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Ground Water Quality Analysis Studies on the Seasonally in Kalburagi, District Karnataka State, India

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ABSTRACT

The present study deals with the physico- chemical parameters of seasonal fluctuations of Ground water quality analysis in Gulbarga district, Karnataka, India. Research findings for fluoride asses in drinking water reveals that in the period of 2015 to 2016 most of all the samples were found to be exceeded the WHO 1995 drinking water standards it effects on the Human health

It is said that water was found on Earth approximately 3 billion years ago. Groundwater quality is an important issue to assure from its safe and stable use. However, describing quality conditions is generally difficult considering the spatial variability of pollutants and a wide range of indicators (biological, physical and chemical substances) which can be measured. In this research, groundwater quality of Gulbarga District, Karnataka located in southern part of India. I have been selected to 35 study sites and analyzed the quality of water. A groundwater threat is now posed by an ever-increasing number of soluble chemicals from urban and industrial activities and from modern agricultural practices. Nevertheless, landslides, fires and other surface processes that increase or decrease infiltration or that expose rock and soil surfaces interacting with downward-moving surface water, may also affect the quality of shallow groundwater.

Keywords: *Groundwater, Fluoride, Seasonal Wise Fluctuation, Health Issues, Rocks, Pollution.*

1. INTRODUCTION

Water is one of the essential constituents of the human environment and its occurrence in chemically pure form is very rare. It is good solvent and carries a variety of constituents. Water is not only a vital environmental factor to all the forms of life but it has also a great role of life but it has also a great role to play in socioeconomic development of human population (Park 1997, Jayakumar *et al*., 2003). No other substance on the earth is as abundant as water. It is almost everywhere in air, clouds, oceans, lakes, rivers, springs or glaciers. In the 5 km layer below the sea level on Earth, water is nearly 6 times as abundant as all other substances put together. And none other occurs in three states *viz* solid, liquid and gaseous at the same time. It is water that had conditioned our climate. The water in oceans, seas and the atmosphere (vapour) acts as an accumulator of heat. In hot weather, it absorbs heat and in cold, it gives up heat thus it keeps the planet warm. The volume of water on the earth is about 1,36,00,00,000 cubic kilometres, which covers nearly 70% of the earth's surface. The global scenario is that 97% of water in the sea, 2% lacked up in the Arctic and antarctic oceans, and 1% is fresh water. Of this 1% fresh water, 0.22% is in the underground aquifer and the remaining 0.78% of the World's water fills the rivers, streams, lakes, and ponds. The distribution of fresh water on earth is uneven.

Water intended for human consumption must be free from an organism and chemical constituents that may be hazardous to human health. With increased consumption of water, it plays important resources for all kinds of life on this planet. The quality of water depends on a large number of individual hydrological, physical, chemical and biochemical factors. Chemical parameters are the most important indices, which characterizes the quality of water.

Chemical Attributes of Water

- Water accounts for about 70% of the mass of our body.
- Over 80% of the earth's surface is covered by water in the form of relatively pure liquid in lakes and rivers, as a dilute salt solution in oceans or as nearly pure solid in snow fields, glaciers, and the polar ice caps.
- The expansion of water on freezing is advantageous and disadvantageous too. The damage to plants and animal tissues that accompanies freezing is largely due to expansion and this causes cell walls to burst. On the surface of the earth, the same process causes the breakdown of rocky materials to yield fertile soils.
- Water is the most important substance for the existence of life on the earth after the air.
- When surface water potential is scarce, a need for ground water search arises.

Ground Water

Ground water is the world's largest source of fresh water. Ground water is one of the earth's most important resources and it plays a vital role in countries economy. Ground water is underground water that occurs in a saturated zone of variable thickness and depth below the earth's surface. Ground water is the major source of drinking water in both urban and rural India. Also, it is an important source of water for agriculture and industrial sector. Being an important and integral part of the hydrological cycle, its availability depends on the rainfall and recharge conditions.

Ground water crisis is due to various anthropogenic activities and mainly constitutes the extraction of the ground water to the fullest and seepage of the wastes generated on the surface of the earth. During past two decades, the water level in several parts of the country has been falling rapidly due to an increase extraction. The number of wells drilled for irrigation of both food and cash crops has rapidly increased. India's rapidly rising population and changing life style has also increased the domestic need for water. Ground water is underground water that occurs in a saturated zone of variable thickness and depth below the earth's surface. Unfortunately, during these days, water resources are getting polluted by human activities and becoming unfit for usage purpose. Human dependence on ground water has steadily increased as moved away from perennial sources of surface water to harness agricultural lands and in more recent times for developing industries (Karanth, 1989).

Use of polluted water takes toll of 25000 people all over the world every day. In India out of 6 lakh villages, one third or about 2 lakh villages are without access to water. In these villages, women have to walk daily about 1-14 km to collect water for cooking, drinking and for various other activities (Anil Kumar De *et al*., 2001).

It is said that water was found on Earth approximately 3 billion years ago. That was the time when the oceans were formed and the first life forms originated in the oceans through a process called Abiogenesis. It is the most abundant substance on the earth and is universally present in air, clouds, oceans, streams, springs, or glaciers. On the globe, nearly 80% of the water is present in the oceans and most of the fresh water is trapped in the Icebergs. We have hardly around three percent as fresh water and only 0.3% of that water is accessible for our day-to-day usage and consumption. It is the only substance that simultaneously occurs in the three states namely solid, liquid and gaseous. One of the important function of water is that it acts as a heat regulator of the planet by the absorption and release of heat.

Many archaeological evidences reveal that the birth and growth of any civilization always took place either on the bank of a river or in the vicinity of a good water source. Water is used for irrigation, domestic needs and shipping of goods and waste materials since then. The Roman Empire had a system of pipelines. They used Lead pipes to supply water to the houses, which is evident from the Lead pipes which are preserved even today. (Abbasi, S. A. 1998)

Modern civilization is reliant on water for all purpose like irrigation, domestic needs, industrial applications, shipping and disposal of domestic waste; but if we look at the present scenario, as an impact of many anthropogenic activities the ground water and the rivers, which are the major sources, are polluted either by untreated effluent discharge by the industry or any other man-made or natural reason.

Water intended for human consumption must be free from an organism and chemical constituents that may be hazardous to human health. Water is an important natural resource for all kinds of life form on this planet and with increased consumption coupled with contamination, it is fast becoming a critical resource.

Water Demand

Twenty percent of the entire world population lives in areas suffering from physical scarcity of water. Today, water scarcity is affecting all continents. As many as 783 million people in the world do not have access to clean and fresh potable water. On an average, a person in rural Africa and Asia has to walk 6 kilometers to collect clean and safe drinking water. The fact that about 66% of Africa is arid or semi-arid and more than 300 million people out of 800 million people in the sub-Saharan Africa live in a water–scarce environment implies that they have less than 1000 m^3 per capita water (NEPAD, 2006). The IPCC predicts that water stress will increase in central and southern Europe and that by 2070s, the number of people affected will rise from 28 million to 44 million. Water availability is expected to decrease in many regions. Yet, future agricultural water consumption alone is estimated to increase by approximately 19% by 2050 and will be even greater in the absence of any technological progress to make available more water for consumption or policy intervention to control its usage.

Material and Methods

Chemical analysis of water samples provides much information which is useful for many practical problems such as study of mixing of waters from different sources, groundwater quality condition, the effect of different structures on water quality, investigation of the origin of salinity. In this research, 35 wells with complete records in terms of Electrical conductivity (EC), Total dissolved solids (T.D.S), PH, Calcium (Ca), Magnesium (Mg), Sodium (Na), Potassium (K), Bicarbonate (HCO3), Chlorine (CL), Carbonate (CO3), and Sulfate (SO4) during 2014 until 2016 were used and their data converted to mg/l as per the APHA, Then data were analyzed and tabulated

Study Area

Kalaburagi was known as 'kalburgi' in former days which means stony land in Kannada. Kalaburagi district is situated in the northern part of Karnataka State. In the earlier days, Kalaburagi was a district of Hyderabad Karnataka area and became a part of Karnataka State after re-organization of states. This region was located between 17.3297° N, 76.8343° E.I have been selected the study area in Taluks of Gulbarga district of Karnataka viz,(table 1 and Fig 1,2)

Table: 1

Sl.No	Taluks
1	Afzalpur
2	Aland
3	Chincholli
4	Chittapur
5	Gulbarga
6	Jewargi
7	Sedam

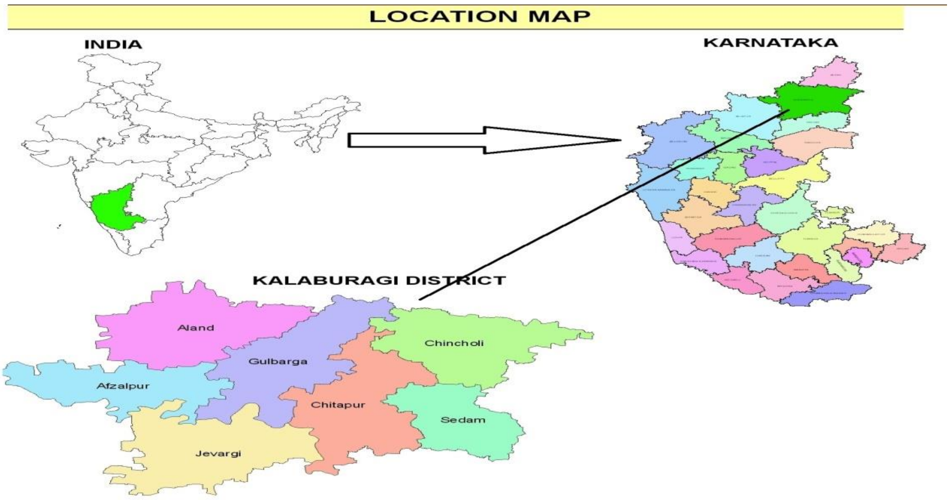

Fig -1- Study Area Map of Gulbarga Districts.

Rainfall

The average rainfall of Gulbarga is 704 mm. The city receives rainfall from both the north and east monsoons (June to September). The 15 years of rainfall in Gulbarga is depicted in the Table – 2
Rainfall Data of Gulbarga (2001 – 2016) (Table – 2)

Table: 2

Sl No	**Year**	**Average rainfall**	**Sl No**	**Year**	**Average rainfall**
1	2001	511.00	9	2009	771.8
2	2002	525.99	10	2010	1075.7
3	2003	504.14	11	2011	710.8
4	2004	578.64	12	2012	626.2
5	2005	790.12	13	2013	700.0
6	2006	508.6	14	2014	818.2
7	2007	622.7	15	2015	600.0
8	2008	769.9	16	2016	926.0

Cropping Pattern

The cropping pattern is mainly dominated by food crops. Tur is the main crop produced in the district. The district is called as Tur Bowl of the state. Jawar is the other main food crop Sunflower and Groundnut are the major oilseeds which occupy the area of 1783870 and 59047 respectively.

Geographical Traits

The district has a total area of 16174 Sq. Kms. This constitutes 5.93% of the area of the state. The region is characterized by black cotton soil, expanses of the flat treeless surface, a range of hills covering a surface of about 60 miles and same lower belts following the main rivers. The district is devoid of forest except in the hilly portion of Aland and Chincholi. The area under forest is 4.2% of the total area.

2. RESULTS AND DISCUSSION

Electrical Conductivity

In the present study, the values of electrical conductivity ranged between the minimum of 241 μmhos/cm **(S31)** and a maximum of 3650 μmhos/cm **(S6)** in pre monsoon season (Table-3). Similarly, S31 has recorded the lowest electrical conductivity in monsoon (214 μmhos/cm) and also in post monsoon (230 μmhos/cm) and maximum values recorded in S6 (3547 μmhos/cm and 3715 μmhos/cm respectively for monsoon and post monsoon seasons) (Table 3). Owing to the fact that during post-monsoon season the dissolution of salts, minerals and other soil constituents increases due to increase in the ground water table (Shivashankaran, 1997, Basavarajappa 2002 and Gupta et al., 2009).

The variability of electrical conductivity could be explained – to the natural concentration of ionized substances present in water. Higher the concentration of acid, base, and salts in water, more will be the conductivity (Kataria and Jain, 1995). Ballukraya and Ravi, (1999) had proved the variation of the conductivity of the water due to residential times and the geographical features of the sampling locations. A similar observation was also observed by Paliwal (1975) should that in semi-acid and acid zones of Rajasthan ground water available mostly at depths of 200 to 300 feet showed electrical conductivity of well – water between 5,000 μmhos/cm to 6,000 μmhos/cm. Hedge *et al*., (1992) observed the electrical conductivity between 839 to 15,310 μmhos/cm and explains that 50% samples having conductivity values above 1000 μmhos/cm indicating high mineralization in the region. Tiwari (2001) should that the electrical conductivity ranged between 375 and 925 μmhos/cm.

Total Dissolved Solids (TDS)

In the present study 24.2% of total water samples for pre-monsoon and 26% in monsoon season and in post monsoon nearly 34% of the samples cross the permissible limit. Nevertheless, the remaining water samples were within the prescribed BIS drinking water standards.

PH

The pH values in the present investigation varied from a minimum of 7.0 (S7) to a maximum of 8.7 (S4) in pre monsoon. During monsoon, it ranged between 7.12 (S18) to 8.7 (S4) and in post monsoon, it ranged between 7.5 (S6 and S4) to 8.8 in S4 .The recommended - value of pH for drinking purposes is from 6.5 to 8.5 (BIS, 1998). The data obtained reveal that the pH in all the water samples analysed is all well with in the permissible limits except in (S4 and S24, which showed the slight increase in the water pH than the permissible limits. Similar observations were made by Narayana and Suresh 1989, Gill *et al*., (1993), Mehta and Trivedi (1993), Mittal *et al*., (1994) in their studies.

Calcium (Ca^{++})

In the present study, reports that calcium values ranged from minimum of 50 mg/L (S20) to a maximum of 621 mg/L (S6) in pre monsoon season, 38 mg/L (S20) to 737 mg/L(S6) in monsoon season and 30 mg/L (S20) to 568 mg/L (S32) in post monsoon season.

Magnesium (Mg^{++})

In the present investigation, magnesium values varied from a minimum of 5.8 mg/L (S27) to a maximum of 184 mg/L (S30) in pre monsoon season and a minimum of 4.2 mg/L (S27) to a maximum of 180 mg/L (S30) in monsoon season. In post monsoon season, the values of magnesium ranged between 5.7 mg/L (S18) to 185 mg/L (S30)

Sodium (Na^{+})

In the present investigation the sodium values are ranged from a minimum of 3.8 mg/L to a maximum of 59 mg/L in pre monsoon season, a minimum of 2.6 mg/L to a maximum of 70 mg/L in monsoon season and in post monsoon season, the values of sodium ranged between 3.8 mg/L to 115.2 mg/L The mean values for three seasons are 175.9 mg/L, 177.6 mg/L, and 181.2 mg/L respectively.

Potassium (K^{+})

In the present study, potassium values varies from a minimum of 3.8 mg/L (S3, S22) to a maximum of 59 mg/L (S6, S24) in pre monsoon season and a minimum of 3.0 mg/L (S3, S22) to a maximum of 32.9 mg/L in monsoon season. In post-monsoon season the values of potassium ranged between 4.1 mg/L (S25) to 11.5 mg/ L.

Sulphate (SO_4^{--})

In the present findings, sulphate values range from a minimum of 5.8 mg/L (S31) to a maximum of 262 mg/L (S12) in pre monsoon season and 13.2 mg/L (S23) to 252 mg/L (S12) in monsoon season. In post monsoon season the range of sulphate is 14.7 mg/L (S33) to 275 mg/ L.

Chemical Oxygen Demand (COD)

In the present findings, the COD values fluctuated between 1.2 mg/L (S8) to 60.0 mg/L (S3) in pre monsoon season and in monsoon season between 0.5 mg/L (S8) to 63.2 mg/L (S6). In post monsoon season, it varies between 1.2 mg/L (S8) to 63.1 mg/L (S3) (Table 14). The BIS permissible limit for COD is 10 mg/L. Nevertheless, in present investigation, 60% of the water samples in pre monsoon season, 54% in monsoon season and 62% of water samples in post-monsoon season found above the permissible limit prescribed by BIS drinking water standards.

Biochemical Oxygen Demand (BOD)

In the present study, the biochemical oxygen demand values varied from a minimum of 0.5 mg/L (S33) to a maximum of 31 mg/L (S7) in pre-monsoon season and in monsoon season a minimum of 0.0 mg/L (S30) to a maximum of 30.1 mg/L (S3). In post monsoon season it varies from a minimum of 0.0 mg/L (S33) to maximum of 26.4 mg/L (S3). All the samples showed BOD values are well within the permissible limits for drinking standards.

Total Hardness (TH)

In the present study total hardness values varied from a minimum of 145 mg/L (S49) to a maximum 1260 mg/L (S6) in pre monsoon season and a minimum of 112 mg/L (S31) to a maximum of 1330 mg/L (S6) in monsoon season. In post monsoon season the values ranged between 141 mg/L (S49) to 1442 mg/L (S6). The Station 6 has been recorded the highest value of the total hardness among all the seasons.

3. CONCLUSION

In the present investigation, a sincere attempt has been made to evaluate the concentration of major physicochemical parameters, bacteriological parameters and heavy metals in the ground water of Gulbarga district. The following are the contusions drawn from the investigation. Increasing in population intense agricultural activities and irrigation drainages in rural arts are the major threats to groundwater pollution in the study area. Indiscriminate application of chemical fertilizers for paddy and other cereal crops. Lack of proper scientific information to the farmers is found to be the other category of sources for contamination in aquifer systems. a seasonal variation has been observed for most of the physicochemical and bacteriological parameters analysed. This is probably due to rising of ground water table in monsoon and post monsoon season compare to pre-monsoon season. the findings of the present study with regard to the nutrients and trace metal concentrations in most of the sampling sites have been influenced by anthropogenic activities in polluting the overlaying environment. High-level fluorides concentration has been noticed in most of the sampling stations of Gulbarga district. This is due to the geological strata of the study area. It is evident from the investigation made that there is also a correlation between the geology of the study area with the physicochemical parameters concentrations analyzed. in the study area, due to the lack of sanitation which leads to the deterioration to the quality and quantity of ground water. Polluted water plays a key role in the direct transmission of various diseases. The Gulbarga town and the villages of Gulbarga district facing lack of hygiene at the surroundings of bore well. In general, poverty, illiteracy, and lack of awareness influence the quality of water.

Table- 3 An Average Physicochemical and Biological Parameters of the Study Sites -for the Year: 2014-2016

Sample No.	AT	pH	EC	TDS	DO	BOD	COD	Cl^-	F^-	Alk	SO_4^{--}	TH	Ca^{++}	Mg^{++}	PO_4^{-3}	NO_3^-	Na^+	K^+	MPN
S_1	31.5	7.8	885	495	5	23	31.5	80	1.85	48	70	325	122	49	0.16	3.98	20.4	9.7	NE
S_2	30.5	7.7	1354	795	5.2	25	46	215	1.58	54	73	465	233	59	0.18	4.1	24.2	16.2	NE
S_3	27.5	7.8	1998	1101	4.2	31	62	318	1.2	44	203	572	274	70	0.02	7.2	3.8	23	1
S_4	28	8	1754	972	5.1	14.5	29.4	253	3.4	60	142	172	72	29	0.24	3.1	30.4	5	NE
S_5	26	7.7	934	538	4	12.4	31.2	90	1.8	34	88	280	159	149	0.03	2.7	11.4	7.7	NE
S_6	29	7.2	3700	2098	5.8	13.6	39.1	88	0.47	59	221	1397	741	112	0.1	10.2	36.3	12.1	NE
S_7	27	7.5	1829	1052	5.3	11	25	401	0.68	49	127	802	343	65	0.09	22	16.7	12	NE
S_8	28.5	7.7	1415	790	7	1	1	214	0.92	58	40	495	225	124	0.25	13	20.3	11.1	2

S_9	30	7.3	2735	1612	7.2	4.9	11.1	602	1	54	238	998	489	81	0.12	2.5	30.2	9	NE
S_{10}	33	7.5	2250	1205	6.1	7.4	19	504	1.1	56	184	690	358	36	0.09	3.4	31.1	15.8	NE
S_{11}	31	7.8	635	358	4.2	9	22.5	60	0.92	64	56	295	124	114	0.12	1.2	12	9	NE
S_{12}	32	7.6	3200	1800	6.5	8	16.1	787	1.28	40	258	954	498	80	0.11	12.8	31.7	11.8	NE
S_{13}	29.5	7.7	1650	906	5.8	6	20.2	349	1.1	50	102	625	223	65	0.32	2.2	22	24.4	NE
S_{14}	28	8	1515	825	4	3.4	8.4	341	1	38	120	384	133	99	0.3	3	23	16.1	3
S_{15}	24	7.9	2817	1450	5.8	4.2	8.9	701	2.38	70	108	727	272	80	0.1	30.6	34	32.7	NE
S_{16}	23.5	7.4	1490	780	5	8.6	21.8	256	1.21	52	132	542	224	87	0.09	4	19	11.5	NE
S_{17}	24	8.2	1905	918	5.6	4.1	11	332	1.52	64	164	579	232	29	0.14	13.2	25.5	9.2	NE
S_{18}	25	8	835	458	4.1	3	8	45	1.39	57	52	238	143	25	0.19	4.1	15.2	19.2	NE
S_{19}	22.5	8	715	420	3.6	4	8.4	56	1.71	34	59	204	154	45	0.12	3	13	14.5	NE
S_{20}	21	7.9	1055	620	4.1	3.5	8.2	151	1.52	50	69	421	248	45	0.23	2.7	15	30.5	NE
S_{21}	22	7.8	2717	1494	6.7	4	8.9	585	0.61	47	172	687	365	82	0.36	9.2	29.4	17.2	1
S_{22}	31	8	1584	884	6	4.2	8	338	1.52	50	55.2	654	271	91	0.29	35	15.2	12.1	2
S_{23}	27	8	803	525	4.8	6.3	14	82	1.17	50	54.2	359	214	35	0.25	2.2	11.7	8.5	NE
S_{24}	30	8.1	1607	854	6.2	7.9	19.1	231	0.94	52	126	649	314	84	0.09	28	14.5	22	NE
S_{25}	32	7.9	1632	994	5.6	4.8	9.1	208	1.48	62	121	435	113	89	0.01	4	24.5	16.8	NE
S_{26}	31	7.8	1832	1140	5.4	5.3	12	361	2.52	52	90	394	178	66	0.21	27.4	30.4	14.9	NE
S_{27}	28	8.1	1322	794	5.1	6	13	228	4.6	42	101	221	113	27	0.07	11.4	26.4	14	2
S_{28}	29	8.1	984	518	4.4	6.5	16.1	85	0.71	54	73	315	170	34	0.23	3	17.8	4.5	NE
S_{29}	28	8	1031	624	5	5.6	1305	105	2.2	58	72	268	121	40	0.09	4	19.8	20.1	NE
S_{30}	28.5	7.7	2428	1400	6.8	0.2	0.5	638	0.87	36	108	1168	442	180	0.26	50	14.7	3.8	1
S_{31}	29	7.9	241	151	3	4.5	9.1	28	0.27	36	5.8	121	70	17	0.05	2	4	7.9	NE
S_{32}	27.5	7.7	2005	992	5.8	2.5	6.1	52	0.28	37	116	894	546	68	0.07	20	17.7	30.2	NE
S_{33}	28.5	8.2	932	540	3.5	0.5	1.2	78	4.24	50	57	148	58	20	0.13	2.2	23.2	15.7	NE
S_{34}	34	7.8	1453	815	5	5.2	12.1	230	1.9	53	89.1	472	214	54	0.36	9.2	22	10.3	NE
S_{35}	32	8.1	1767	994	5.3	7	18.1	330	0.82	62	108	558	256	62	0.06	24.5	24.3	13.4	NE

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