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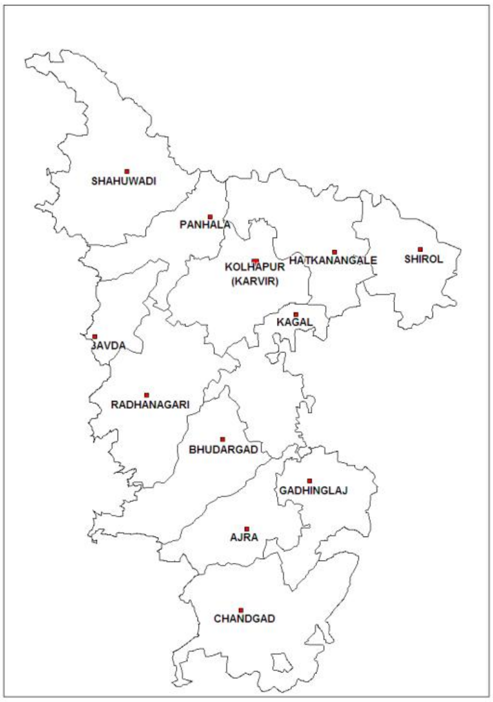
भारत सरकार
जल संसाधन मंत्रालय
केंद्रीय भूजल बोर्ड

GOVT OF INDIA
MINISTRY OF WATER RESOURCES
CENTRAL GROUND WATER BOARD

महाराष्ट्र राज्य के अंतर्गत कोल्हापुर जिले की भूजल विज्ञान जानकारी

GROUND WATER INFORMATION
KOLHAPUR DISTRICT
MAHARASHTRA



By
SOURABH GUPTA
Scientist-D

दवारा
सौरभ गुप्ता
वैज्ञानिक – घ

मध्य क्षेत्र, नागपुर
CENTRAL REGION, NAGPUR
2013

KOLHAPUR DISTRICT AT A GLANCE

1.	**GENERAL INFORMATION**		
	Geographical Area	:	7620 sq. km
	Administrative Divisions (As on 31/03/2011)	:	Taluka- 12, Karveer, Panhala, Shanuwadi, Kogal, Hatkanangle, Shirol, Gadhinglaj, Chandgad, Ajra, Bhudergad, Radhanagari, Gagan Bavda
	Villages	:	1217
	Population	:	3523162
	Normal Annual Rainfall		2200-5000 mm
2.	**GEOMORPHOLOGY**		
	Major Physiographic unit	:	Hills and plateau, Foot hill Zone, Plains,
	Major Drainage	:	Varna,Panchganga, Dudhaganga , Vedganga, Ghataprabha Hirenyasheri
3.	**LAND USE (2010-11)**		
	Forest Area	:	1401 sq.km
	Cultivable Area	:	5810 sq.km
	Net Area Sown	:	4550 sq.km
4.	**SOIL TYPE**	:	Medium Black and Deep Black soil
5.	**PRINCIPAL CROPS (2000-01)**		
	Rice	:	1720 sq. km.
	Sugarcane	:	1090 sq. km.
	Pulses		2029 sq km
	Oil Seeds	:	1041 sq. km.
6.	**IRRIGATION BY DIFFERENT SOURCES (2000-01) (No.'s)**		
	Dugwells	:	28878
	Borewells	:	660
	Net Area Irrigated	:	128584 ha
7.	**GROUND WATER MONITORING WELLS (May-2011)**		
	Dugwells	:	32
	Piezometers	:	Nil
8.	**GEOLOGY**		
	Age		Formation
	Liestocene-Recent	:	Alluvium
	Upper Cretaceous to Lower Eocene		Basalt (Deccan Traps)
9.	**HYDROGEOLOGY**		
	Water Bearing Formation	:	Basalt- Weathered/fractured/ jointed vesicular/ massive, under phreatic condition and semi-confined to confined conditions.
	Pre-monsoon Depth to Water Level	:	0.0 to 16.28 m bgl (May-2011))
	Post-monsoon Depth to Water Level)	:	0.30 to 9.60 m bgl (Nov-2011)

	Pre-monsoon Water Level Trend (2002-2011)	:	Rise: 0.008 to 1.17 m/year Fall: 0.03 to 0.47 m/year
	Post-monsoon water level trend (2002-2011)	:	Rise: 0.003 to 0.70 m/year Fall: Negligible to 0.06 m/year
10.	**GROUND WATER EXPLORATION (March 2011)**		
	Wells Drilled	:	3 PZ
11.	**GROUND WATER QUALITY (May 2011)**		
	Type of Water	:	Ca-HCO_3
	General Water Quality	:	Suitable for both drinking and irrigation purposes.
12.	**DYNAMIC GROUND WATER RESOURCES (March 2009)**		
	Net Annual Ground Water Availability	:	782.26 MCM
	Annual Ground Water Draft (Irrigation+Domestic)	:	458.66 MCM
	Allocation for Domestic and Industrial requirement up to next 25 years	:	13.26 MCM
	Stage of Ground Water Development	:	35.81 %
13. AWARENESS AND TRAINING ACTIVITY			
	Mass Awareness Programme (MAP)	:	NIL
	Water Management Training Programme (WMTP)	:	NIL
14	**GROUND WATER CONTROL AND REGULATION**		
	Over Exploited Taluka		None
	Critical Taluka		None
	Notified Area		None
15	**ARTIFICIAL & RAINWATER HARVESTING**		
	Projects Completed		None
	Projects under Technical Guidance		None

16. MAJOR GROUND WATER PROBLEMS AND ISSUES

The basaltic rocks form prominent hill ranges, isolated hillocks, undulation etc. in the district. These basalts have poor primary as well as secondary porosity. As a result, these rocks have poor storage as well as transmissivity characteristics, which give rise to higher runoff, rather than natural recharge. The formations due to poor storage and transmission characteristics get fully saturated during the monsoon and a situation of rejected recharge is resulted. These aquifers then are drained naturally due to slopping and undulation topography. As a result, the dugwells becomes dry by the month of February onwards. In addition to this, the laterites occurring as capping on basalt are highly porous and permeable which do not retain ground water into interstices as a result, the ground water is not available during the time it is required.

Ground Water Information
Kolhapur District

Contents

List of Figures

List of Tables

Ground Water Information
Kolhapur District

1.0 Introduction

The Kolhapur district is located at southern end of Maharashtra State. This district was ruled by pioneer social reformer “Chhatarapati Sahu Maharaj”. It is among the few districts of India, having the distinction of first wired village in India. The famous Goddess of Kolhapur “Godess Ambabai Mahalaxmi” is worshiped in almost every Maharashtrian house . The Place like Panhala, Jyotibha, Vishalgad, Nurshinwadi and Bahubali are the famous tourist places.

The district has total area of 7620 sq. km which is about 2.5% by the area by State. The district is bounded by n latitudes $15^{o}40^{'}$, $17^{o}15^{'}$, and east longitudes $73^{o}30^{'}$, and $74^{o}45^{'}$, . The district is sub divided into four sub divisions i.e. Karveer, Ichalkaranj, Gandhinglaj, Radhanagri which are further divided into 12 talukas viz Karveer, Panhala, Shanuwadi, Kogal, Hatkanangle, Shirol, Gadhinglaj, Chandgad, Ajra, Bhudergad, Radhanagari, Gagan Bavda. The district has 18 towns and 1217 villages. It has a total population by 35,23162 as per 2001 census. A map of the district showing taluka boundaries and taluka headquarters is presented in fig 1.

The central Ground water Board has taken up several Studies in the district. A list of the studies conducted in the district is presented in table-1.

Table-1 Studies undertaken by CGWB.

S. No.	Officer	AAP	Type of Study
1	D. K. Chadda	1975-76	Systematic Hydrogeological Surveys
2	N.G. Gajbhiye	1976-77	--do--
3	D. K. Chadda	1976-77	--do--
4	B. K. Kallapur, Sc-B	1988-89	--do--
5	P.R. Subramanian, SHG	1990	Ground water Resources and Development Potential of Kolhapur District

In addition to this, geological mapping has been carried out by Sh. Sahasrabudhe Y. S. in field season 1959-60.

2.0 Climate and Rainfall

The climate of the district is characterized by general dryness except during south west monsoon season. The cold season is from December to February followed by summer from March to May. June to September is the south west monsoon season while October and November constitute the post monsoon season.

The normal annual rainfall by the district is 1239 mm. It varies from about 500 to 6000 mm across the district. It is minimum in the extreme eastern part of the district around Kurundawad and Shiral and maximum around Gogan Bavada. The taluka wise rainfall by the district is given in Table -2.

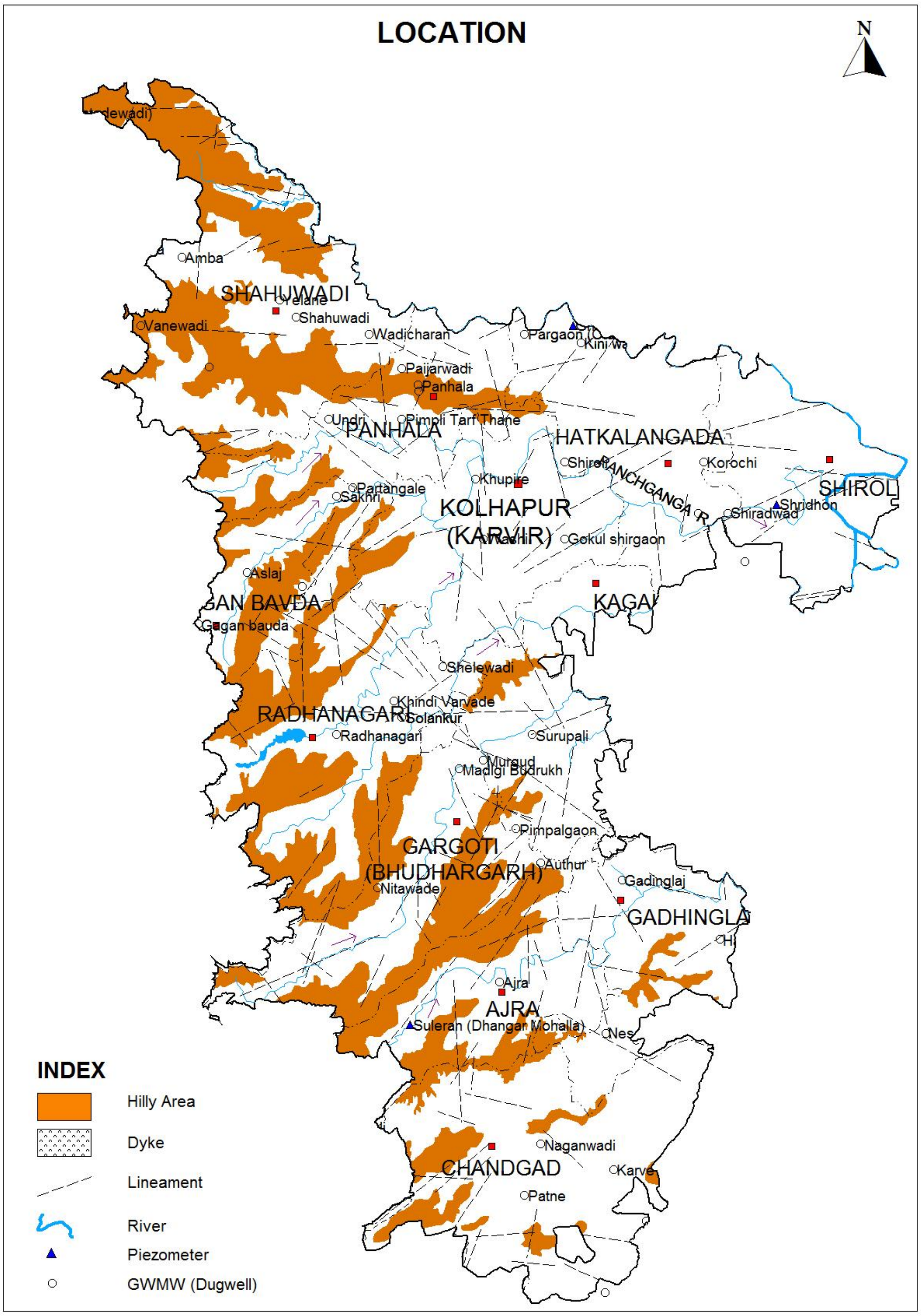


Figure 1: Location

Table 2: Annual Rainfall (2003-12) in mm

Taluka	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Hatkangle	364.1	742.0	1334.0	1609.6	921.0	987.7	984.0	1082.0	737.0	791.0
Shirol	404.0	617.0	1050.0	958.0	676.4	500.2	766.0	565.0	272.0	467.0
Panhala	1290.0	1948.0	2540.0	2735.0	2649.4	1863.0	1498.2	1473.0	1405.0	1384.0
Shauwadi	1620.6	2249.0	3450.0	3097.2	2344.0	1867.0	1945.0	1968.0	1819.0	1823.0
Radhanagari	2834.0	3510	5227.0	5471.0	4601.0	3684.0	5155.0	3000.9	4405	3072.0

Taluka	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Bavda	4689.0	5482.2	6912.6	7304.0	6272.7	6207.0	4759.2	6177.8	7077.0	5878.0
Karveer	541.0	1027.0	1743.0	1397.7	1036.9	1087.2	900.7	898.0	912.4	734.0
Kagal	442.2	824.4	1607.8	1313.9	839.2	779.4	891.3	823.0	836.0	569.0
Gadhinglaj	650.0	863.0	1559.0	1256.0	955.0	1079.9	1042.4	1242.0	1012.0	616.0
Bhudargad	1277.4	1509.0	2758.4	2326.0	1688.0	1624.0	1730.4	1749.0	1680.0	1309.2
Ajara	1274.3	1462.8	2973.4	2781.0	2196.7	1743.1	1967.2	2133.0	2130.0	1408.6
Changad	2054	2462.4	3502.4	3593.0	3219.0	2872.5	2733.1	2752.0	3277.0	2602.0
Average	**1453.4**	**1891.4**	**2888.1**	**2820.2**	**2283.3**	**2024.6**	**2031.0**	**1988.6**	**2130.2**	**1721.2**

3.0 Geomorphology and Soil Types:

The district is a part by the Deccan table land with an average height by 550 m. amsl with the Sahyadrian Scrap forming the most prominent feature along its western administrative boundary. The Central portion by the district, the hill range exhibit a similar form and posses the same height but they have a south west- north east trend and they extend to a length of about 24 kms. The southern hill range viz the Kagal range and Budargad range maintain the same trend SW-NF.

Broadly, the district has three major characteristic land forms (1) the hill, ghats and plateau (2) the foot hill zones (3) the plains.

The soils in the district are formed from the Deccan trap which is predominating rock formation. The hill tops are covered with lateritic soil while in the valleys, the soil are of mixed character varying in colour from brownish to reddish.

4.0 Ground Water Scenario

4.1 Hydrogeology

4.1.1 Deccan Traps

The major portion of district is covered by Basaltic lava flows of upper Cretaceous to lower Eocene age. These flows are part of the plateau Basalt of the Peninsular India, and believed to have been extruded by fissure type of Volcanoes.

The Basaltic flows of the area are of 'aa' type. These show a basal section having chilled basalt of greyish clincker with fragments of highly vesicular or dense purple trap cemented by zeolites, secondary silica, glass and powdered rock. The main middle section of the flow comprises dark or dark grey dense basalt. Over this is found a section of flow breccia, which also consists of sub-rounded angular blocks of vesicular traps cemented by zeolites, glass or pulverized rock. The thickness of the Breccia varies from a few centimeters to more than half the thickness of the flow. The top most layer of the flow is pinkish or purplish glass, which at places gives rise to clay like material after weathering and is referred to as "Red bole". The Breccia portion is generally altered and is pinkish or purplish in colour. The Breccia is easily weathered, the product of weathering comprises fine fragments and it gives rise to smooth slopes. The dense rock sections of the flows show spheroidal weathering and yield large fragments. They stand out as cliffs. Owing to this difference of the weathering characters, cliffs, benches, and terraces are formed. Brand bottomed valleys are derived whenever the erosion is arrested by the dense sections of the flows, Amphitheater like geomorphological features are also conspicuous in these area. While the fragmental tops of flows yield reddish soil with admixture of zeolitic and chert, the dense rock sections yield dark coloured soil.

In the Basaltic Terrain, in parts of Kolhapur district, the ground water occurs under un-confined conditions in the phreatic zone up to the depth of 15.00 m in the weathered zone, joints and fractures in the massive units, and weathered vesicular units. The water bearing strata below the red bole and massive units exhibits mild confined conditions as observed in the borewells tapping deeper aquifers. In the laterites plateaus, the ground water occurs down to a depth of 15.00 to 20.00 m. bgl under un-confined conditions. The wells of these areas show rapid decline in water level during post monsoon period and practically go dry in peak summer, due to lateral movement at lithomargic/lateritic contact and spring discharge is noticed.

4.1.2 Laterites

Laterites forms plateaus in the area and cap the Basalts at different elevations. Mostly these are confined to flat and top hill ranges. Due to Laterite capping holding adequate moisture it is generally good for forests grown on such plateaus. The top of the many plateaus in the Western ghats and south and southeast of Kolhapur show development of Laterites. The thickness of Laterites varies from few meters to 30.00. The section of laterites shows, Bauxite, Laterites and Lithomargic clays. At places the Bauxite occurs as patches within the Laterite. All the above are derived from the leaching processes acting on weathered trap. The Laterites with numerous vesicles, irregular channel ways are moistly filled with yellowish to reddish yellow and greyish white clayey material. The laterites and bauxite in the area show massive vermicular concretionary and brecciated structure. Secondary laterites derived from the denudation of plateaus laterites are found along slopes of the hills, and valleys.

Laterites in the study area has better porosity due to network of sinuous conduits making it porous formations. The Ground Water circulates through a net work of voids and conduits, joints and fractures. The lithomargic clays occurring at the base act as aquiclude for percolating ground water, and springs emerge at this contact due to lateral movement of ground water.

4.1.3 Alluvium

Due to hilly terrain, conspicuous spreads of Alluvium are rarely noticed, except in some lower reaches of rivers. Few isolated patches of recent Alluvium varying in thickness from 3.00m to 5.00 m are seen at places along the banks of the River Krishna and Vairna. The Alluvium rests directly over the weathered basalt and comprises of pebbles, boulders and fragments of clayey and siliceous material. A map depicting hydrogeology of the district is shown in fig 2.

The Alluvium deposits in the area have primary porosity due to inter granular pore spaces making sands and gravels a good water bearing formations. But their irregular lithological nature results in variable water yielding capacity, depending on the sand/clay ratio.

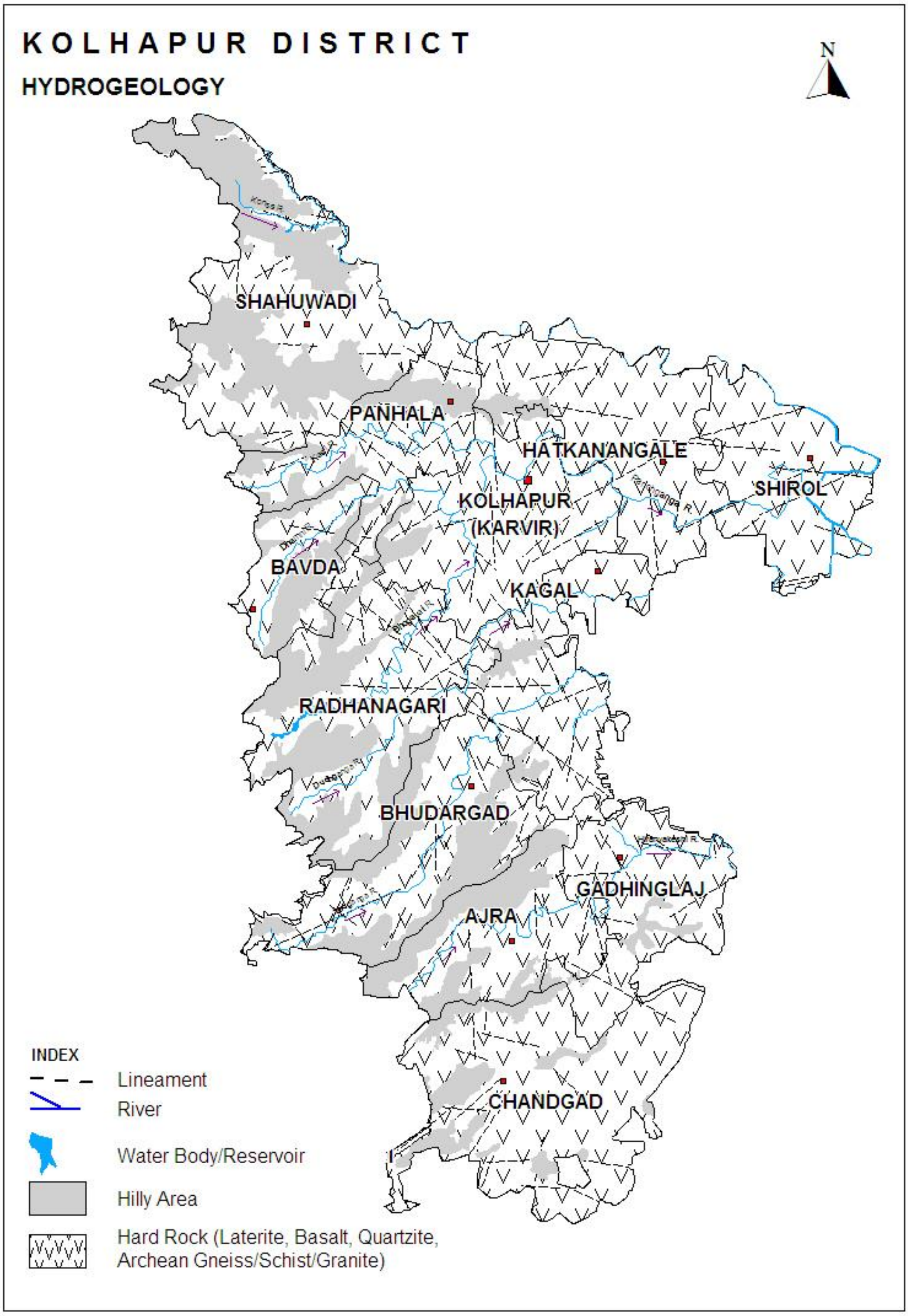


Figure 2: Hydrogeology

4.2 Water Level Scenario

The Central Ground water Board periodically monitors 36 National Hydrograph Network Stations (NHNS) in Kolhapur district, four times a year i.e. January, May, August and November.

4.2.1 Depth to Water Level

Depth to water level varies with in the district depending upon hydrogeological framework, level of ground water development and topography of the area. It also varies with time. The general rise during monsoon and decline after monsoon till the next monsoon is witnessed in the region. The water level data of 36 National Hydrograph Network monitoring Stations (NHNS) established by CGWB have been analyzed to depict the ground water level during pre monsoon and post monsoon 2011.

4.2.1.1 Pre monsoon Depth to Water Level (May-2011)

Pre monsoon depth to water level map has been prepared using the NHNS water level data of May-2011 and is presented as Figure 3. The premonsoon depth to water level ranges from 0.00 to 16.28 m. bgl. The depth to water level ranges between 5 to 10 m. bgl. in major part of the district. The water levels of 2.0 to 5.0 m. bgl is observed as elongated patch in the central part of the district. The deeper water levels of more than 10.00 m bgl are observed in the northern and southern part of the district.

4.2.1.2 Post monsoon Depth to Water Level (Nov-2011)

Postmonsoon depth to water level map has been prepared based on Nov 2011 water level data. The post monsoon water level ranges from 0.3 to 9.6 m bgl. The water levels of 2 to 5m bgl is observed in major part of the district. The shallow water level of less than 2.0m. bgl occur as scattered patches in northern and south eastern parts of the district. The deeper water levels of 5 to 10 m bgl are observed in eastern parts of the district. Spatial variation of post monsoon depth to water level is shown in fig 4

4.2.1.3 Water Level Fluctuation (May-Nov 2011)

The difference between pre monsoon and post monsoon water level is taken as fluctuation, which assumes significance for ground water recharge, estimates. The difference between pre monsoon and post monsoon water level is the seasonal fluctuation, which may vary due to excess or deficit rainfall during that particular year. The fluctuation is less than 2.0m bgl. in almost entire district except in a few isolated patches where the fluctuation is more than 2.0m.

4.2.1.4 Pre-monsoon water Level trend (2002-11)

Trend of water levels for premonsoon and postmonsoon periods for last ten years (2002-2011) have been computed for 33 NHNS during premonsoon and 31 NHNS during postmonsoon periods. Analysis of trend indicates that during premonsoon period, rise in water levels has been recorded at 22 stations and it ranges between 0.008 (Khindi Varvade) and 1.17 m/year (Panhala). Fall in water levels has been observed at 11 stations and ranges between 0.03 (Pimpri tarf) and 0.47m/year (Shahuwadi). During postmonsoon period, rise in water levels has been recorded at 20 stations and it ranges between 0.003 (Surupali) and 0.70m/year (Kini Wathar) whereas at 11 stations, fall in water levels ranging between Negligible (Aslaj) and 0.06m/year (Radhanagri) is observed. In majority of NHNS, both during pre and postmonsoon periods rising trend of water levels has been observed.

The premonsoon water level trend map was also prepared for the period May 2002-2011 and the same is presented in Figure- 5.

A perusal of the map indicates that in major part of the district the rising trend of water level in the range 0 to 0.20 m/year is observed. The falling trend of water level is observed in central elongated parts of the district and in some parts of Gadhinglaj taluka in southeastern parts.

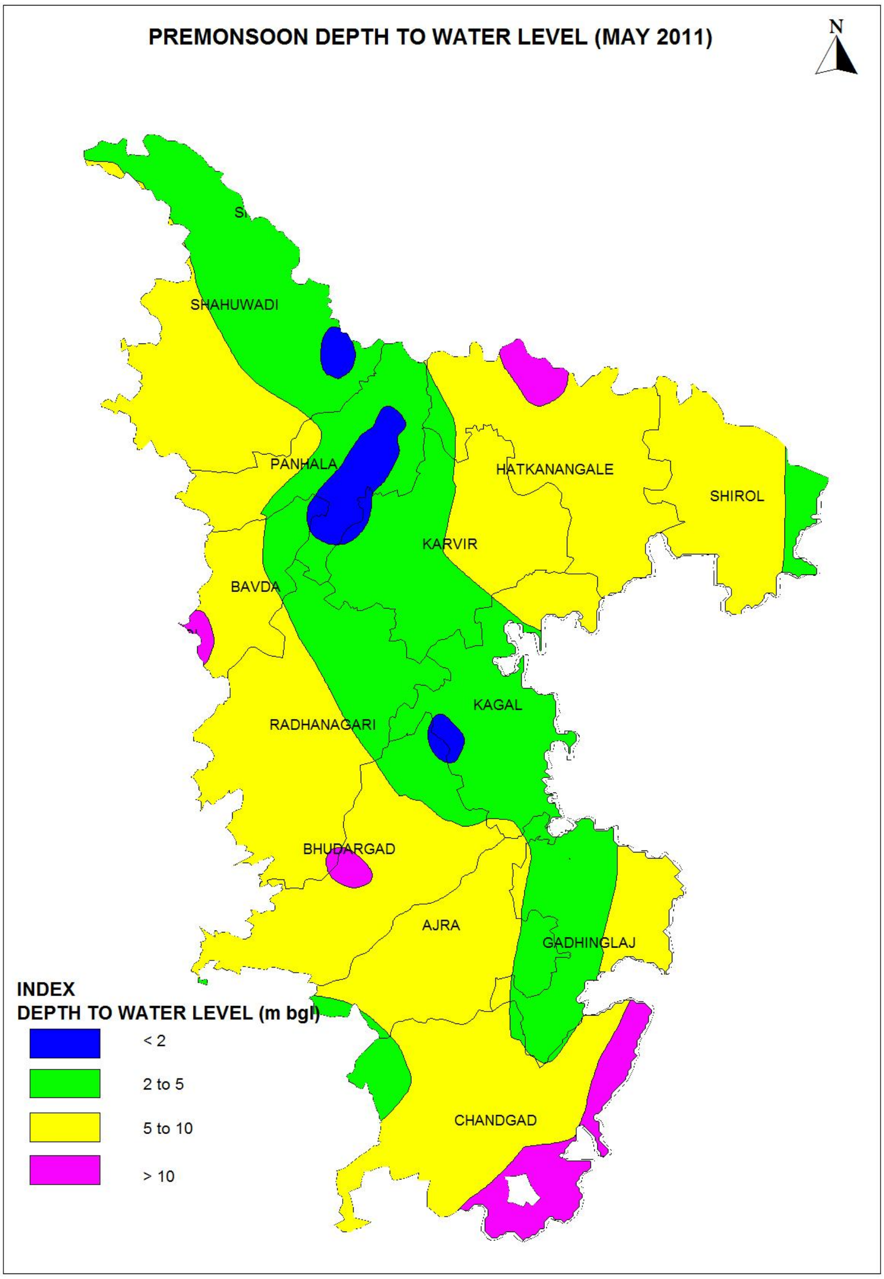


Figure-3: Premonsoon depth to water level (May 2011)

4.2.2 Long Term Water Level Trend

Long term water level trend has been worked out in the district for 10 years data (2001-2010) of pre monsoon and post monsoon season separately. Total 30 stations have been analyzed for trend analysis.

4.2.2.1 Pre monsoon water level trend.

Out of 30 station, 8 are showing declining trend @ 0.0113-0.3077 m/yr., whereas 12 stations are showing, rising trend @ 0.0231-05685 m/yr. The declining trend indicated the tendency of increasing pumpage of ground water in the area.

4.2.2.2 Post Monsoon Water level Trend

Out of 30 hydrograph stations, 24 station show rising trend @ 0.0004-0.5029 m/yr., whereas 6 stations are showing declining trend @ 0.0383- 0.1018 m/yr., Post monsoon declining trend indicate inadequate and decreasing recharge to ground water over a period of time. Therefore, ground water development has to be done carefully and efforts of ground water augmentations should be encouraged in these areas.

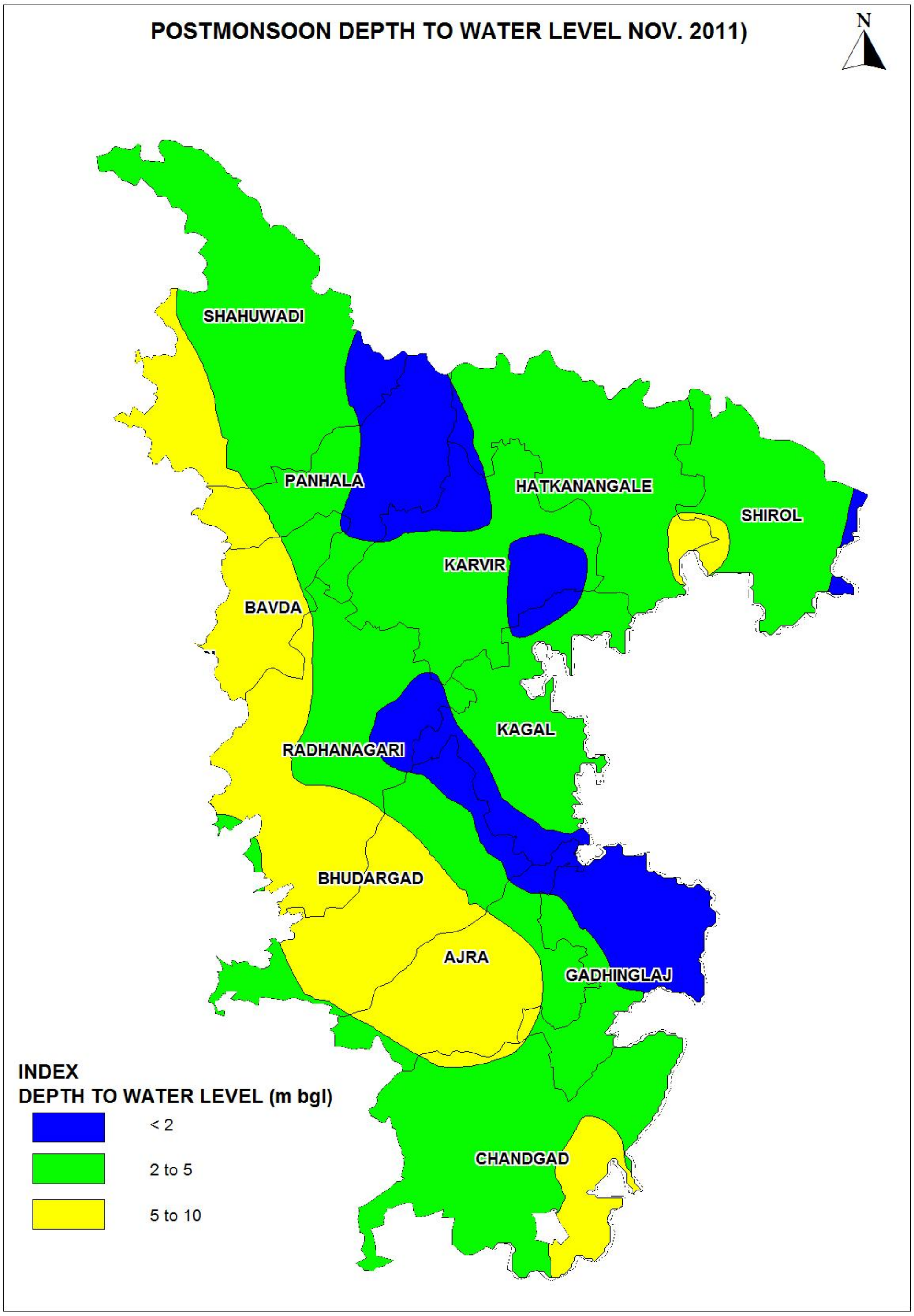


Figure-4: Postmonsoon depth to water level (Nov. 2011)

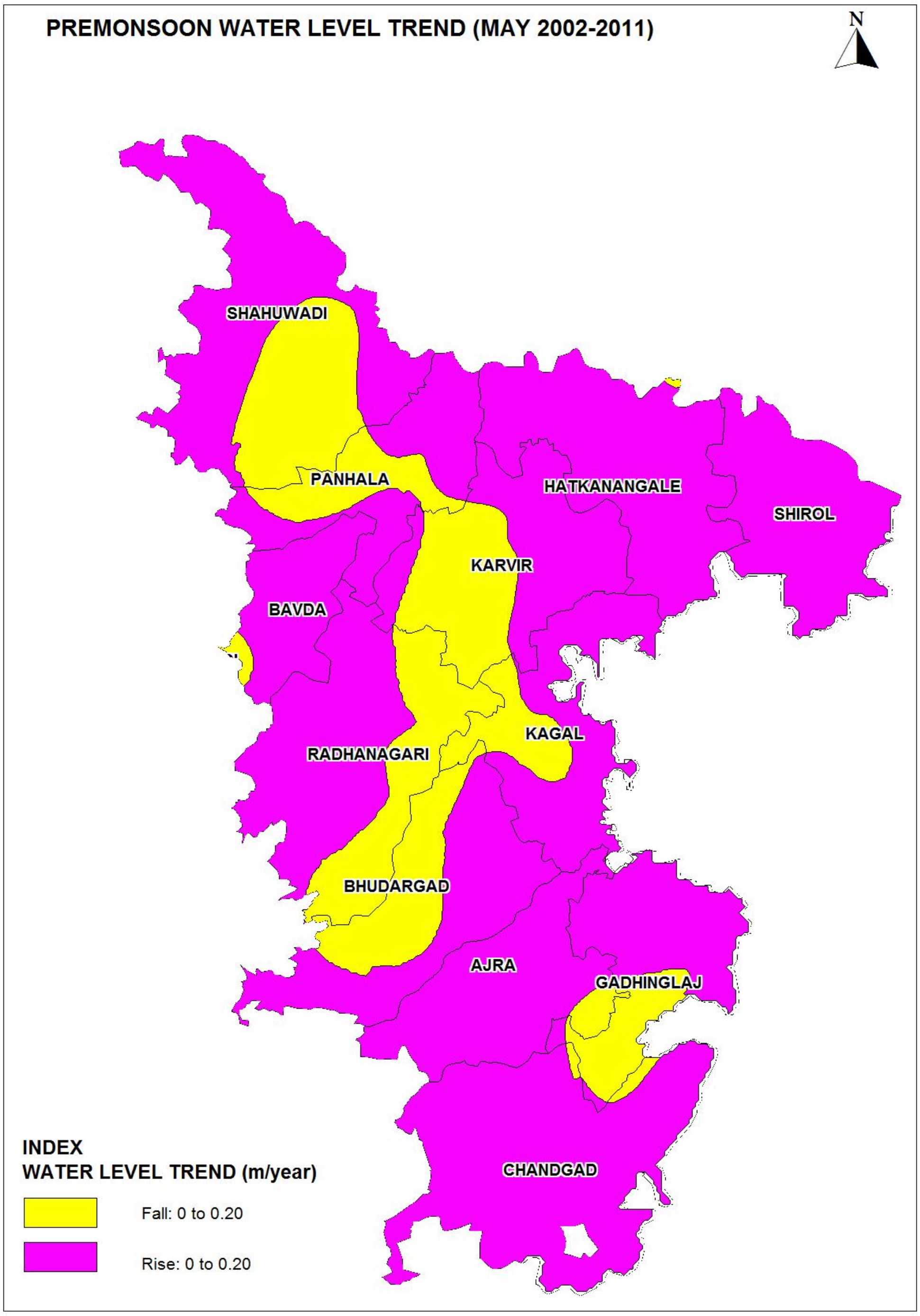


Figure-5: Premonsoon water level trend (May 2002-2011)

4.3 Aquifer Parameters

The aquifer parameters represent the hydraulic properties of an aquifer namely permeability, transmissivity and storalivity, which governs the ground water flow through the aquifer system.

The Central Ground Water Board and the State Ground Water Survey and Development. Agency (GSDA) while conducting systematic hydrogeological surveys in parts of Kolhapur district have conducted number of pumping tests on large diameter dug wells for observing well performance and computed values of aquifers parameters. The results of these tests are presented in the bellow table-3 A and table 3 B.

Table 3A: Summarized Results of Pumping Tests Conducted by Central Ground Water Board

S. No.	Aquifer	Specific capacity (Lpm/mdd)	Transmissivity (m^2/day)	Storativity in (Fraction)
1.	Weathered jointed Massive Basalts	29.20 to150.09	31	0.001
2.	Vesicular Basalts	89.73 to 421.58	-	-
3.	Alluvium	143.83to 516.11		

Table 3B: Summarized Results of Pumping tests Conducted by Ground Water Surveys and Development Agency (G.S.D.A)

S. No.	Aquifer Formation	No. of Tests Conducted	Specific Capacity (Lpm/mdd)	Transmissivity (m^2/day)	Storativity
1	Alluvium	8	39.41 to 361.91	30.00 to 409	0.03-0.16
2	Laterites	4	9.21 to 31.40	4.03 to 35.05	0.03-.06
3	Moderate to highly weathered fractured Massive Basalt	89	30.04 to 617.18	40.60 to 377.54	0.01-.09
4	Weathered Massive Basalt	17	7.05 to 112.63	5.59 to 118.05	0.02-.04
5	Vesicular Zeolitic Basalt weathered fractured.	29	31.74 to 444.13	34.31 to 417.48	0.03-0.09

Neither the Central Ground Water Board nor Ground Water Survey and Developed Agency (G.S.D.A) has carried out any deep exploratory drilling in the area and as such no data is available on aquifer parameters of deeper aquifers.

4.4 Yield of Wells

The yields of the wells are the function of the permeability and transmissivity of aquifer encountered. This varies with location, diameter and depth of wells. There are mainly two types of ground water structures in the district i.e. dugwells and borewells. Yield of dugwells in basalt varies according to the nature of formations tapped. The yield of dugwells in phreatic aquifer ranges from 15 to 60 m^3/day during summer and 30 to 60 m^3/day during winter, pumping rarely exceeds 2 to 3 hours in basaltic formation.

4.5 Ground Water Resources

Central Ground Water Board and Ground Water Survey and Development Agency (GSDA) have jointly estimated the ground water resources of Kolhapur district based on GEC-97 methodology. The same is presented in Table-4.

The estimation the total annual ground water recharge is 565.77 MCM with the natural discharge of 41.17 MCM, thus the net annual ground water availability comes to be 782.26 MCM. The gross draft for all uses is estimated of 458.66MCM with irrigation sector being the major consumer having a draft of 445.40 MCM, whereas the domestic and industrial draft is to the tune of 13.26 MCM. The net ground water availability for future irrigation is estimated to be 310.33 MCM, whereas the allocation for domestic and industrial supply up to 2025 is 26.52MCM. Stage of ground water development varies from 35.81% (Sahuwadi) to 82.16% (Hatkangale). Overall stage of ground water development for the district is 58.63. All the 12 talukas and 40 watersheds of the district fall in "Safe" category.

Table 4: Taluka wise Ground water Resources (2008-09)

Taluka	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 %
Ajara	6474.13	3520.35	82.17	3602.52	164.34	2789.44	55.64
Bhudargad	4760.09	2142.82	80.34	2223.16	160.68	2456.58	46.70
Chandgad	13099.78	6461.67	139.28	6600.94	278.55	6359.56	50.39
Gadhinglaj	9439.92	6929.73	100.86	7030.59	201.72	2308.47	74.48
Gaganbawada	1669.04	626.78	47.79	674.57	95.58	946.68	40.42
Hatkanangale	6579.92	5249.70	156.43	5406.13	312.87	1017.35	82.16
Kagal	8133.79	4247.42	88.40	4335.82	176.80	3709.57	53.31
Karvir	6047.26	4165.82	145.29	4311.11	290.58	1590.86	71.29
Panhala	5269.85	3494.87	126.68	3621.55	253.37	1521.61	68.72
Radhanagari	8662.79	3441.81	93.08	3534.88	186.16	5034.82	40.81
Shahuwadi	3904.15	1274.24	123.79	1398.03	247.59	2382.32	35.81
Shirol	4185.99	2984.99	142.31	3127.29	284.61	916.39	74.71
Total	**78226.7**	**44540.2**	**1326.4**	**45866.6**	**2652.8**	**31033.6**	**58.63**

4.6 Ground Water Quality

CGWB is monitoring the ground water quality of the Kolhapur 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 30 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 to 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.

4.6.1 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., 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
TH (mg/L)	300	600	27	3	Nil
NO_3 (mg/L)	45	No relaxation	26	-	4
F (mg/L)	1.0	1.5	30	Nil	Nil

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

The perusal of Table-5 shows that the concentrations of most of the parameters are within desirable limit of the BIS standards except nitrate which is more than MPL in 4 samples. It is also seen from the Table-5 that the potability of ground water in the wells is good in general. Overall, it can be concluded that the ground water quality in the wells monitored in the district is not much affected.

4.6.2 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.

4.6.2.1 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 was carried out irrigation purpose and given below in Table-6.

It is clear from the Table-6 that maximum number of samples (57%) falls under the category of Medium salinity water while nearly 30% of samples fall in Low salinity water category. This shows that the ground water in the pre-monsoon season from shallow aquifer in the district can 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	9	30
Medium Salinity Water	250-750	17	57
High Salinity Water	750-2250	4	13
Very High Salinity Water	>2250	Nil	Nil
Total		**30**	**100**

4.7 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 in the district is predominantly used for irrigation as it is the major ground water utilizing sector. He ground water development in the district is mostly through dugwells. The minor irrigation census data of 2000-2001 indicates that the area irrigated by ground water is about 795.66 sq.km, whereas surface water accounts for about 490.18 sq. km. of the area and the net irrigated area stand at 1285.84 sq. km. Thus it is clear that ground water is the major source of irrigation as it accounts for 62% of the net irrigated area. There are about 28878 dugwells in use in the district which create an irrigation potential of 795.66 sq. km. Out of which almost entire irrigation potential of 795.66 sq. km. has been utilized, whereas 660 borewells create an irrigation potential of about 4 sq. km. and entire irrigation potential has been utilized.

5.0 Ground Water Development and Management Strategy

Agricultural development in the district mainly depends on rainfall. The ground water development in almost entire district is on the lower side mainly due to the presence of hilly areas in major part of the district. The district also faces water scarcity during summer months in spite of heavy rainfall. There is thus a need to adopt an integrated approach of development of ground water resources dovetailed with ground water augmentation and rainwater conservation to provide sustainability to ground water development.

5.1 Ground Water Development

Physiography, geology and rainfall of the district plays a major role in the ground water resource availability and sustainability, The high, steep hill ranges, isolated hillocks, undulation etc give rise to high run off. The predominance of hard rock formation in the form of basaltic lava flows facilities the run off rather than natural recharge due to the poor ground water storage and transmission capabilities. The formation due to poor storage and transmission characteristics gets fully saturated during monsoon and a situation of rejected recharge is resulted. These aquifers then are drained naturally due to slopping and undulation topography. In these areas, the villagers depends on seasonal nalas, springs for domestic needs.

The valley portion in basaltic terrain is underlain by thick weathered mantle deposited by weathered material slides from slopes of adjacent hills. These areas form potential zones for ground water development through dug wells.

The eastern part of the district is characterized by ground water convergence zone and form ground water potential zones. The above area can be developed by dug wells of 15m depth which can yield 3 to 5 Ips at the draw down of 2.0 to 3.0m.

The dugwells used for drinking and for irrigation are shallow in depth (4-8. bgl). The yield as well as sustenance of these wells can be increased by deepening of wells by 4 to 6 m, if porous and permeable formation is likely to occur at depth.

Ground water resource estimation has indicated scope for further development in all the talukas. The net ground water availability for irrigation is about 310.33 MCM. In the eastern part of the district, consisting of valley and plain is most suitable for ground water development and additional wells can be constructed in favorable areas. To develop the ground water resources in these parts dugwells are most feasible structures for ground water development.

The borewells should normally be avoided as they generally tap deeper fractures, which may not be sustainable. Besides, the borewells should only be used for drinking water supply and not for irrigation. The sites for borewells also needs to be selected only after proper scientific investigation so as to minimize the rate of failure.

5.2 Water Conservation and Artificial Recharge

In basaltic area, the artificial recharge structures feasible are check dams, gully plus, percolation tanks, nalla bunds, etc. The structures like gully plugs, contour bunds are most favorable in the hilly areas. In the highland area and wide lateritic plateau areas, contour trenching should be carried out to arrest the surface runoff and ensure recharge of rainfall runoff into the ground water reservoir. Existing dugwells can also be used for artificial recharge; however, the source water should be properly filtered before being put in the wells. These sites need to be located where the hydrogeological conditions are favorable, i.e, where water levels are deeper than 5m.

Rainwater harvesting through village ponds, roof top and individual tank storage are also appropriate and can render as supplementary source of water. Conservation of ground water source through sub-surface trench and regulating the flow of spring discharge can be effective in hilly area.

6.0 Ground Water Related Issues and Problems

The basaltic rocks form prominent hill ranges, isolated hillocks, undulation etc., in the district. These basalts have poor primary as well as secondary porosity. As a result, these rocks have poor storage as well as transmissivity characteristics, which give rise to higher runoff, rather than natural recharge. The formations due to poor storage and transmission characteristics get fully saturated during the monsoon and a situation of rejected recharge is resulted. These aquifers then are drained naturally due to slopping and undulation topography. As a result, the dugwells becomes dry by the month of February onwards. In addition to this, the laterites occurring as capping on basalt are highly porous and permeable which do not retain ground water into interstices as a result, the ground water is not available during the time it is required.

7.0 Areas Notified by CGWA/SGWA

As per ground water resource estimation all the talukas fall under "safe" category, hence till March 2011 the area has not been notified either by CGWA or SGWA.

8.0 Recommendations

- Major part of the district is underlain by Deccan Trap Basalt where dugwells are most feasible structures. The dugwells may be constructed down to the depth of 15 m, so as to tap the weathered, vesicular / fractured and jointed basalt, normally available down to the depth of 15 m bgl in the eastern part of the area and the valley portion in the hilly areas.
- The stage of ground water development indicates that there is scope for ground water development by dug wells and bore wells.
- The sites for borewell need to be selected only after proper scientific investigation. 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.
- In the district, hilly part gives rise to higher runoff. The basaltic formation has poor storage and transmission capabilities. The water levels are less than 5.0 m bgl during postmonsoon. Under such situation the potential of artificial recharge is quite limited. It is therefore, recommended to conserve the water through storage in tanks, ponds and masonry structures.
- Conservation of ground water flow is also recommended by constructing sub-surface trench down the slope of major water supply structure.
- To enhance the ground water resources and for sustainable development, mass awareness programmes should be organized in large scale by district administration. Such programmes are necessary so as to educate the user regarding yielding capacity of aquifer and declining trend of water levels in the district. Similarly farmer should also be encouraged to adopt appropriate crop planning and irrigation practices.