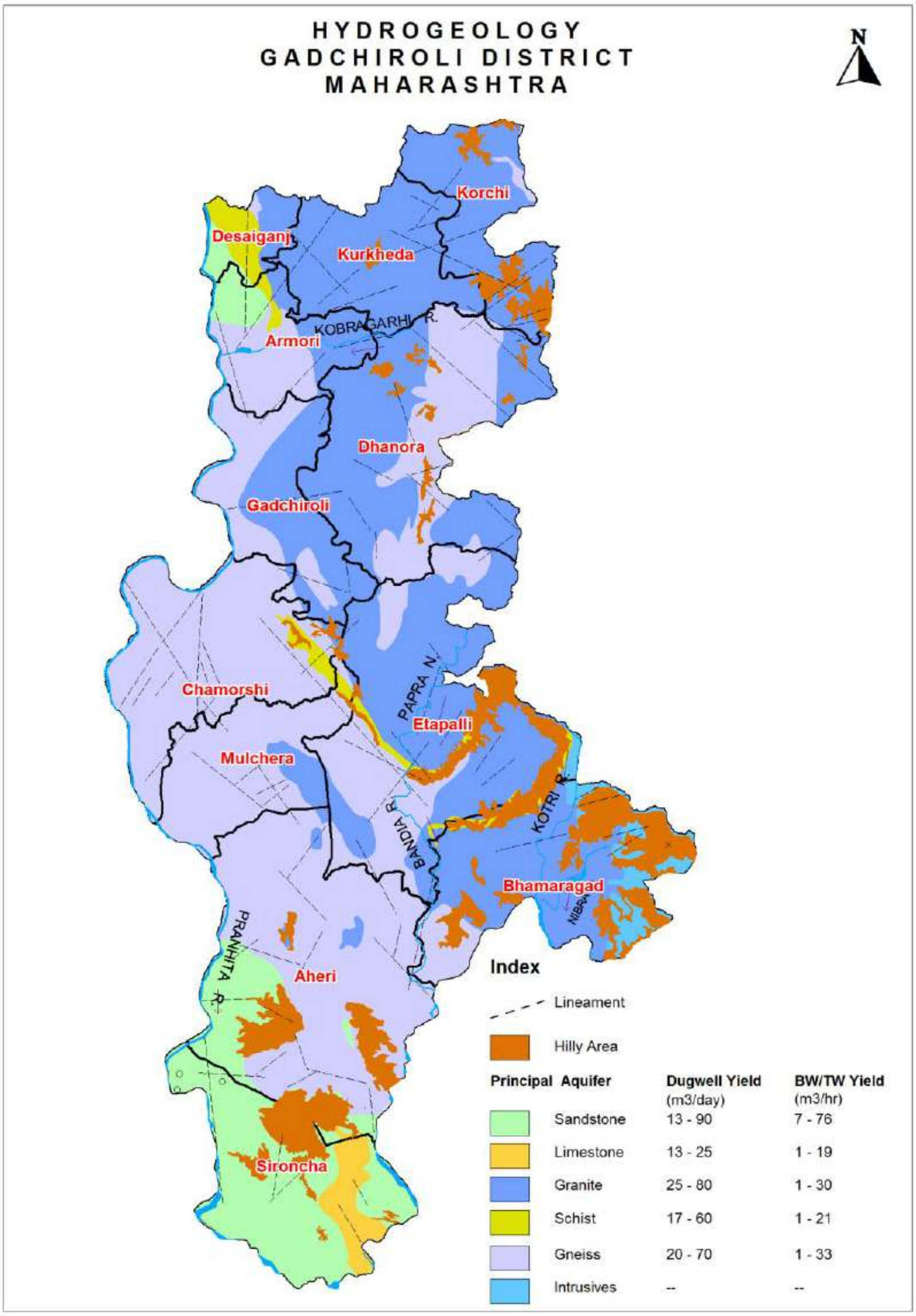

Figure-2: Hydrogeology

4.1.1.2 Pre-Cambrian

The Pre-Cambrian formation belonging to Pakhals occupy the south and south-western part of the district covering an area of about 820 sq.km They are composed of Limestone, Shales, Conglomerates, Breccias, Quartzite and Sandstones. These argillaceous sedimentary rocks are inter-bedded with Shales and Clays. Sandstones and Conglomerates have inter-granular porosity. Joints and fractures in these rocks impart additional secondary porosity and permeability forming good aquifers. Ground water occurs in unconfined and confined conditions in these formations. Limestone's and Dolomite of Cuddapahs form good aquifers at places in northern part of the district. They show karstification around Bugga Gutta SE of Umanur. They show promising potential of ground water.

4.1.2 Soft Rock Formation

4.1.2.1 Gondwana

An area of about 740 sq.km. is covered by the Gondwana formation constituting Kamthis, Kota and Chikiala stages in the southern part of the district along the banks of Pranhita and Godavari rivers in a narrow trough. They form the best aquifers in the area. They are composed of Sandstones, Shales and Conglomerates. The Sandstones and Conglomerates of this formation have good primary porosity and permeability. The Chikiala group of rocks generally occupy flat topped hills and ridges and forms ideal recharge areas. Due to variation of permeability between different stages at number of localities springs can be seen especially between Kota and Chikiala stages. The Kota group of rocks generally occupies intermediate and discharge areas.

Kamthi Sandstone forms the best aquifers in the area. The thickness of the Kamthis in the district is more than 300 m as observed from the exploratory drilling programme carried out by Central Ground Water Board. Along the contacts of Kamthi and Kota formations numerous springs have also been reported. Ground water occurs in semi-confined to confined conditions in these formations.

In the south-western parts of Sironcha taluka, Limestones of Kota stage are found. Ground water occurs both under confined and unconfined conditions. Aquifers are formed in these rocks due to solution cavities and fractures at places.

4.1.2.2 Alluvium

Alluvium occurs over a small area of about 10 sq.km. along the banks of major rivers. It consists of sand, gravel, silt, clay and kankar. The thickness of alluvium deposits is very limited and is generally within 30 m. At places alluvium is underlain by colluvium having a thickness varying from 1 to 8 m. Coarse grained sand and colluvium forms very good aquifers. Ground water occurs under semi-confined to confined conditions.

4.1.3 Water Level Scenario

Central Ground Water Board periodically monitors 55 National Hydrograph Network Stations (NHNS) (52 dugwells and 3 Piezometers) in the district, four times a year i.e. in January, May (Premonsoon), August and November (Postmonsoon).

4.1.3.1 Premonsoon Depth to Water Level (May-2011)

The depth to water levels in the district during May 2011 ranges between 4.10 (Talodhi Rampur) and 15.30 (Sironcha) m bgl. Depth to water levels during premonsoon (May 2011) has been depicted in **Figure-3**. In almost entire district moderate water level in the range of 5 to 10 m bgl are observed. The deeper water levels in the range of 10 to 20 m bgl are observed in southern and central parts of the district i.e., in parts of Sironcha and Itapalli talukas.

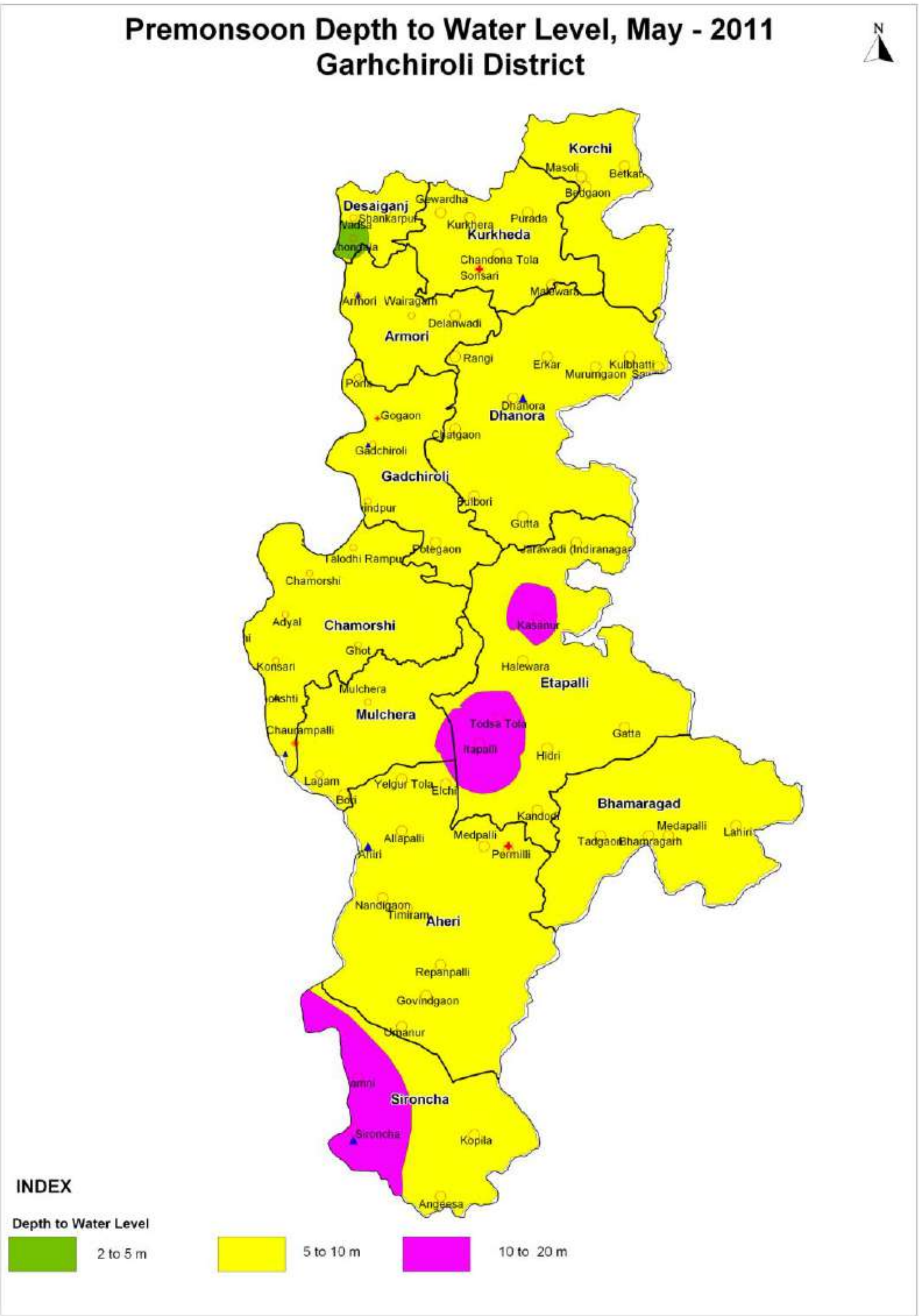

Figure 3- Premonsoon Depth to Water Level (May 2011)

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

The depth to water levels during postmonsoon (Nov. 2011) ranges between 1.35 m bgl (Khondala) and 14.50 m bgl (Sironcha). Spatial variation in postmonsoon depth to water levels is shown in **Figure-4**. Shallow water levels, within 2 m bgl are seen in small patch in northern part of the district in Kurkheda taluka and water levels between 2 and 5 m bgl are observed in northern and central parts of the district in Armori, Dhanora, Gadchiroli and Chamorshi talukas. The moderate water levels in the range of 5 to 10 m bgl are seen in southeastern parts of the district occupying parts of Itapalli, Aheri and Sironcha. The deeper water levels in the range of 10 to 20 m bgl, observed in parts of Sironcha taluka.

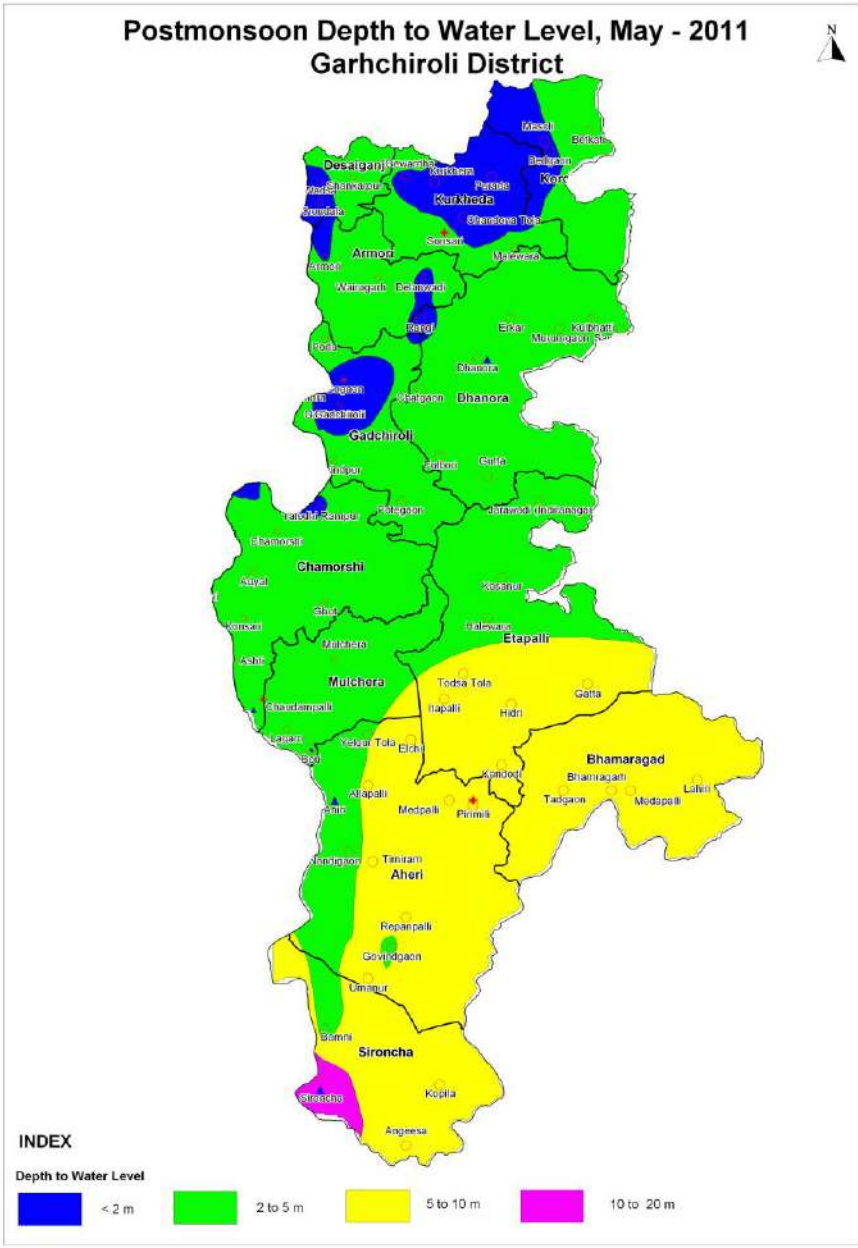

Figure-4: Postmonsoon Depth to Water Level (Nov. 2011)

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

In entire district rise in water level fluctuation in the range of 1.35 (Talodhi Rampur) to 7.13 m (Mulchera) is observed. The fluctuation of 2 to 4 m is observed in southern parts of the district, whereas > 4 m fluctuation is observed in northern parts of the district.

4.1.6 Water Level Trend (2002-2011)

Trend of water levels for pre-monsoon and post-monsoon periods for last ten years (2002-2011) have been computed for 59 NHNS.

Analysis of trend indicates that during premonsoon period, rise in water levels has been recorded at 33 stations and it ranges between negligible and 0.61 m/year (Betkati). Fall in water levels has been observed at 26 stations and ranges between 0.01 (Armori) and 0.65 m/year (Khandala). During postmonsoon period, rise in water levels has been recorded at 27 stations and it ranges from to negligible at Konsari to 0.80 m/year (Purada), whereas at 27 stations, fall in water levels ranging between negligible at few stations and 0.28 m/year (Angeesa) is observed. Thus, both during pre and postmonsoon periods rising and falling trends have been equitably distributed. The premonsoon trend map was also prepared and the same is presented in **Figure-5**.

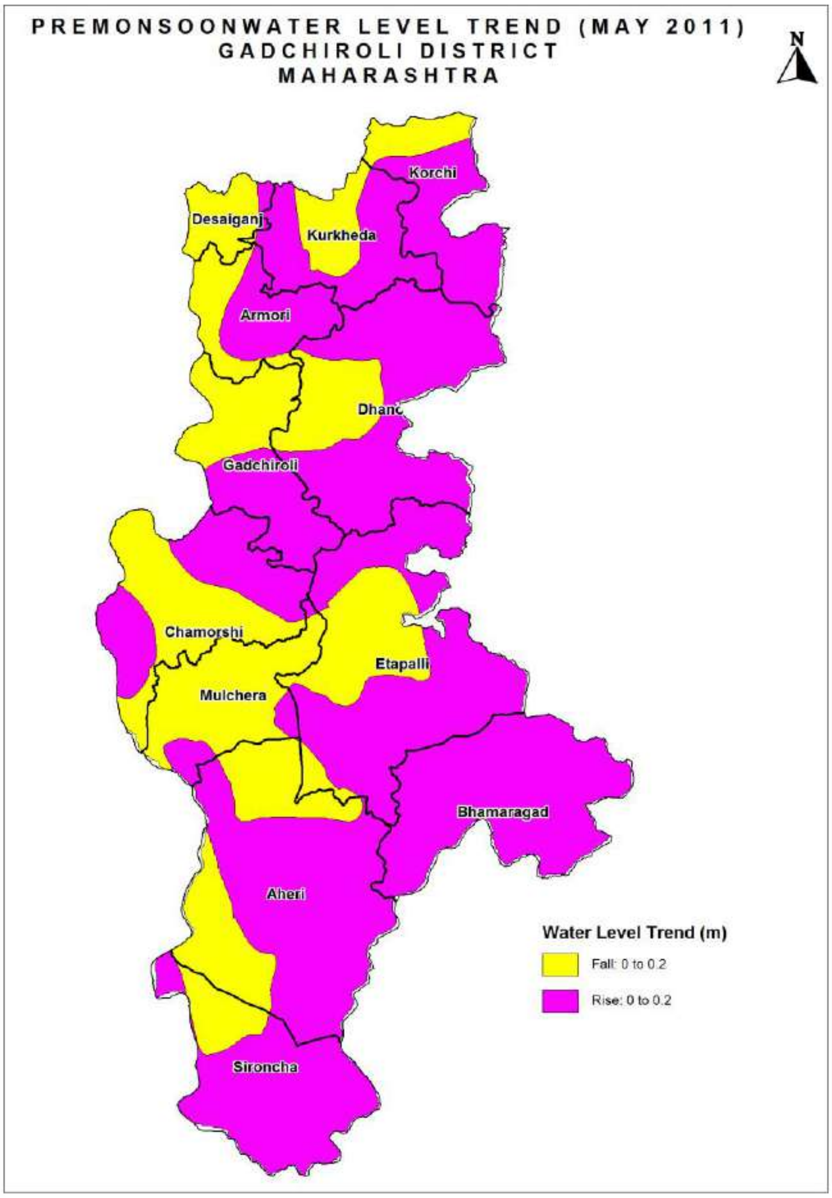

Figure-5: Premonsoon Water Level Trend (2002-2011).

It indicates that about 60% of the area show rise in water level. The rise of up to 20 cm/year is observed in southern, eastern, north-central and northern parts of the district. The fall of up to 20 cm/year is observed north western and southern-central parts of the district occupying almost entire Desaiganj (Wadsa), Chamorshi and Mulchera talukas and parts of Armori, Gadchiroli, Dhanora, Etapalli, Aheri and Sironcha talukas. Thus, the future water conservation and artificial recharge structures needs to be prioritised in these areas.

4.2 Yield of Wells

The yields of wells are functions of the permeability and transmissivity of aquifer encountered and vary with location, diameter and depth etc. Ground water in the area is being developed by three type of abstraction structures i.e., dugwells, borewells and tubewells. However dugwells are the main ground water abstraction structures in the district for both domestic and irrigation use. High yielding dugwells are generally located in sandstones and conglomerates of Gondwana, coarse grained sand and colluvium of Alluvium also form potential aquifer although its occurrence is limited to bank of major rivers. In the hard rock formations like granite and gneisses, when weathered and fractured occurring in physiographic depressions, have also good yield. The yield of wells in different types of formations encountered in the district is presented in **Table-4**.

Table-4: Yield of Wells.

S. No	Water Bearing Formations	Yield		
		Dugwells (m^3/day)		Borewells/Tubewells (m^3/hr)
		Summer	Winter	
1	Alluvium	-	40-135	-
2	Gondwana	13-67	30-90	7-76
3	Pakhals	13	25	1-19
4	Granites	25	80	5-30
5	Schist's	17	60	1-21
6	Gneisses	20	70	1-33

4.3 Aquifer Parameters

Based on pumping tests conducted on exploratory wells, it was observed that in Sandstone of Gondwana formation the transmissivity ranges from 1.99 to 99.14 m^2/day and the storativity ranges from 1.5 x 10^{-3} to 8.8 x 10^{-4}. The specific capacity ranges form 0.08 to 3.02 lps/m of drawdown, whereas the permeability was of the order of 200 m/day.

4.4 Ground Water Resources

Central Ground Water Board and Groundwater Survey and Development Agency (GSDA) have jointly estimated the ground water resources of Gadchiroli district as on March 2009 based on GEC-97 methodology. The same is presented in **Table-5**. Ground water resources estimation was carried out for 886649.10 Ha area out of which 22679.71 Ha is under command and 863969.39 Ha is non-command.

As per the estimation the total annual ground water recharge is 1373.12 MCM with the natural discharge is 92.42 MCM, thus the net annual ground water availability comes to be 1280.70 MCM. The total annual gross draft for all uses is estimated at 184.23 MCM with irrigation sector being the major consumer having a annual draft of 162.70 MCM. The domestic and industrial allocation is worked at 43.06 MCM/year for the next 25 years. The net annual ground water availability for future irrigation is estimated at 1074.93 MCM. Stage of ground water development varies from 3.46% (Wadsa) to 28.59% (Kurkheda). The overall stage of ground water development for the district is 17% and all the talukas have been categorised as “Safe”. Similarly, ground water resources were also assessed for 83 watersheds and all the watersheds had been categorised as “Safe”.

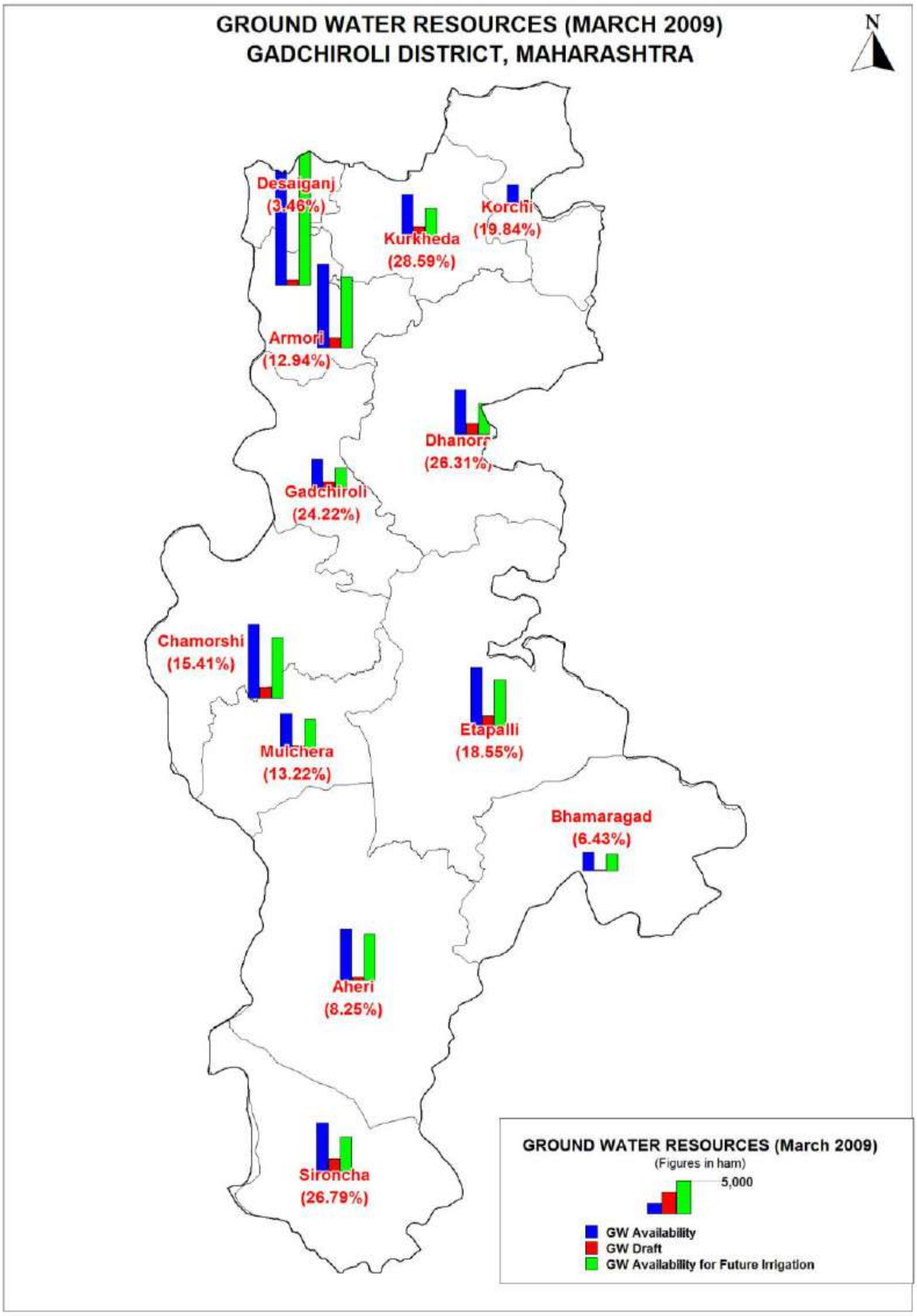

Figure-5: Ground Water Resources (March 2009)

Table 5:-Talukawise Ground Water Resources of Garhchiroli District, Maharashtra. (March 2009)

Administra-tive Unit	Command / Non-Command / Total	Net Annual Ground Water Availability	Existing Gross Ground Water Draft for irrigation	Existing Gross Ground Water Draft for domestic and industrial water supply	Existing Gross Ground Water Draft for All uses	Provision for domestic and industrial requirement supply to 2025	Net Ground Water Availability for future irrigation development	Stage of Ground Water Develop-ment (%)	Category
Aheri	Command								
	Non Command	9611.91	606.50	186.91	793.41				
	Total	9611.91	606.50	186.91	793.41	374.05	8664.39	8.25	Safe
Armori	Command	9259.78	75.22	35.97	111.19				
	Non Command	6445.50	1764.51	156.33	1920.84				
	Total	15705.27	1839.73	192.30	2032.03	384.62	13482.38	12.94	Safe
Bhamragad	Command								
	Non Command	3555.17	180.00	48.54	228.54				
	Total	3555.17	180.00	48.54	228.54	97.08	3278.09	6.43	Safe
Chamorshi	Command	3175.34	300.56	105.97	406.52				
	Non Command	10778.27	1415.57	328.11	1743.67				
	Total	13953.61	1716.12	434.07	2150.19	868.14	11369.34	15.41	Safe
Dhanora	Command								
	Non Command	8312.29	1986.55	200.70	2187.24				
	Total	8312.29	1986.55	200.70	2187.24	401.40	5924.34	26.31	Safe
Etapalli	Command								
	Non Command	11039.86	1821.31	226.81	2048.12				
	Total	11039.86	1821.31	226.81	2048.12	453.62	8764.93	18.55	Safe
Gadchiroli	Command								
	Non Command	5723.75	1225.77	160.60	1386.37				

Administra-tive Unit	Command / Non-Command / Total	Net Annual Ground Water Availability	Existing Gross Ground Water Draft for irrigation	Existing Gross Ground Water Draft for domestic and industrial water supply	Existing Gross Ground Water Draft for All uses	Provision for domestic and industrial requirement supply to 2025	Net Ground Water Availability for future irrigation development	Stage of Ground Water Develop-ment (%)	Category
	Total	5723.75	1225.77	160.60	1386.37	321.19	4176.79	24.22	Safe
Korchi	Command								
	Non Command	3637.64	600.06	121.62	721.68				
	Total	3637.64	600.06	121.62	721.68	243.08	2794.50	19.84	Safe
Kurkheda	Command								
	Non Command	8388.26	2225.89	172.50	2398.39				
	Total	8388.26	2225.89	172.50	2398.39	345.00	5817.38	28.59	Safe
Mulchera	Command	726.40	110.40	2.45	112.85				
	Non Command	6083.71	673.36	113.79	787.15				
	Total	6810.11	783.76	116.24	900.00	232.26	5761.05	13.22	Safe
Sironcha	Command								
	Non Command	9206.31	2336.47	130.09	2466.55				
	Total	9206.31	2336.47	130.09	2466.55	260.17	6609.67	26.79	Safe
Wadsa	Command	29615.62	261.62	95.70	357.31				
	Non Command	2510.55	686.98	67.15	754.13				
	Total	32126.17	948.59	162.85	1111.44	325.68	30850.44	3.46	Safe
District Total	**Command**	**42777.13**	**747.79**	**240.077**	**987.872**				
	Non Command	**85293.20**	**15522.95**	**1913.14**	**17436.09**				
	Total	**128070.34**	**16270.74**	**2153.22**	**18423.97**	**4306.29**	**107493.30**	**17.00**	Safe

4.5 Ground Water Quality

CGWB is monitoring the ground water quality of the 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 2010, the Board has carried out the ground water quality monitoring of 14 monitoring wells. These wells mainly consist of the dugwells representing the shallow aquifer. The sampling of ground water from these wells was carried out in the month of May 2010 (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 (NO3) 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 2010.

4.5.1 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., 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), (May 2010).

Parameters	DL	MPL	Samples with conc. < DL	Samples with conc. in DL-MPL	Samples with conc. >MPL
TA (mg/L)	200	600	4	10	Nil
TH (mg/L)	300	600	6	7	1
NO_3 (mg/L)	45	No relaxation	7	-	7
F (mg/L)	1.0	1.5	11	3	Nil

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

The perusal **Table-6** shows that the concentrations of all the parameters except nitrate in most of the samples are below the maximum permissible limit of the BIS standards. Only one sample is having the concentration of Total Hardness (TH) more than the maximum permissible limits. It is also seen from the **Table-5** 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 50% 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.

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

4.5.2.1 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 (79%) falls under the category of high salinity water while nearly 7% 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	2	14.0
High Salinity Water	750-2250	11	79.0
Very High Salinity Water	>2250	1	7.0
Total		**14**	**100.0**

4.5.2.2 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	13	93.0
Doubtful	1.25-2.50	Nil	-
Unsuitable	>2.50	1	7.0
Total		**14**	**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 93% of wells, which reflects that the overall quality of ground water in the monitoring wells is good for irrigation purpose. The high value of RSC (>2.50) was found in only 1 well located at Allapalli and is unsuitable for irrigation purpose..

4.6 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.

Ground water is predominantly used for irrigation, as it is the major ground water utilising sector. As per the 4th minor irrigation census data available for year 2006-07, area irrigated by ground water is 155.08 sq. km., whereas the surface water accounts for about 220.55 sq.km. and the net irrigated area is about 375.63 sq.km., thus ground water account for 41%, of net irrigated area. There are about 13124 irrigation dugwells in the district which, create an irrigation potential of 212.27 sq.km., out of which 151.91 sq.km., potential is utilised. In addition to this meagre irrigation potential of 3.17 sq.km. is utilised through 93 borewells/tubewells.

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 2011, Government of Maharashtra is operating 7716 successful borewells/tubewells for rural water supply under various schemes in the district, out of which 46 borewells are fitted with electric pumps and the rest 7670 are fitted with hand pumps.

5.0 Ground Water Management Strategy

Ground water has special significance for agricultural development in the district. The ground water development in some parts of the district has resulted in decline of 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

In hard rocks areas which occupy the major part of the district, the future ground water development can be undertaken through dugwells, dug-cum-borewells and dugwells. In the area where thickness of weathering is up to 25m., dug-cum-bore wells may be constructed and in the area where the thickness is more than 25m, tubewells may be constructed. Borewells in the close vicinity of lineaments and fractured zones are likely to give better yield.

The sedimentary formation of the district which constitute 11% of the total area, there is large scope for ground water development through dugwells and tubewells. Tubewells of 90-100 m are likely to yield 5-10 lps. In Alluvial strip towards the southern part of the district along Godavari River shallow tubewells down to a depth of 20-25 m, may give yield of up to 50 m^3/hr. However in these parts the water levels are showing declining trends thus future ground water development should be done in these areas with adherence to the precautionary measures, i.e., artificial recharge to augment the ground water resources and adoption of ground water management practices, so that the sustainable development is achieved.

5.2 Water Conservation and Artificial Recharge

In hard rock 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 the hilly area. Existing dugwells can also be used for artificial recharge, however, the source water should be properly filtered before being put in the wells.

In soft rock areas occupied by Gondwana Sandstone in Sironcha taluka recharge wells/shafts can be constructed as the phreatic aquifer has been partly de-saturated as reflected from pre and postmonsoon water level maps. The dry/unused dugwells/borewells can be also be utilized for artificial recharge with proper precautions i.e., the source water should be non-polluted and presence of filtration mechanism.

These sites need to be located where the hydrogeological conditions are favourable, i.e., where sufficient thickness of unsaturated/de-saturated aquifer exists and water levels are more than 5 m deep in postmonsoon period such areas are observed in southern and south eastern parts of the district occupying parts of Itapalli, Aheri talukas and entire Sironcha taluka.

6.0 Ground Water Related Issues and Problems

The water level trends in soft rock formations occurring in southern parts and hard rock areas of central part are showing declining trends thus future ground water development should be done in these areas with adherence to the precautionary measures, i.e., artificial recharge to augment the ground water resources and adoption of ground water management practices, so that the sustainable development is achieved.

In the district, about 50% samples have nitrate concentration more than MPL. This indicates that the potability of ground water is mainly affected due to NO_3. Continuous 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 as well as other major ions and if the contents are 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, two Mass Awareness Programmes (MAP) have been organised in the district at Ranwahi, Taluka-Kurkheda, whereas WMTP (Water Management Training Programme) has been not organised in the district so far. The details are given in **Table-9**.

Table-9: Status of MAP & WMTP (March 2012).

S. No.	Year	Programme	Venue	Date	Participants
1	2003-04	MAP	Ranwahi, Taluka-Kurkheda	26/02/2004	150
2	2011-12	MAP	Gadchiroli	28/02/2012	200

8.0 Areas Notified by CGWA/SGWA

Ground water resources were calculated for all 12 talukas and 83 watersheds. All the talukas and watersheds have been categorised as “Safe”. Till March 2011 the area has not been notified either by CGWA or SGWA.

9.0 Recommendations

1 Major part of the district is underlain by hard rock, where only dugwells are 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, which may not be sustainable. Besides, the borewells should only be used for drinking water supply and not for irrigation.

3 The overall stage of ground water development for the district is only about 17%. Therefore, there is scope for further development of ground water resources, in the plain and habitated/un-forested areas.

4 The ground water development in the soft rock areas of the district is recommended by constructing tubewells of 90-100 m, with yield of 5-10 lps. Whereas in hard rock areas DCB and borewells can be drilled, wherever the weathered thickness is more than 25 m bgl.

5 However, the water level trends in soft rock formations occurring in southern parts and hard rock areas of central part are showing declining trends thus future ground water development should be done in these areas with adherence to the precautionary measures, i.e., artificial recharge to augment the ground water resources and adoption of ground water management practices, so that the sustainable development is achieved

6 All the talukas and watersheds in the district fall in “Safe” Category. So

there is a plenty of scope for ground water development.

7 The scope exists for construction of suitable artificial recharge structures in the district. The structures recommended for hard rock areas are nala bunds, check dams and KT weirs. The existing dugwells may also be used for artificial recharge of ground water provided source water is free of silt and dissolved impurities. In soft rock areas occupied by Gondwana sandstone in Sironcha taluka recharge wells/shafts can be constructed as the phreatic aquifer has been partly de-saturated. The dry/unused dugwells/borewells can be also be utilized for artificial recharge with proper precautions i.e., the source water should be non-polluted and presence of filtration mechanism.

8 In the district the potability of ground water is mainly affected due to NO_3. Continuous 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 as well as other major ions and if the contents are 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.

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