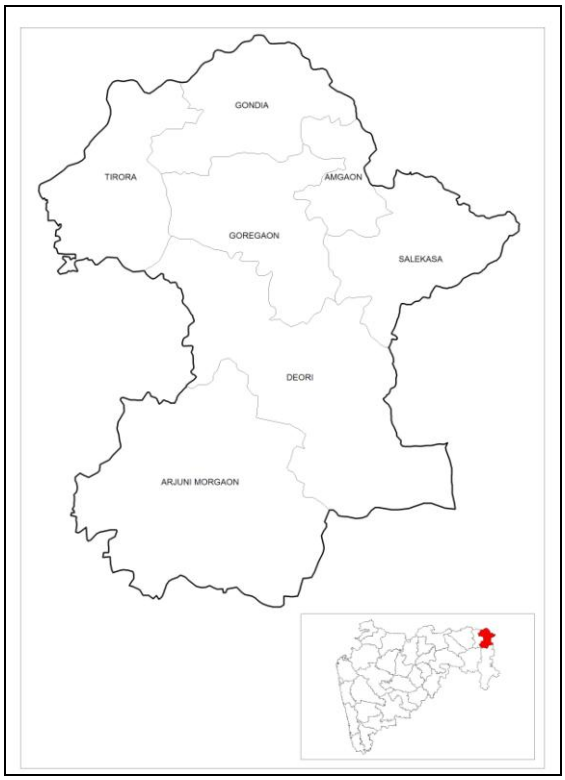
1795/DBR/2010

भारत सरकार
जल संसाधन मंत्रालय
केंद्रीय भूजल बोर्ड

GOVT OF INDIA
MINISTRY OF WATER RESOURCES
CENTRAL GROUND WATER BOARD

महाराष्ट्र राज्य के अंतर्गत गोंदिया जिले की भूजल विज्ञान जानकारी

GROUND WATER INFORMATION
GONDIA DISTRICT
MAHARASHTRA



By
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द्वारा
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वैज्ञानिक – ख

मध्य क्षेत्र, नागपुर
CENTRAL REGION
NAGPUR
2013

GONDIA DISTRICT AT A GLANCE

1.	**GENERAL INFORMATION**	
	Geographical Area	5858.95 sq. km.
	Administrative Divisions (As on 31/03/20011)	Taluka- 8, Gondia, Goregaon, Tiroda, Arjuni Moregaon, Deori, Amgaon, Salekasa, Sadak Arjuni
	Villages	994
	Population (2011)	1,32,2331
	Normal Annual Rainfall	1300 to 1500 mm
2.	**GEOMORPHOLOGY**	
	Major Physiographic unit	Two: Structural units like hills and ridges, denudational units like pediments and fluvial units
	Major Drainage	One: Wainganga River and its tributaries like Bagh, Chulbandh, Panghodi Suz, Gadhavi, Chandan, Bavanthadi
3.	**LAND USE** (2010-11)	
	Forest Area	2151.15 sq.km
	Cultivable Area	2967.47 sq.km
	Net Area Sown	1608.09 sq.km
4.	**SOIL TYPE**	The main types of soils are Kali, Kankar, Morand, Khardi, Sihar and Bardi
5.	**PRINCIPAL CROPS** (2010-11) **(Net area sown)**	
	Rice	1726.30 sq.km
	Total Pulses	932.20 sq.km
	Total Oil Seeds	67.26 sq.km
	Wheat	38.16 sq.km
6.	**IRRIGA TION BY DIFFERENT SOURCES** (2006-07) ***(Nos)* Potential Created in ha)**	
	Dugwells	9480/13480
	Borewells	308/485
	Tanks & Ponds	2505/67146
	Other Minor Surface Sources	491/2835
	Area under Surface water irrigation	67049
	Area under Ground water irrigation	31511
7.	**GROUND WATER MONITORING WELLS (May 2011)**	
	Dugwells	26
	Piezometers	2
8.	**GEOLOGY**	
	Recent	Alluvium and Laterite
	Proterozoic (Vindhyan, Dongargarh, Sausar and Sakoli Super Group)	Quartzite and Shale, Andesite, Sandstone, Granite, Rhyolite; Mu scovite-b iotite-sch ist, Granite, Tirodi Gneiss; Schist, Phyllites, Quartzite.

	Archeans (Amgaon Super Group)	Granite & Gneisses.
9.	**HYDROGEOLOGY**	
	Water Bearing Formation	Weathered Granite & Gneisses
	Pre-monsoon Depth to Water Level (May - 2011)	0.55 to 12.60 m bgl (May-2011)
	Post-monsoon Depth to Water Level (November - 2011)	0.60 to 7.70 m bgl (Nov-2011)
	Pre-monsoon Water Level Trend (2001-2010)	Rise: 0.0186 to 0.6656 m/year Fall: 0.0038 to 0.9321 m/year
	Post-monsoon water level trend (2001-2010)	Rise: 0.0028 to 0.1814 m/year Fall: 0.0015 to 0.1842 m/year
10.	**GROUND WATER EXPLORATION as on March 2011)**	
	Wells Drilled	EW- 13, OW-6, PZ-3
	Depth Range	24.50 to 201.50 m bgl
	Discharge	0.38 to 7.76 lps
	Transmissivity	3.42 to 56 m^2/day
	Storativity	2.1 0 x 10^{-5} to 1.7 x 10^{-5}
11.	**GROUND WATER QUALITY (May 2011)**	
	EC (μS/cm)	160 - 1200
	TDS	-
	Cl (ppm)	-
	F (ppm)	0.06 - 2.38
	$N0_3$ (ppm)	O. 03 -0.84
	Type of Water	Mainly Ca-$HC0_3$
	General Water Quality	Nitrate concentration exceeds MPL for drinking water standards in 37% of samples
12.	**DYNAMIC GROUND WATER RESOURCES (2009)**	
	Net Annual Ground Water Availability	587.32 MCM
	Annual Ground Water Draft (Irrigation+Domestic)	109.35 MCM
	Allocation for Domestic and Industrial requirement up to next 25 years	122.36 MCM
	Stage of Ground Water Development	20.58%
	Category	All Talukas are Safe

Ground Water Information
Gondia District

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Gondia District

1.0 Introduction

The district comes under Nagpur division (Vidarbha) in Maharashtra State. It is newly formed district and carved out by the division of Bhandara district in May 1999. Gondia district as well as its parent district is unique in Maharashtra and differs from the rest of the State in the following three ways:-

i. The entire area of the district is occupied by crystalline rocks while rest of the State is covered by Deccan Basalt.

ii. Paddy is the staple food crop of the district while wheat is the main agriculture produce in the rest of the State; and

iii. It is endowed with the presence of Malguzari Tanks.

Gondia district is situated on north-eastern side of Maharashtra State and shares the state borders with Madhya Pradesh on north and Chattisgarh in east. It covers an area of about 5859 sq.km and lies between 20°39 and 21°38 north latitudes and 79° 52' to 80°42 east longitudes. The adjoining districts to Gondia are on northern side Balaghat district of Madhya Pradesh State and on eastern side Rajnandgaon district of Chhatisgarh State. To the south and west are Chandrapur district and Bhandara district of Maharashtra respectively.

The total population of the district is about 13,22,331 and the population density is 225 per sq.km as per 2001 census. The literacy rate of district is about 68%. Basically district is divided into eight talukas namely Gondia, Goregaon, Tiroda, Arjuni Moregaon, Deori, Amgaon, Salekasa, Sadak Arjuni and eight Panchayat Samiti. Only two Municipalities exist at Gondia and Tiroda. The district falls under the Wainganga basin with rivers like Bagh, Chulbandh, Gadhavi and Bavanthadi as the tributaries of river Wainganga. A list of studies conducted in different parts of the district is presented in **Table-1**.

Table 1: Studies undertaken by CGWB (March 2007).

S. No.	Year	Surveyed Area	Work Done
1.	1986-87	Covering parts of Toposheet No's 55 O/16 & 55 P/13	Systematic Hydrogeological Survey
2.	1987-88	Site Selection for Rural Water Supply in parts of Gondia district.	Drought Relief Work in Maharashtra
3.	1991-92	Wainganga Basin, north western parts of Gondia district.	Reappraisal Hydrogeological Surveys
4.	1995-96	Wanganga Basin, northern part of Gondia district.	Reappraisal Hydrogeological Surveys

A report on 'Ground Water Resources and Development Potential of Gondia district' was compiled by Smt. Pushpa Jain, Scientist-B and Ms. Priya Alimchandani, Asstt. Hydrogeologist in the year 2004. A map of the district showing the taluka boundaries, taluka headquarters and location of monitoring wells is presented as **Figure-1**.

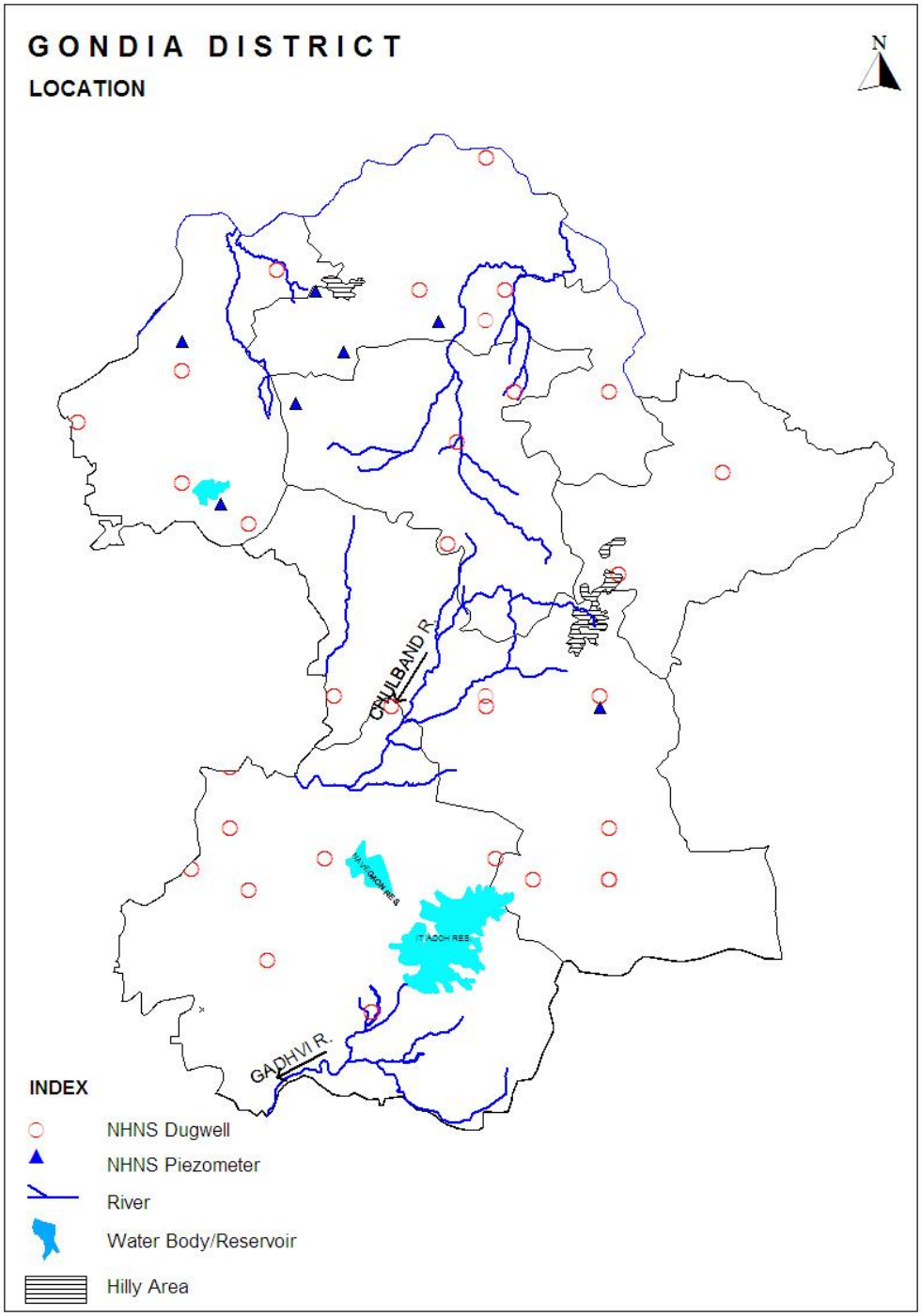

Figure-1: Location

Apart from above studies, the CGWB has also taken up 'Ground Water Exploration Programme' in the district. The exploratory drilling programme in Gondia district was started in the year 1992-93 and a total of 13 exploratory wells, 6 observation wells and 3 Piezometers have been drilled in the district tapping weathered granites and gneisses. The drilling was carried out by a DTH Rig. The drilling was carried out down to depths of 24.50 to 201.50 m bgl. Two to three water-bearing zones were taped totalling to a thickness varying from 3 to 30 m. The shallowest zone was struck at 10.30 m bgl while the deepest zone at 129.30 m bgl. The static water level ranged from 2.24-17.20 m bgl. Preliminary yield tests have shown yields ranging from 0.38 to 7.76 lps with six wells having yields of more than 3 lps. The transmissivity of these wells ranged from 3.42 to 56.00 m^2/day while the Storativity ranges from 2.1 x 10^{-3} to 1.7 x 10^{-5}. The specific capacities of these tubewells ranged from 0.19 to 0.80 lpm/m of drawdown. The salient features of ground water exploration are given in **Table-2**.

Table 2: Salient Features of Ground Water Exploration (March 2012).

S. No.	Salient Features	Details
1	No. of exploratory wells drilled	EW-13, OW-6, Pz-3,
2	Depth range (m bgl)	24.50 to 201.50
3	Number of zones encountered	2 to 3
4	Thickness of individual zone (m)	3 to 30
5	Formation	Weathered granites and gneisses
6	Depth range of zones encountered (m bgl)	10.30 to 129.30
7	SWL range (m bgl)	2.24 to 17.2
8	Yield range (lps)	0.38 to 7.76
9	No./ % of boreholes with yield more than 3 lps	6/50 %
10	Transmissivity (m^2/day)	3.42 to 56.00
11	Storativity	2.1 x 10^{-3} to 1.7 x 10^{-5}

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 6°C and mean maximum temperature is 45°C.

The normal annual rainfall over the district ranges from 1300 mm to 1500 mm. It is the minimum in the north-west south-east direction and increases in the

north-east direction. Tiroda receives the minimum rainfall of 1357.8 mm while the maximum rainfall of 1415.8 mm is received at Deori. The average annual rainfall of the period 1998-2007 in the district varies from 1221 mm (Goregaon) to 1402 mm (Arjuni Morgaon) and the same is presented in **Table-3**.

Table 3: Annual Rainfall Data (2002-2011)

Taluka	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Average
Amgaon	1133.1	1375.2	998.8	1963.5	1860.7	1449.5	1194.6	1055	1459	1297.7	1378.71
Deori	776.7	1357.5	757.8	2420.8	2068.7	1491.7	854	996.6	1272	949.3	1294.51
Gondiya	1196.6	1328.9	831.4	1603.1	1383.9	1100.1	1402.02	1020.4	1331	1133.6	1233.1
Goregaon	1212.8	1304.3	964.4	1486.0	1670.7	1159.4	865	1013	1363.4	1177.7	1221.67
Arjuni Morgaon	1003.2	1519.2	915.6	1743.8	1408.0	1572.3	1061.2	1063.1	2043	1693.7	1402.31
Sadak-Arjuni	1183.9	1210.5	1081.2	1477.0	1345.9	1120.0	1182.4	1191.1	1940.4	1222.7	1295.51
Salekasa	890.9	1564.2	967.9	1989.7	1536.7	1390.2	1243.5	1099.1	1439.3	1421.6	1354.31
Tirora	886.1	1896.7	1072.1	1638.4	1156.1	953.7	1093	1006.4	1471.7	1045.8	1222

3.0 Geomorphology and Soil Types

The district forms part of Wainganga sub-basin and has an undulating terrain with elevations ranging from 263 to 315 m amsl. Physiographically, the district can be broadly divided into two physiographic units viz., the one controlled by structural features i.e., the Structural Origin and the one controlled by differential weathering i.e., the Denudation Origin. The structural hills and ridges are more common in the eastern and south eastern parts of the district, while the denudational features like pediments/pediplains are seen in north-central, west central and south-west portions.

The soils of the district are highly varied and are derived from weathering of crystalline metamorphic and igneous rocks. The main types of soils are Kali, Kankar, Morand, Khardi, Sihar and Bardi. Out of these, Sihar soils are used for growing the Rice, which is the main crop in the district.

4.0 Ground Water Scenario

4.1 Hydrogeology

Gondia district is unique in Maharashtra in the sense that the entire area of the district is occupied by metamorphic and igneous rocks. Major part of the district is occupied by the crystalline rocks of Pre-Cambrian formations viz; Archaean, Dharwars. A map depicting the hydrogeological features is shown in **Figure-2**.

4.1.1 Hard Rock Areas

4.1.1.1 Archeans

The Archeans are represented by Amgaon Group consisting of Augen gneisses, amphibolites, migmatites and these formations are confined to the N & NW corner of the district around Amgaon and Bahela.

4.1.1.2 Dharwars

The Amgaon group is followed by Dharwars (Lower Precambrian) are represented by Sakoli Group and Dongargarh Group of rocks, the latter forms the major stratigraphic unit in the district. The Sakoli Group consists of quartzites, schists, phyllites, metavolcanics and BIF and are confined to the N and NW part of Nagjhira. The areas surrounding Salekasa, Wadegaon, Murdoli, Deori and Chinchgarh rocks consisting of Rhyolites, Andesites, basic volcanics are present which respectively represents Bijli, Pitepani and Sitagota formations of the Dongargarh Group.

4.1.2 Occurrence of Ground Water

The Pre-Cambrian crystalline rocks are the major water bearing formations in the district. The weathered portions of crystalline rocks together with joints and fracture zones act as good aquifers. Ground water occurs under water table conditions in the weathered mantle and then the fractured, well-jointed and sheared zones. Dug wells, dug cum bore wells and bore wells are the common ground water abstraction structures. Ground water occurs under water table conditions and semi-confined conditions in these formations. Water table conditions prevail in the weathered mantle and the fractures, jointed and sheared zones. At places where the argillaceous litho-units like phyllites and mica schists act as a confining medium, the ground water is found to occur under semi-confined conditions.

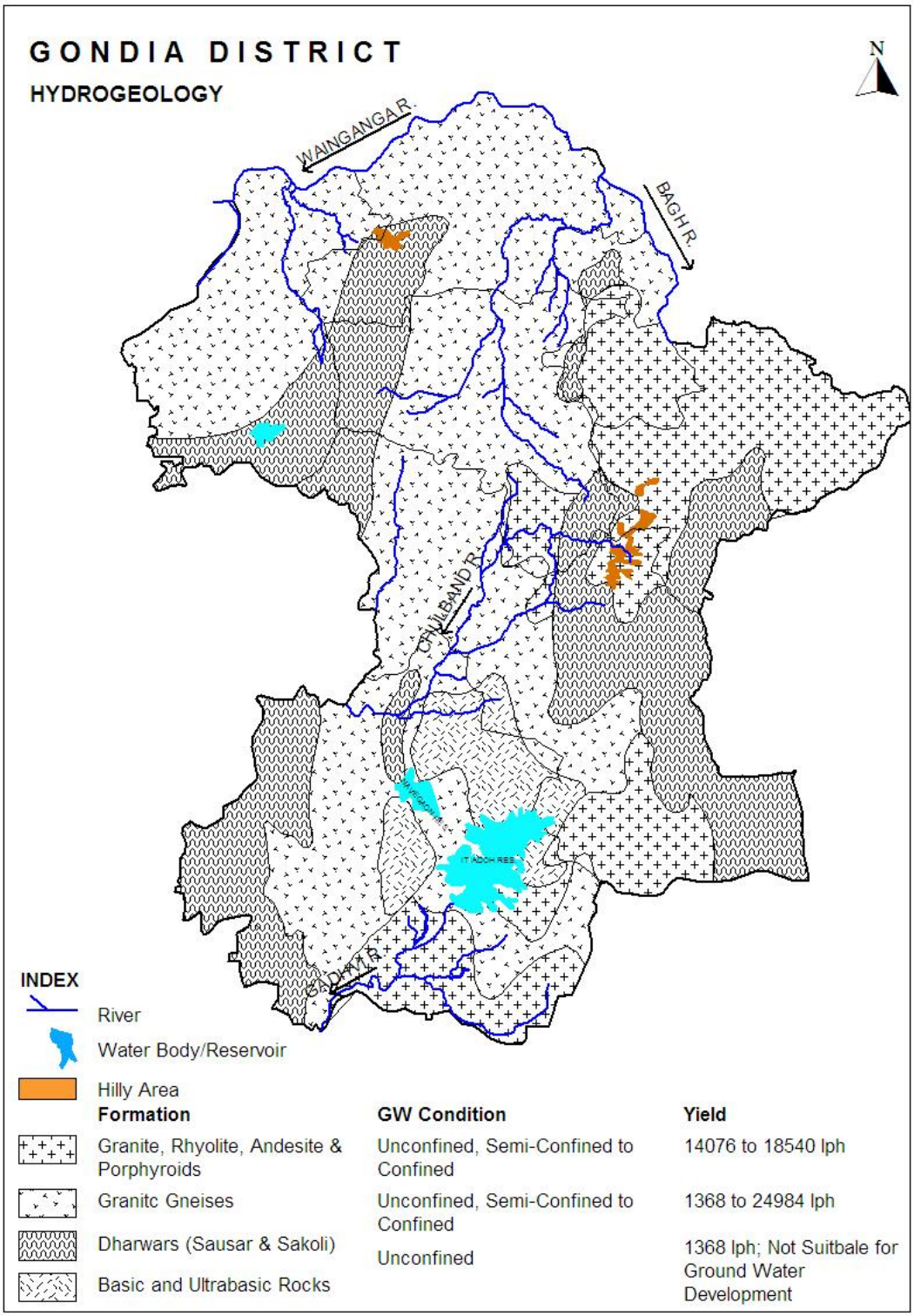

Figure-2: Hydrogeology

4.1.3 Water Level Scenario

Central Ground Water Board periodically monitors 26 Ground Water Monitoring Stations (GWMS) stations in the Gondia district four times a year i.e. during January, May (Pre-monsoon), August and November (Postmonsoon).

4.1.3.1 Premonsoon Depth to Water Level (May-2011)

The depth to water level in the district during May 2011 ranges between 0.55 (Sarra) and 12.65 m bgl (Salekassa). Depth to water level during premonsoon has been depicted in **Figure-3**. Shallow water levels in the range of 5 to 10 m bgl are seen in major part of the district, i.e., in major parts of Tiroda, Amgaon, Gondia and Salekasa talukas. Deep water levels in the range of 10 to 20 mbgl are observed in the eastern parts of the district covering parts of Deori and Salekasa talukas.

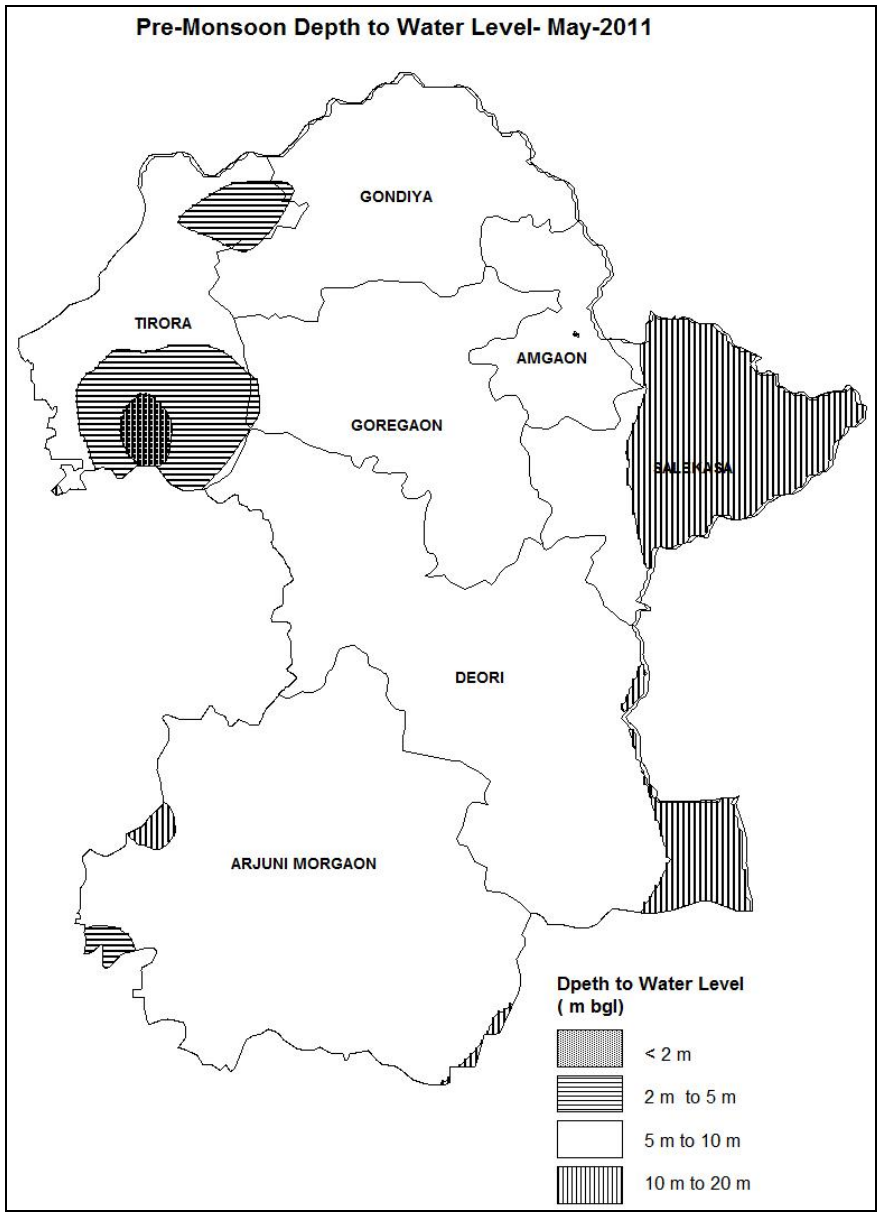

Figure-3: Premonsoon Depth to Water Level (May 2011)

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

The depth to water level during postmonsoon (Nov. 2007) ranges between

0.6 m bgl (Sarra) and 7.70 m bgl (Kudwa Pz). Spatial variation in post monsoon depth to water level is shown in **Figure-4**. Shallow water levels within 5 m bgl occupy almost entire district. Water levels between 5 and 10 m bgl are observed in central and northern part of the district, occupying parts of Gondia, Goregaon Deori and western part of Arjuni Morgaon talukas.

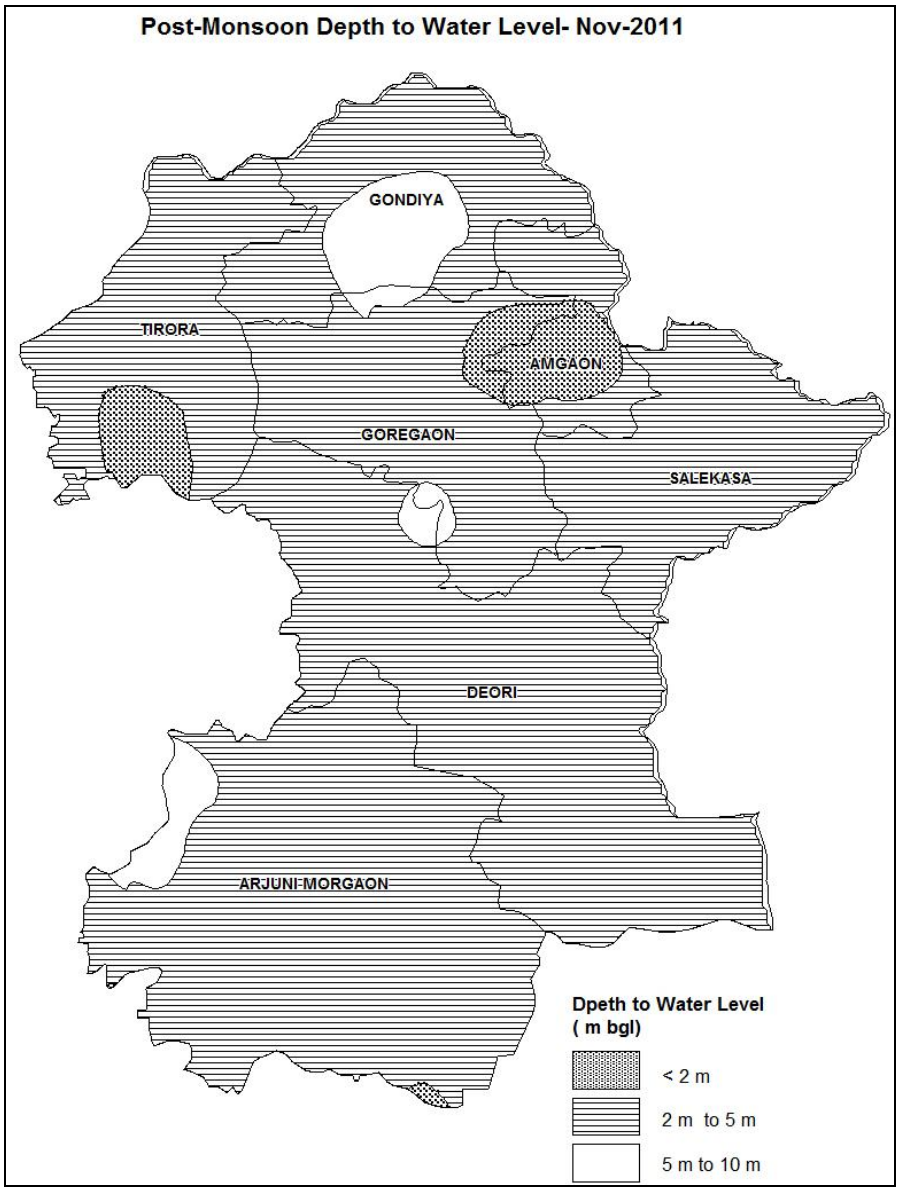

Figure-4: Postmonsoon Depth to Water Level (Nov. 2011)

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

The pre and post-monsoon fluctuation varies from 0.05 to 9.05 m. In the northern and central parts of district the fluctuation is 2 to 4 m covering Gondia,TirodaGoregaon and Deori. In southern and eastern parts the fluctuation observed is more than 4 m covering Salekasa, Deori and Arjuni Morgaon talukas.

4.1.4 Water Level Trend (2001-2010)

Trend of water levels for premonsoon and postmonsoon period for last ten years (2001-2010) have been computed. Analysis of trend indicates that during premonsoon period, rise in water level has been recorded at 11 stations and it ranges between 0.0186 m/year (Sangadi) and 0.6656 m/year (Sondad). Fall in water level has been observed at 19 stations and it ranges between 0.0038 m/year at Kohemera and 0.9321 m/year at Bondgaon. During post-monsoon period, rise in water levels has been recorded at 16 stations and it ranges from 0.0028 m/year (Bondgaon) to 0.1814 m/year (Salekassa), whereas at 14 stations, fall in water level ranging between 0.0015 m/year (Sindbiri) and 0.1842 m/year (Arjuni) is observed.

4.2 Yield of Wells

The CGWB has drilled 13 exploratory wells in Gondia district to evaluate the potential and aquifer parameters. The yield of these borewells ranged between 0.38 and 7.76 lps. Out of 13 exploratory wells, six are high yielding with more than 3 lps discharge. It has been observed that the borewells drilled in granitic gneisses are more productive than drilled in Schist's/ Quartzite's. The yield of GSDA borewells generally range between 2000 to 5000 lph.

4.3 Aquifer Parameters

Based on pumping tests, it was observed that in Fractured Gneisses the transmissivity ranges from 7.25 to 56.00 m^2/day, the storativity ranges from 2.00 x 10^{-4} to 1.70 x 10^{-5} and special capacity ranges from 0.19 to 0.80 lps/m of drawdown. The transmissivity in Fractured Schist's ranges from 3.42 to 17.00 m^2/day, the storativity estimated ranges from 2.1 x 10^{-3} to 1.7*10^{-5}.

4.4 Ground Water Resources

Based on GEC-97 methodology, the Central Ground Water Board and Ground Water Survey and Development Agency (GSDA) have jointly estimated the dynamic ground water resources of Gondia district as on 2009. The same is presented in **Table-4**.

Ground water resources assessment was done for 4597.22 sq.km area of which 812.45 sq.km is under command and 3784.58 sq.km is non-command. As per this estimation, the total annual ground water recharge is 624.70 MCM with the natural discharge of 37.37 MCM, thus the net annual ground water availability comes to be 587.32 MCM. The gross draft for all uses is estimated at 109.34

MCM with irrigation sector being the major consumer having a draft of 44.38 MCM. The allocation for domestic and industrial water requirement up to the next 25 years are worked out at 122.35 MCM. The net ground water availability for future irrigation is estimated at 397.81 MCM. The stage of ground water development varies from 7.61 % (Arjuni Morgaon) to 37.37 % (Gondia). The overall stage of ground water development for the district is 20.58 % and falls in 'Safe' category.

4.5 Ground Water Quality

CGWB is monitoring the ground water quality of the Gondia 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 19 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 (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 2011.

Table-4: Ground Water Resources (March 2008-2009). (Figures in ham)

Administrative Unit	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 Development	Category
Amgaon	4838.53	537.46	757.60	1295.06	1627.17	2870.54	26.77	Safe
Arjuni Moregaon	13695.22	412.23	629.61	1041.84	1261.62	11944.21	7.61	Safe
Deori	7341.79	537.53	365.32	902.85	732.47	6121.76	12.30	Safe
Gondia	8293.40	1615.10	1484.54	3099.64	2892.24	3526.76	37.37	Safe
Goregaon	4380.78	617.34	923.91	1541.25	2018.87	2108.73	35.18	Safe
Sadak Arjuni	7910.17	470.00	514.88	984.88	983.08	6425.44	12.45	Safe
Salekasa	5604.94	175.37	522.57	697.94	924.34	4272.01	12.45	Safe
Tirora	6667.69	451.84	919.42	1371.27	1795.91	4410.49	20.57	Safe
District Total	**58732.51**	**4816.88**	**6117.85**	**10934.73**	**12235.70**	**41679.92**	**18.62**	

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-5**.

Table-5: 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	18	1	-
TH (mg/L)	300	600	14	5	-
NO_3 (mg/L)	45	No relaxation	12	-	7
F (mg/L)	1.0	1.5	19	-	-

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

The perusal of **Table-5** shows that the concentrations of all the parameters except nitrate, most of the samples are below the maximum permissible limit of the BIS standards. It is also seen 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 37% 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.

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-6**.

It is clear from the **Table-6** that maximum number of samples (69%) falls under the category of medium salinity water while nearly 26% of samples fall in 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-6: Classification of Ground Water for Irrigation based on EC.

Type	EC (µS/cm)	No. of Samples	% of Samples
Low Salinity Water	<250	1	5
Medium Salinity Water	250-750	13	69
High Salinity Water	750-2250	5	26
Very High Salinity Water	>2250	-	
	Total	**19**	**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-7**.

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

Type	RSC (meg/l)	No. of Samples	% of Samples
Good	<1.25	18	95
Doubtful	1.25-2.50	1	5
Unsuitable	>2.50	-	-
	Total	**19**	**100**

The perusal of **Table-7** shows that the RSC values of ground water samples collected from the wells is less than 1.25 in about 95% of wells, which reflects that the overall quality of ground water in the monitoring wells is good 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.

As per 2001 census the district had 994 villages and two major towns. The drinking water to these villages is mainly from dugwells, borewells and tubewells in the area. As per the Minor Irrigation Census (2006-07), the district has 9480 irrigation dugwells and 308 borewells which create on ground water potential of 139.64 sq.km., out of which 112.09 sq.km., potential is utilized. Apart from these irrigation wells, a number of small diameter domestic wells are located in the house holds which are used mainly for domestic purposes.

The GSDA under Rural Water Supply Scheme has drilled about 7017 successful borewells in the district till March 2007, out of which 6884 are fitted with hand pumps and 133 are fitted with electric pumps.

5.0 Geophysical Studies

In Gondia district, VES was carried out at 7 sites and the results reveals the three layered geo-electrical sections. The first layer resistivity ranges from 6.60 to 200.00 ohm-m with thickness ranging from 0.50 to 3.00 m which may be

attributed as top soil. The second layer resistivity ranges from 16 to 80 ohm meters and thickness of 13 to 44 m this layer can be inferred as weathered fractured formation. The third layer resistivity is very high which may be attributed to the hard compact granite. Thus the middle layer having resistivity in the range of 16 to 80 ohm meters and thickness of 13 to 44 m has good ground water potential. The drilling at some of these sites have yielded up to 2820 lph of discharge.

6.0 Ground Water Management Strategy

Ground water has special significance for agricultural development in the district. Although, the ground water development in the district is on lower side, major parts are experiencing declining of ground water levels over a period of time. Thus there is 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.

6.1 Ground Water Development

Major part of the Gondia district is underlain by crystalline rocks comprising of granitic gneisses, schist's, volcanics etc. These formations act as good aquifers only where the thickness of the weathered mantle is high and they are affected by sets of open joints and fractures. Ground water development in the area is on moderate scale. There are three type of ground water structures i.e. dugwells, borewells and tubewells in the area. Dugwells one normally able to sustain 3 to 6 hours of pumping per day and the duration of recuperation varies from 3 to 9 hours. A large number of dug-cum-borewells are present in this district with the depth of the bores ranging from 15 to 30 meters from the bottom of the well. Topographic lows and the areas where the thickness of weathered mantle is high are usually the favourable zones for such wells. The study of litholog of exploratory wells indicates the presence of weathered formations down to 30 m bgl followed by jointed/fractured formations extending up to 129 m bgl. Due to this fact, the depth of dugwells should not exceed more than 25 m and depth of borewells by more than 130 mbgl.

Table-8: Nature and Yield Potential of Aquifers

S. No.	Taluka	Major Formation	Yield Potential	Feasible Structures
1	Gondia	Granite Gneisses	Low to High	DW, DCB, BW
2	Tiroda	Granite Gneisses, Schist's/Quartzite	High	DW, DCB, BW
3	Amgaon	Granite, Rhyolite	Low to High	DW, DCB, BW
4	Goregaon	Granite Gneisses	Medium to High	DW, DCB, BW
5	Salekasa	Granite, Rhyolite	Medium to High	DW, DCB, BW
6	Arjuni Moregaon	Granite Gneisses, Schist's/Quartzite, Granite, Rhyolite	Low	DW
7	Sadak Arjuni	Granite Gneisses	Mostly low to high	DW
8	Deori	Schist's, Quartzite etc.	Medium to High	DW, DCB, BW

Here, DW- Dugwell, BW- Borewell and DCB- Dug-cum-Borewell.

The overall stage of ground water development for the district is on lower side, i.e., 20.58% thus there is a plenty of scope for further development of ground water resources throughout the district. However the development should be done in planned and scientific manner as northern parts of the district are showing falling water level trends.

6.2 Water Conservation and Artificial Recharge

Percolation Tanks and Cement Bandharas are the feasible artificial recharge structures in the district. The existing dugwells can also be used for artificial recharge; however, the source water should be properly filtered before being put in the wells. As the post-monsoon water levels are shallow in major part of the district, extreme care should be taken while selecting the sites for artificial recharge structures. The sites 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 in postmonsoon season. Such areas are restricted and occur in central and southern part of the district, occupying parts of Deori and Arjuni Morgaon talukas. However roof top rainwater harvesting by storing the water in storage tanks during rainy season for use during non-monsoon season should be encouraged in scarcity affected areas as well as in urban areas.

7.0 Areas Notified by CGWA/SGWA

As per ground water resource estimation all the talukas fall under “Safe” category, hence till March 2012 the area has not been notified either by CGWA or SGWA.

8.0 Recommendations

1. Major part of the district is underlain by crystalline rocks comprising of granitic gneisses, schist’s, volcanics, etc. These formations act as good aquifers only where the thickness of the weathered mantle is high and they are affected by sets of open joints and fractures. Therefore, the topographic lows and the areas where the thickness of weathered mantle is high are usually the favourable zones for dugwells and dug-cum-borewells.
2. The study of litholog of borewells indicates the presence of weathered formations up to 30 m bgl followed by jointed/fractured formations extending up to another 30 to 40 m bgl and deeper fractures occur up to 130 mbgl.. Due to this fact, the depth of dugwells should not exceed more than 25 m and that of borewells by more than 150 m.
3. 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.
4. 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.
5. The geophysical surveys in Gondia district reveals the three layered geo-electrical sections and the middle layer having resistivity in the range of 16 to 80 Ohm meters and thickness of 13 to 44 m has good ground water potential.
6. The overall stage of ground water development for the district is on lower side, i.e., 20.58% thus there is a plenty of scope for further development of ground water resources throughout the district. However the development should be done in planned and scientific manner as northern parts of the district are showing falling water level trends.

7. As the post-monsoon water levels are shallow in major part of the district, extreme care should be taken while selecting the sites for artificial recharge structures. The sites 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. Such areas are restricted and occur in central and southern part of the district, occupying parts of Deori and Arjuni Morgaon talukas
8. Roof top rainwater harvesting by storing the water in storage tanks during rainy season for use during non-monsoon season should be encouraged in scarcity affected areas as well as in urban area.
9. Abandoned Malguzari tanks should be revived and proper care should be taken of the existing tanks by regularly de-silting them and reclamation of tanks should be stopped.
10. Ground water quality is adversely affected at many places due to high concentration of nitrate. Adequate sanitary protection to the wells may be provided to control the nitrate contamination. Proper disposal domestic sewerage may be made to avoid nitrate contamination of ground water.