A study of physico-chemical properties of groundwater in some parts of Karveer taluka, District Kolhapur

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Abstract

Groundwater sources are important in urban as well as in rural areas of India. More than two billion people worldwide depend upon ground water. In the present day scenario, millions of people worldwide are deprived of this due to over exploitation, poor management practices. Many anthropogenic activities have lead to such circumstances. The state like Maharashtra has also been in the clutches of drought due to early commencement of summer conditions and unpredictable monsoon. During such situation the water supply remains inadequate in the cities and hence the only option remains is the aquifer that is the groundwater.

Therefore, the present study was carried out with an objective to identify the hydro chemical characters influencing the quality of the groundwater during the three seasons of the year 2011. A detailed study was carried out to assess the suitability of the groundwater for domestic as well as for agricultural purposes in some distant areas as well as in urban area of Karveer taluka of Kolhapur district. The results of the study reveal that seasonal variation in the groundwater quality takes place which is temporal and spatial and it illustrates a good correlation between various parameters which characterize and evaluate the quality of the groundwater. Graphical and statistical analysis has been applied to the obtained chemical data. Also but partially few geological factors can also be held responsible for the temporal and spatial variations in water quality. The results are discussed in the paper.

Keywords: Groundwater, Karveer taluka, Hydro geochemical.

Introduction:

Groundwater sources are the important water source in urban as well as in the rural areas of India. More than two billion people worldwide depend upon ground water. Today, with a global withdrawal rate of 600–700 km^3/year, groundwater is the world's most extracted raw material (IAH, 2003). But mostly in cities households' water supply is through pipeline. Sources of groundwater have failed to escape pollution in India. Therefore, India is pertaining with issues of water crisis and pollution. Extensively changing land use patterns in most parts of the country are responsible for degradation of groundwater quality. Contamination of potable water due to changing land use patterns has become a major issue in the developing country like India. Hardly any state in the country does not have problem of water quality. Population stress, irrigation requirements and industrialization are major pressures for water security (MINARS 2010-11). Maharashtra state is not an exceptional case in an issue with groundwater contamination problems. The state like Maharashtra has also been in the clutches of drought due to early commencement of summer conditions and unpredictable monsoon. During such situation the water supply by the corporation in the cities is not adequate and hence the only option remains is the aquifer that is the groundwater. Aquifer is the saturated zone containing sufficient groundwater that the water can be pumped out. Plenty amount of water can be fetched out for use in domestic purpose, irrigation, industrial and other uses. Groundwater plays a fundamental role in shaping the economic and social health of many urban areas (Patel and Krishnan, 2009). The communities residing in urban areas then rely on groundwater for drinking as it is one of the reliable and clean source of water. Serious degradation of water quality in urban India has often been attributed to indiscriminate disposal of sewage and industrial effluents into surface water bodies (Srikanth, 2009). Generally industries during dry season which otherwise depend on surface water in such conditions rely on groundwater. Due to increasing industrialization on one hand and exploding population on the other, the demands of water supply have been increasing tremendously (Firmal, 2009). Also the irrigation done to the crops is provided with the groundwater. The discharge of domestic sewages, industrial effluents, application of chemical fertilizers along with geology and local climate alters the quality of rivers, lakes, and aquifers (Vasanthavigar et al., 2011). Moreover, intensive use of groundwater and it's over utilization causes the entire aquifer to contaminate. Therefore, considerable quantity and quality of this limited fresh water is being polluted. Some part of the proposed study area i.e. Kolhapur district is dealing with the same problem.

Many reports have been heading with the water contamination. Exceeding limits of Iron, Chlorides, Nitrates and many other parameters have been reported and therefore the study of the groundwater quality in and around Kolhapur was carried out.

Materials and methods:

Study location and climate: The Karveer taluka lies between 16.69 ^{0} N and 74.24 ^{0} E. The average temperature is about 27^{0}C throughout the year. While the annual rainfall is about 1025 mm. The total population of Kolhapur district is 38,74,015 while 5,49,283 in Kolhapur city according to census 2011.

The geology of Kolhapur consists of Deccan traps with inter-trapped beds. The rock is mainly of igneous basalt types. The soil type of Kolhapur consists of black soil and red soil. The city has ample supply of water, good quality of soil, plentiful green areas, etc. which are responsible for overall growth and development of the city (ESR, 2009)

2009)

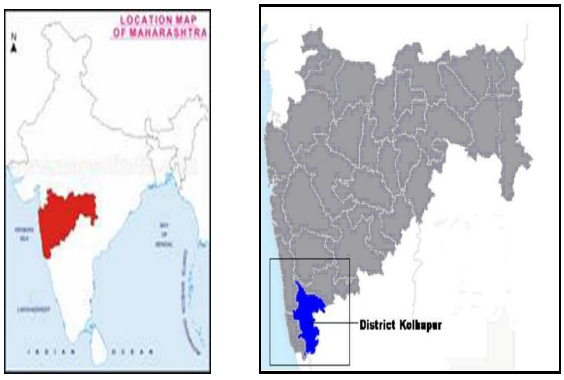

Fig:1 Location of study area

Groundwater is of major importance in providing the main water supply, and is intensively exploited for private, domestic and industrial use in many urban centers (Patel and Krishnan, 2009). Ninety two per cent groundwater extracted is used in the agricultural sector, five and three per cent respectively for industrial and domestic sector. (Khurana and Sen, 2008). Karveer taluka is also being engaged in such activities as it is settled on the river Panchaganga. The developing industries around the city are coming up with many environmental issues. Especially the pressure on the fresh water resources is increasing which has failed to cope up the declination in quality as well as quantity. In dry season, interrupted water supply by corporation is satisfied by the groundwater which is generally considered as a reliable water resource. But this source is also facing stress from multiple sources such as from agricultural sector for irrigation, from industrial sectors for various processing units. The ever rising demand for water, have led to over extraction of groundwater. Hence, degrading its quality as well as its quantity. Present study deals with the qualitative analysis of few sites in Karveer taluka.

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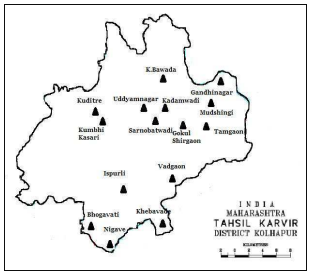

Fig 2 Sector wise distribution of sampling sites

Industrial	Residential
Sugar mill, K.Bawada	Kadamwadi
Gokul Shirgaon	Tamgaon
Bhogavati Sugar mill	Khebvade
Kumbhi Kasari	Kuditre
Agricultural	Sarnobatwadi
Vadgaon	Mudshingi
Ispurli	**Commercial**
Nigave	Uddyamnagar
	Gandhinagar

Table 1 Sampling sites

Sector wise division of the sites was done so as to segregate the probable impacts (Table: 1) The groundwater samples from open wells as well as from hand pumps were collected in pre monsoon (Jan-May), monsoon (June-Sept) and post monsoon period (Oct-Dec) of the year 2010. Groundwater from 15 sites was collected in pre washed 250 ml polyethylene bottles. The bottles were rinsed with the water which was to be sampled. The physico chemicals characters were analyzed. The physical characters like pH, electrical conductivity and TDS were measured at the site with the help of portable meters. Sodium and Potassium by flame photometer, total hardness and chlorides by titrimetric methods.

Results and Discussion:

Various physico chemical parameters were determined. The hydrochemistry of all the sites is given in Table: 2. The qualitative composition of groundwater from all the sites show a varying range. The pH of the sites from various sectors varies from 5.93 to 10.8. Although pH usually has no direct impact on consumers, it is one of the most important operational water quality parameter. (WHO, 2006) The commercial site that is Gandhinagar show a very high and the industrial site viz; Gokul Shirgaon show low pH value which are out of the WHO drinking water guidelines. The EC ranges from 300 to 1165 ìsiemens/cm. Total Dissolved Solids (TDS) of nearly 5 sites show values out of the acceptable limit for the drinking water as per BIS which is about 500 mg/l (Table: 3). Hardness is one of the important parameter. Depending on pH and alkalinity, hardness above about 200 mg/litre can result in scale deposition, particularly on heating. (WHO, 2006). Values of three sites show exceeding acceptable limits and one site show limits beyond permissible limit which is 300 and 600

mg/l respectively as per BIS (Table: 3). As Ca and Mg are responsible for increased hardness in these water samples the values of them also exceed. Sodium and Potassium of all the sites from all sectors are well within the limits. Chloride ranges from 11.3 to 253.9 mg/l. A site from commercial sector that is Gandhinagar show highest value of the chloride. It surpasses WHO as well as BIS acceptable limits which is 200 mg/l and 250 mg/l respectively.

Sr.	Sites	pH	E.C	TDS	TH	Ca	Mg	Na	K	Cl
1	Vadgaon	7.02	537.3	336	212	59.9	15.23	30	1	14.0
2	Khebvade	6.83	391.7	260.4	163	40.6	14.90	25	3	18.0
3	Nigave	7.23	619.8	412	193	61.7	9.56	50	0	43.3
4	Ispurli	6.70	449.7	287.6	185	48.4	15.71	35	0	11.3
5	Kumbhi	8.23	381.7	259	76	21.9	5.18	86	2.73	66.6
6	Kuditre	8.19	463.3	295	98	6.7	19.76	87	0.4	93.3
7	Bhogawati	6.70	115	78.3	82.7	13.6	11.83	13	0.3	18.7
8	Kadamwadi	6.70	1116.3	742.6	198	**80.7**	28.67	49	0.0	106
9	Gandhinagar	**10.80**	1165.3	761.6	**944**	**107**	**164.58**	30	0.1	**253.9**
10	Sarnobatwadi	6.77	609	388.9	260	51.3	**32.08**	12	0	30
11	Uddyamnagar	7.80	1109	720.9	**452**	**97.8**	**50.54**	24	0	52
12	Tamgaon	6.77	809	525.9	**336**	**80.2**	**33.05**	17	0	48
13	Gokul Shirgaon	**5.93**	526	341.9	264	54.5	**31.10**	23	0	34
14	Mudshingi	7.90	1345	874.3	**400**	**97.8**	**37.91**	45	0.4	84
15	Sugarmill bawada	6.97	300	178.6	244	59.3	23.33	8	0.8	70

Table 2 Mean values of physico chemical parameters during 2010(all the values except pH and EC are expressed in mg/l, EC expressed in µsiemens/cm)

Sr. no.	Parameters	WHO	BIS	
1			Acceptable	Permissible
2	pH	6.5-8.5	6.5-8.5	6.5-8.5
3	E.C	-	-	-
4	TDS	1000	500	2000
5	Total Hardness	100	300	600
6	Calcium	-	75	200
7	Magnesium	-	30	200
8	Sodium	200	-	-
9	Potassium	-	-	-
10	Chlorides	200	250	1000

Table 3 WHO and BIS drinking water limits

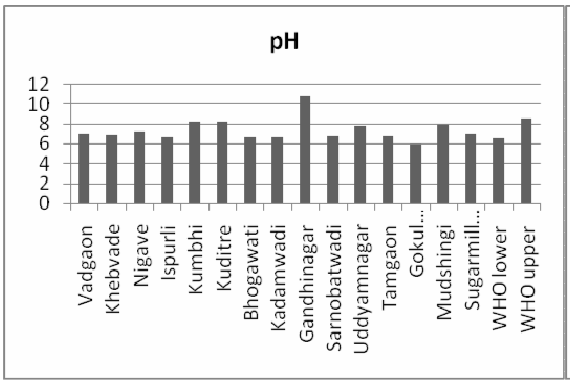

Fig 3 pH values of study sites

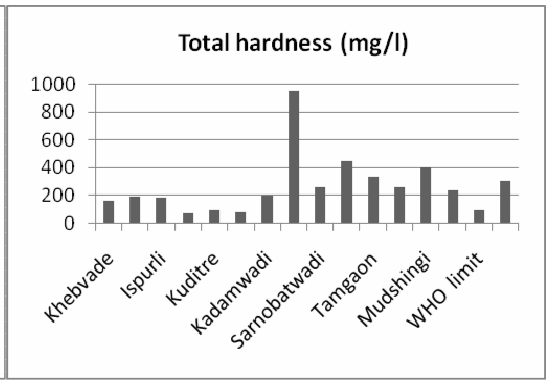

Fig 4 Total Hardness

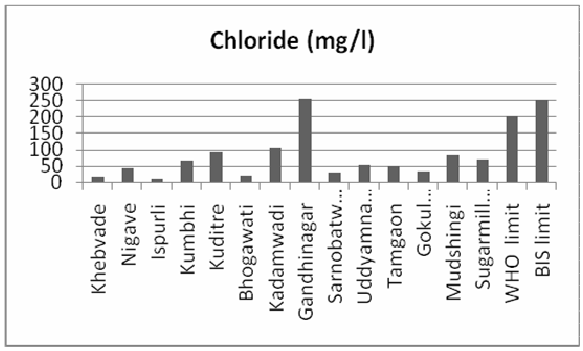

Fig 5 Chlorides values

Correlation is the mutual relationship between two variables. Direct correlation exists when increase or decrease in the value of one parameter is associated with a corresponding increase or decrease in the value of the other. The correlation is said to be positive when increase in one parameter causes the increase in the other parameter and it is negative when increase in one parameter causes the decrease in the other parameter (Karunakaran, 2009). Similar attempt has made to correlate the various parameters which have been studied. Correlation study help to know whether increase or decrease in value of one parameter influences any other parameter. The calculated values of r are shown in table 4. Strong positive correlation can be seen between EC and TDS (r = 0.999), total hardness and magnesium (r=0.962). Positive relation can also be observed in pH and magnesium, pH and chloride, E.C and calcium, TDS and calcium, magnesium and chloride. Moderate correlation can be seen in pH and total hardness, chloride and total hardness.

On the basis of the results obtained of the physico chemical parameters, the sites from commercial sector that is Gandhinagar and Uddyamnagar show exceeding values beyond BIS and WHO drinking water limits. The probable reasons for contamination may be the environmental state around the sampling site, location of the bore well, hand pump and open well and the pattern of the usage of the groundwater. The sewage lines were observed to be in broken condition, where the sewage water was seen percolating. Also sites from residential sector such as Tamgaon and Mudshingi show exceeding values of total hardness. However, the water can be used for household utilities. Gandhinagar can be considered as the most contaminated site amongst the study area.

	pH	E.C	TDS	TH	Ca	Mg	Na	K	Cl
pH	1.00	--	--	--	--	--	--	--	--
E.C	0.440	1.00	--	--	--	--	--	--	--
TDS	0.440	**0.999**	1.00	--	--	--	--	--	--
TH	0.761	0.682	0.675	1.00	--	--	--	--	--
Ca	0.354	**0.869**	**0.862**	0.785	1.00	--	--	--	--
Mg	**0.834**	0.578	0.574	**0.962**	0.626	1.00	--	--	--
Na	0.255	0.087	0.100	-0.252	-0.322	-0.163	1.00	--	--
K	0.014	-0.384	-0.374	-0.329	-0.402	-0.287	0.248	1.00	--
Cl	**0.886**	0.561	0.564	0.778	0.470	**0.869**	0.187	-0.170	1.00

Table: 4 Correlation coefficient(r) for different parameters

When it comes to dealing with maintaining water quality, the users and in large the communities have to play a

When it comes to dealing with maintaining water quality, the users and in large the communities have to play a key role in maintaining hygiene near water sources (Khurana and Sen, 2008). The measures for such contamination can be avoided by keeping the environment around the bore well, open well clean. Excess or abuse of groundwater must be avoided. Excess use of detergents should be prevented though used; the wastewater should

be disposed properly away from the ground water source. The resultant requirement is proper designing and maintenance of the sewage and drainage systems can also help to avoid contamination. Apart from the remediation at the community and users level it is also responsibility of various agencies such as State Government, Central Groundwater Board (CGWB), district Ground Water Survey and Development Agency (GSDA) to look deep into the probable contaminating source at root level. It can be done by regulating the use of the groundwater for irrigation as well as for industrial purposes, regular monitoring of the groundwater level and predicting the depletion of the water level, continuous water quality analysis, maintaining standards for the treatment plants especially for the industries dependent on the groundwater, provoking implementation of rain water harvesting system in houses in residential areas who solely depend on the groundwater. Integrated approach towards this managerial system will help to regulate and maintain the quality of such precious fresh source.

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