



COMPARATIVE STUDY OF GROUND AND SURFACE WATER QUALITY IN AND AROUND CHANNARAYAPATNA TOWN OF HASSAN DISTRICT OF KARNATAKA

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Abstract: Water is one of the most important resources people need for their well being, all-round development and material prosperity. Water covers 70.9% of the Earth's surface and is vital for all known forms of life. On earth it is found in oceans and other large water bodies, with 1.6% of water below ground in aquifers and 0.001% in the air as vapour, clouds and precipitation. Oceans hold 97% of surface water, glaciers and polar ice caps 2.4% and other land surface water such as rivers, lakes and ponds 0.6%. However it is not merely the abundance of water that is important. Water quality is no less important in all respects. Water quality may be affected on account of man's unwise interference with ecosystem. The quality of water depends on the locations and state of environment in a given area. The present study was undertaken to assess the exact level of physico-chemical parameters of ground and surface water of different locations in and around Channarayapatna town of Hassan district which normally experiences less rain in the rainy seasons. A comparative study of water quality of ground and surface water is undertaken.

Key Words: Water Quality Assessment, Ground Water, Surface Water, Channarayapatna, Physico-chemical characteristics.

I. INTRODUCTION

Clean drinking water is essential for humans and other life forms. Access to safe drinking water has improved steadily and substantially over the periods in almost every part of the world. A report suggests that by 2030, in some developing regions of the world, water demand will exceed supply by 50%. Water plays an important role in the world economy, as it functions as a solvent for a wide variety of chemical substances and facilitates industrial cooling and transportation. Approximately 70% of fresh water is consumed for agriculture. In the present scenario, even though abundant quantity of water is available, it is rare to get good quality of water. A complex and interlinked series of modifications to the natural water quality is created by the diversity of human activities impairing hydrological cycle.

Ground water and surface water are used directly for drinking as well as other household purposes. To safeguard the long term sustainability of water resources, the quality of water needs to be monitored. The assessment of ground and surface water quality is very much essential for the optimal usage of water resources. Determination of physico-chemical characteristics and biological characteristics of water is essential for assessing the suitability of water for various purposes. For effective maintenance of water quality through appropriate control measures, one needs continuous monitoring of water quality. For this purpose it is very important to know about different physico-chemical and biological parameters of water namely pH, Electrical Conductance, Total dissolved solids, hardness, total alkalinity, cations like calcium, magnesium, iron, potassium, sodium and anions like chloride, nitrate, phosphate, sulphate etc.

In order to assess the water quality condition of Channarayapatna of Hassan district, the present study has been taken up. The study aims at determination of water quality parameters like physical parameters, chemical parameters and biological parameters.

II. MATERIAL AND METHODS

2.1 Study Area

The samples of water are collected from different locations of Channarayapatna town which is situated at 12.9035° N latitude and 76.3898° E longitudes. Samples were collected from various bore wells and different locations covering extensively populated area, commercial, industrial and residential areas so as to obtain a good aerial and vertical representation. The samples were collected so that the water quality of whole city and surroundings get represented.

2.2 Collection of samples and analysis

The water samples from bore wells as well as from lakes were collected in a cleanly washed polythene bottles of 2 litre capacity as per standard procedure (APHA). Physical parameters like pH, Electrical conductivity and chemical and biological parameters like COD, BOD, and Total Bacterial Coli form Tests were measured immediately after taking sample into the laboratory (within 24 Hrs of sample collection). For the analysis of water samples different analytical methods like gravimetric, titrimetric, electrometric and spectrophotometric methods are used. A comparative analysis was made for ground and surface water samples. Samples were tested according to standard procedures and all the reagents used in the present study were of AR grade and distilled water was used for the preparation of reagents and for blank throughout the study. The quality parameters are divided into three types- physical parameter, chemical parameter and biological parameter.

III. RESULTS AND DISCUSSION

3.1 Physical Parameters

Parameters like colour, odour, pH, EC, Turbidity and Total dissolved solids are collectively called physical parameters. All the samples were colourless and of unobjectionable odour. The pH values are determined using Digital pH meter, EC using Digital Conductivity meter, Turbidity using Nephelo turbidometer and TDS by gravimetric method.

The results of analysis for the physical parameters of ground and surface water samples are summarised in the tables 1 and 2 respectively.

Table 1: Physical parameters of Ground water samples

Sample No	pH	Electrical Conductivity (Siemens/cm)	Turbidity (NTU)	Total Dissolved Solids (mg/l)
GS-1	7.5	1600	1.0	600
GS-2	7.33	1000	1.0	1030
GS-3	7.48	1540	2.0	400
GS-4	7.06	1590	1.0	658
GS-5	7.44	1090	9.9	232
GS-6	7.52	1000	2.3	693
GS-7	7.45	1000	9.6	852
GS-8	7.37	1830	4.4	399
GS-9	7.21	1000	0.5	486
GS-10	7.38	1000	2.8	1005

Table 2: Physical parameters of Surface water samples

Sample No	pH	Electrical Conductivity (Siemens/cm)	Turbidity (NTU)	Total Dissolved Solids (mg/l)
SS-1	8.39	1970	5.6	256
SS-2	8.06	1500	7.3	269
SS-3	8.13	1800	2.3	423
SS-4	8.05	980	6.9	659
SS-5	8.26	1230	11.2	1010
SS-6	8.42	1990	10.6	622
SS-7	8.19	1080	11.8	236
SS-8	8.06	1450	7.9	346
SS-9	8.41	1230	1.7	265
SS-10	8.27	1400	5.8	316

The desirable pH limit is 7.0 to 8.5 as per WHO standards. On comparison of pH of ground and surface water samples, it is found that ground water samples have nearly neutral pH values but surface water samples have pH in slightly alkaline range. The desirable turbidity value is less than 10.0 NTU as per WHO. The ground water samples have permissible turbidity limit but some surface water samples have little more turbidity than the desirable value. As per WHO the permissible limit for EC is 2000S/cm. From the analysis, it is found that both ground and surface water samples have EC within the limit. The permissible limit for TDS is 1000mg/l. It is found that ground water and one surface water samples exceed the limit. On comparison it is found that ground water samples have higher amount of TDS. This may be due to some salts that dissolve in ground water.

3.2 Chemical Parameters

In the present study chemical parameters like Total hardness, Calcium, Magnesium, sodium, potassium, sulphate, phosphate, nitrate, chloride, fluoride and chemical oxygen demand were determined using standard procedures and the results are presented in the tables 3 and 4 for ground and surface water samples respectively.

Table 3: Chemical parameters of Ground water samples

Sample No	Alkalinity mg/l	Total Hardness mg/l	Ca mg/l	Mg mg/l	Na mg/l	K mg/l	SO ₄ ²⁻ mg/l	PO ₄ ³⁻ mg/l	NO ₃ ⁻ mg/l	Cl ⁻ mg/l	F ⁻ mg/l
GS-1	128	270	65.6	25.76	42.6	42.3	144.8	0.0130	1.6025	48	0.284
GS-2	177	360	84	36.45	69.5	38.9	235.2	0.0126	1.1245	126	0.228
GS-3	203	196	43.2	21.38	28.6	25.7	124.6	0.0100	0.6289	85	0.276
GS-4	159	290	65.6	30.61	47.3	18.8	82.4	0.0125	2.0145	48	0.206
GS-5	98	92	20.8	9.72	56.9	49.7	102.4	0.0122	1.7358	36	0.378
GS-6	213	296	67.2	31.10	52.7	32.8	293.6	0.0122	3.1540	92	0.444
GS-7	284	320	77.6	30.62	35.9	31.2	197.2	0.0111	0.6517	102	0.334
GS-8	163	180	41.6	18.47	65.4	26.9	114.5	0.0126	0.9534	94	0.462
GS-9	249	210	47.2	22.36	49.4	20.8	195.5	0.0130	0.4583	54	0.274
GS-10	174	392	90.4	40.34	41.8	37.1	162.3	0.0125	1.5731	100	0.300

Table 4: Chemical parameters of Surface water samples

Sample No	Alkalinity mg/l	Total Hardness mg/l	Ca mg/l	Mg mg/l	Na mg/l	K mg/l	SO ₄ ²⁻ mg/l	PO ₄ ³⁻ mg/l	NO ₃ ⁻ mg/l	Cl ⁻ mg/l	F ⁻ mg/l
SS-1	312	116	24	13.61	92.7	51.8	89.3	0.0245	0.0514	104	0.125
SS-2	248	124	33.6	9.72	84.5	63.7	136.5	0.0158	0.1983	135	0.256
SS-3	418	196	44	20.90	94.1	60.8	178.2	0.0147	-	94	0.154
SS-4	166	284	63.2	30.62	29.7	37.6	201.6	-	0.0214	28	0.412
SS-5	453	432	115.2	37.42	45.7	20.9	56.2	0.0090	-	156	0.103
SS-6	243	230	55.2	22.36	73.4	54.4	106.8	0.0149	-	128	0.154
SS-7	349	92	19.2	10.69	76.4	58.2	131.4	0.0125	-	38	0.009
SS-8	219	138	36	11.66	68.5	28.6	188.6	0.0126	0.1286	58	0.129
SS-9	254	86	18.4	9.72	93.8	33.2	256.3	0.0178	-	32	0.312
SS-10	161	134	31.2	13.61	47.6	57.5	192.5	0.1243	-	106	0.411

As per BIS standards the permissible limit of total hardness is 300mg/l and excessive limit is 600mg/l. It is found that some of the ground and surface water samples have total hardness above the permissible limit. From this study it is found that the hardness of ground water is more than the hardness of surface water. It may be due to the calcium and magnesium salts present in soil.

The permissible limit of calcium is 75mg/l. Three ground water and one surface water samples exceed this limit. On comparison it is found that calcium content of ground water is usually high as compared to surface water, this may be due to passage of water through or over the rocks. For magnesium the permissible limit is 30mg/l. Some ground and surface water samples exceed the limit. The ground water samples have high magnesium content than surface water.

The WHO permissible limit of chloride is 200mg/l. All the water samples have permissible chloride content. However the average value of chloride of surface water is more relative to ground water samples. The fluoride content is also within the permissible limit. Both ground and surface water samples have nitrate and phosphate contents very much within the permissible limit. On comparison it is found that ground water samples have more amount of nitrate whereas surface water samples have more amount of phosphate. The analysis shows that both ground and surface water samples have excess sulphate content compared to the permissible limit of 150mg/l.

Alkalinity refers to the capability of water to neutralize acid. The maximum permissible limit of total alkalinity is 600mg/l. It is found that all the samples have alkalinity within the permissible limit. On comparison of alkalinity of ground and surface water samples, the average value of alkalinity of surface water is higher than that of ground water samples.

As per BIS standards, the permissible limit of sodium in drinking water is 200mg/l. On comparison it is found that surface water samples have higher amounts of sodium relative to ground water, but sodium contents are within permissible limit. The average amount of potassium in ground water is found to be low as compared to surface water, but the values are within permissible limits.

3.3 COD and BOD

Chemical oxygen demand: COD is a water quality measure used not only to determine the amount of biologically active substances such as bacteria but also biologically inactive organic matter in water. BOD is a measure of the quantity of dissolved oxygen in milligrams per litre necessary for the decomposition of organic matter by microorganisms such as bacteria. The COD and BOD values obtained for surface water samples are given in table 5. The COD values range from 58 to 144mg/l, all are within permissible limit of 250mg/l as per WHO standards. The BOD values are also within permissible limit of 6 except one sample.

Table 4: COD and BOD of Surface water samples

Sample No	COD mg/l	BOD	Sample No	COD	BOD
SS-1	126	4	SS-6	78	2
SS-2	58	8	SS-7	140	3
SS-3	114	4	SS-8	68	5
SS-4	134	2	SS-9	144	4
SS-5	86	2	SS-10	110	4

3.4 Biological Parameters

Water contains many bacteria as it is generally found in streams, lakes and mountain water that comprise innumerable number of autotrophs and saprophytic heterotrophs. Usually ground water is free from bacteria and hence bacterial study is carried out for surface waters only. Water becomes contaminated by intestinal pathogens such as coliform group of bacteria, salmonelle, vibrio and dysentery causing bacilli. The human faecal material carried in sewage is often dumped in rivers and lakes that lead to water contaminations. Therefore water supply has to be checked for the microbiological point of view. For water analysis, Coliform group of bacteria may be differentiated by presumptive test, confirmed test and completed test. The results of presumptive test are summarised in table 6.

Table 6: Result of presumptive test for surface water samples.

Sample No	Number of tubes giving positive reaction out of			MPN index per 100 ml
	3 of 10 ml each	3 of 1 ml each	3 of 0.1 ml each	
SS-1	2	1	1	21
SS-2	2	2	1	28
SS-3	3	3	1	460
SS-4	2	1	1	21
SS-5	3	3	1	460
SS-6	3	2	2	210
SS-7	1	0	0	4
SS-8	2	2	1	28
SS-9	3	3	2	1100
SS-10	3	3	1	460

The presumptive test indicates that all the surface water samples contain coliforms, the MPN index ranging from 1100 to 4 per 100ml. The confirmed test and the completed test give the final coliform count as given in table 7. It is found that the bacterial count is ranging from 32 to 194 in 10 different surface water samples.

Table 7: Bacterial count for surface water samples

Sample No	Bacterial Count
SS-1	98
SS-2	126
SS-3	56
SS-4	168
SS-5	193
SS-6	67
SS-7	32
SS-8	183
SS-9	194
SS-10	185

IV. CONCLUSION

Testing of water before it is supplied for drinking purpose is very important to live a healthy life. In the present study, after conducting these entire tests, it is found that some samples of both ground and surface waters have high amount of TDS and total hardness. So these are not suitable for drinking. Both surface and ground water samples have alkalinity, chloride, fluoride and nitrate within the permissible limits. Some samples have high sulphate content. BOD and COD values are within permissible limits. The bacterial test confirms the presence of coliforms in the surface water samples. So they are unfit for drinking.

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