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Ground water quality analysis of villages in Gulbarga district

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Abstract

A comprehensive study on distribution pattern of fluoride content and some of physic- chemical parameters of Ground water quality analysis in chittapur & Aland taluka around the Six selected villages is extensively monitored for 12 months from july 2014to june 2015.Borewlls from different areas were selected and fixed for sampling station from chittapur Taluka of Gulbarga District for Ground water Quality Analysis .The collected samples were analyzed for physic-chemical parameters and Majourly fluoride content in the Ground water .The study revealed that,The naturally occurring Flouride contamination in Ground water of study area is more wide spread than in generally recognized .our study has been showed a higher 1) **Flouride** 2.2ppm its not in the permissible limits its varied 2**) chloride** 355 .42 mg/l 3)**Alkalinity** the values is 562 mg/l 4), **PH** value is within the permissible limit 6.5to7.2 . 5) **colour** the present values varied from minimum of 3-31HSU in all the study areas ,the mean values is HSU,6) **TURBIDITY** values ranged between 1.5 to 7.1 NTU in jan 2013 to 2014 the mean values showed 3.74 NTU respectively its in permissible limits , 7) **TDS** value is in the month of April to may it increases its values 580 to1681the **TDS** values have exhibited has increasing trend in to April to May 8) **EC** value is 40% of the sampling station its fall in the permissible limits 900-1400mhos/cm 9) **DO** in the month of January to a maximum of 8.57 mg/l in the month of may 10) **TH** the mean values of TH is 343.55 mg/l its very hard category > 300 mg/l 11) **calcium** 220 mg/l its cross the permissible limits 12) **Magnesium** 66.20 mg/l so that the water samples in the all the months are not in the under permissible limits .the permissible limit of Flouride content in its varied station to station ,as provided by WHO. At chittapur& Aland Taluka Sampling station.

Keywords: Ground water, physic-chemical parameters, Monthly fluctuations.

Introduction

Water is the most essential and valuable nature's gift to the mankind as well as the producer and consumer of this planet. Without water there would have been no life, hence it is a matrix of life. It is vital for many aspects of economic and social development for agriculture, energy production, domestic, industrial supply and it is a critical component of environment. Presently, there is growing awareness that the development of water resources must be sustainable, which implies that the natural resources must be managed and conserved in such a way that it meets the needs for present and future generation.

It is of one of the most essential items needed by humans, plants and other living beings for their survival. Man and animal not only consume water but also consume vegetation as their food. Vegetation in turn cannot grow without water and growth of vegetation also depends upon bacterial action, while bacteria need water in order to thrive. The bacterial action can convert vegetable matter into productive soil. New plants, which grow in this soil, will be grown by sneaking nutrients through their roots in the form of solution in water. Thus, an ecological chain is being maintained. Water maintains ecological balance

between living organisms and the environment in which they live.

The water present in oceans, lakes and atmosphere act as an accumulator of heat. It absorbs heat in hot condition and gives up heat in cold weather, thus maintaining the planet in warm condition. Hence, it is indispensable and one of the most precious natural resource on this planet (Rao and Rameshwar, 1998).

Water resources have been the most exploited natural system since the beginning of the human civilization, with rapid growth of human population, increasing levels of living standards, in industrialization and generation of power.

Further, Nanda (1997) reported that every year 1,60,000 children of less than 5 years of age are dying because of water pollution in India. He cautioned that water is to be used carefully if not water scarcity must be biggest problem in the 21st century.

Water was created three billion years ago (Beck, 1985). Earth is said to be a water planet and 70.8% of earth's surface is covered by water. Its reserve is definite and the same water is being used in time and recycled. The self purification capacity during recycling is a prominent phenomenon. Only one percent of earth's water passes the cyclic path and is referred as hydrological cycle (Gupta *et al.,* 2000). The water in the hydrosphere is distributed to an extent of about 97.5% in the oceans as salt water and remaining 2.7% is distributed over the continents as fresh water and as polar ice caps.

Groundwater is an important national asset and one of the earth's renewable resources which occurs as a part of hydrological cycle. It is primarily stored in aquifers, which are geological formations of permeable structured zones of rock sand or gravels (Mehta and Trivedi, 1990). The quality of groundwater depends on the quality of soil through which it percolates. Most of the bacteria, organic compounds and biocides are filtered out during percolation (Beck, 1985). The groundwater pollution is difficult to detect and it is more difficult to control and may persist for decades (Singh *et al.*, 2001).

Groundwater is an important source of water supply throughout the world. Its use in irrigation, industries and domestic usage continues to increase where perennial surface water sources are absent. The quality of groundwater used for these purpose is more important as the case of quantity. The geology of particular area has a greater influence on the occurrence and quality of water and its movement. Many a time groundwater carries a higher mineral content than the surface water, when there is slow circulation and longer period of contact. Changes in groundwater quality with the passage of time have a hydrologic significance. The quality also varies due to a change in chemical composition of formation.

Groundwater quality is influenced both by subsurface physical environment and by the environment where recharge takes place. The quality of groundwater supply is as important as quantity, the required quantity being dependent on the nature of its use. Water, i.e., suitable for the irrigation of crops, may not be suitable for human consumption or industrial use. In brief, the quality of irrigation water should be compatible with the nature of the soil and type of the crop raised thereon.

During last decade, groundwater quality has emerged as one of the most important and confronting environmental issue (Native and Smith, 1987). Management of groundwater quality, however, presents environmental scientists and policy makers with particularly different problem. The process of purification of a groundwater is often technically complex, expensive and only partially effective because restoration of groundwater quality is a formidable and cost- prohibitive task. Great emphasis is being paid upon protection of these resources (Nielen and Lee, 1987; O 'Neir and Rancher, 1987).

Study area

Gulbarga district lies in the northern part of Karnataka between 16^{o}11' –17^{o}45' N. latitudes and 76^{o}03' - 77^{o}30' E. longitudes, with a geographical area of 16,174 sq. km. Gulbarga is one of the chronically drought prone district in North Karnataka. The district is bounded by Bidar district in the north, Bijapur district in west, Raichur district in south and Andhra Pradesh in the east. Gulbarga is the district headquarters. The district comprises of 7 taluks namely, Aland, Afzalpur, Gulbarga, Chincholi, Chittapur, Sedam, Jewargi.

Materials and Methods

Ground water samples were collected in polythene bottles. Date, time of collection and source of water and locality of the area were recorded properly .from each of the sampling site, were collected for physic-chemical Analysis ,Temperature and PH determined were determined immediately at the sampling station.

Samples were taken to the laboratory as early as possible and kept for further analysis .usually 2=liters of samples were sufficient for analysis of physic-chemical parameters .Analysis caused for out for various water quality parameters ,using standard methods (APHA –AMERICAN PUBLIC HEALTH ASSOCIATION .17TH Ed .1989)

As there are several sampling designs available, only one design has been chosen for the study area such that for a given sample size and for a given budgetary constraint will have a smaller sampling error. For the present investigation probability sampling design was selected. Probability sampling design is also known as random sampling or chance sampling has an equal chance of inclusion of every item of an object in the sample. Random sampling (Bisht, 1978) ensures the law of statistical regularity, which states that the sample should represent the composition and characteristics of the whole region as the object under consideration. This may be the reason why random sampling is considered as the best technique of selecting a representative samples.

Water samples from the sampling localities were collected from the bore wells. Initially the water was allowed to run for 15 minutes in order to flush out stationary water. Further, the sample bottles were also flushed with water before the samples were collected. As water is dynamic in nature and during sampling it enter the new environment from its natural environment, its chemical composition may not remain same but may tend to adjust itself according to its new environment (Sawyer, 1978) and its content alters at very different rates particularly with organic materials. Therefore, as soon as the collection of water, temperature and pH were measured immediately. The other parameters of water such as dissolved oxygen, total dissolved solids, and electrical conductivity were analyzed in the spot. The remaining parameter were analyzed in the laboratory. Hence, the water was carried to the laboratory in suitable inhert bottles. The samples were analyzed using various analytical method of (APHA, 1995; BIS, 1998; NEERI, 1998

Results and Discussion

The various physico-chemical characteristics were analysed for ground water 5-different sampling stations. The details of the results were summarised in the table.

pH

The pH value of the water source is a measures of the hydrogen ion concentration in water and indicates whether the water is acidic or alkalinity . most of the biological and chemical reactions are influenced by the pH of water system .in the present study all the ground water samples have pH values between 6.0-8.5 , while WHO is between 7.0-8.5.the sampling stations of shahabad S1 ,Tengali S2 & Aland taluka khajuri S6 , Attur S7 in the month of march and may they have lower value of PH than the permissible limits , if the PH is beyond the permissible limits ,it damages the mucuos membrane of cells.

Colour (Col)

In natural water, colour may occur due to the presence of humic acids, fluvic acids, metallic ions, phytoplankton, weeds and industrial effluents. In some highly coloured industrial wastewater principally colloidal or suspended matter contributes the colour. The intensity of sewage colour is due to strength and condition of the sewage. Colour developed by dissolved solids, dissolved gases, decomposition of vegetarian organic matter, microorganisms, excess of iron and manganese etc. Colour less and above the tolerance limits causes repellant in the consumers (Abbasi, 1998).

In the present investigation, colour values varied from a minimum of 3-31 HSU in the all the study areas monsoon season and 2.1-119 HSU in post-monsoon season. The mean values 17 HSU The BIS acceptable limit for colour is 25 Hazen units. In the present study, BIS (1998) acceptable limits for drinking water (5.0 to 25.0 Hazen units)

Turbidity (Tur)

It is responsible for the light to be scattered or observed rather than straight transmission through the sample. It is the size, shape and refractive index of the suspended particulate matter rather than the total concentration of the matter present in the water samples. The size of the suspended matter varies and it ranges from colloidal to course dispersion, depending upon the degree of turbulence and also from pure inorganic substances to those that are highly organic in nature. It decreases the light penetration, limits the production of phytoplankton, which in consequence decreases the photosynthetic activity and depletion of oxygen content. It is the resistance of water to the passage of light. In natural water, it is caused by

suspended matter like clay, silt organic matter, phytoplankton and other microscopic organisms and is the expression of tyndall effect. It restricts the light penetration in water, resulting in reduced primary production. Under flood conditions and soil erosion, great amounts of topsoil are washed into receiving streams. Groundwater is less turbid since, sand is a good filtering media.

In the present study, the turbidity values ranged between 1.5 to 7.1 jan 2014 and may 2014 in the bellowed table. mean valued showed 3.74 NTU respectively . The BIS (1998) acceptable limit for turbidity is 25 NTU. In the present study,the mean values shown permissible limits with reference to the BIS standards .

Electrical conductivity (EC)

Electrical conductivity is a measure of water's capacity to carry electric current. It is directly proportional to its dissolved mineral matter content. Several factors influence the conductivity, such as temperature, ionic mobility and ionic valences. It is the overall concentrations of ions present in the water which influences conductivity. In turn the conductivity becomes an indicator of dissolved ions present in any water sample. Pure water is a poor conductor of electricity and such substances are called electrolytes. Its value depends on concentration and degree of dissociation of the ions as well as migration velocity of the electric field.

In the present study, the values of electrical conductivity ranged between a minimum900 to a maximum 2450.9 mmhos/cm. of It is observed that the EC values have exhibited an increasing trend in the month of April to May compared to other months . Owing to the fact that during peak summer season the dissolution of salts, minerals and other soil constituents increases due to increase in the groundwater table (Shivasankaran, 1997).

Total dissolved solids (TDS)

The substances dissolved in the water were estimated. Dissolved materials result from the solvent action of water on solids, liquids and gases. The dissolved substances may be organic or inorganic in nature. A large number of salts are found dissolved in natural water. The term solid refers to the matters either filterable or non-filterable that remain as a residues in water. It includes all soluble materials in solution whether ionized or non-ionized. It does not include suspended sediments, colloids or dissolved gasses. TDS values are estimated by pursuing the empirical relationship (USSLS, 1954; Hem, 1985; Kotaiah and Kumaraswamy, 1994; Rambabu *et al.*, 1996). TDS is commonly found in carbonates, bicarbonates, chlorides, sulphates and nitrates of calcium, magnesium sodium, potassium, iron and manganese mineral containing rocks. A high content of dissolved solids elevates the density of water, influencing osmoregulation of fresh water organisms, reduces solubility of gases (oxygen) and utility of water for drinking, irrigation and industrial purposes.

Many dissolved substances are undesirable in water. Dissolved minerals, gases and organic constituents may produce aesthetically displeasing colour, taste and odour. Some dissolved chemicals may be toxic. The dissolved solids increases with depth and with the time and water has traveled in the ground.

In the present study TDS values ranged from a minimum of 580mg/l to a maximum of 1754 mg/l inThe TDS values have exhibited an increasing trend in April and May month. Groundwater chemistry changes as the water flows through the subsurface and the increase in geological environment and dissolved solids and major ions. Chebotarev (1985), Ramababu and Somashekara Rao, (1986) and Joseph (2001) expressed the dissolution of soil particles are responsible for increase in TDS concentration in groundwater. Above the permissible limit (1500 ppm), TDS causes gastrointestinal irritation (Shankar and Muttukrishnan, 1994).

Chemical Parameters

Dissolved oxygen (DO)

The amount of oxygen dissolved in water is referred as DO. It is an important parameter represents the quality of water. It is an index of physical and biological processes occurred in water. DO values varies are varying a according to the physical and chemical activites The DO values of study area are above the permissible limits of WHO (6ppm) The ranges of DO have been found in between 7.00mg/l 14.35mg/l .

Total hardness (TH)

Total hardness of water is the sum of concentration of alkaline earth metal cations present in it. Calcium and magnesium are the principle cations imparting hardness. It is defined as the concentration of

multivalent metallic cations in solution. At saturated conditions, the cations react with anions in water to from solid precipitate.

Hardness in natural water comes mainly from the leaching of igneous rock and carbonate rocks (dolomite, calcite and limestone). Water containing the soluble salts of calcium and magnesium such as chlorides, sulphates and bicarbonates is called hard water (Ramaswamy and Rajaguru, 1991). Generally hard water originates in the areas where thick topsoil and lime stone formations are present. Soft water originates in the areas where the topsoil is thin and limestone formats are absent. The hardness in water is derived largely from contact with the soil and rock formation. The ability to dissolve the ions is gained in the soil where CO_2 exists in equilibrium with carbonic acid. Under low pH condition, the basic materials particularly limestone formations are converted to soluble bicarbonates.

The hardness values shown ranges from 132.0mg/l to 228.0mg/l .the values for samples from all sampling stations were below the permissible limits.

Calcium (Ca^{2+})

Calcium is found abundant in all natural waters and its source lies in the rocks from which it is leached. Its concentration varies in natural waters depending upon the nature of the river basin. Calcium is important micro-nutrient in an aquatic environment. Water receives the calcium leached from the rocks and deposits like limestone, dolomites, calcite, gypsum, amphiboles, feldspar, and industrial waste are also important sources of calcium (Mishra and Saxena, 1989).

Calcium is essential for normal human growth. It has been found in several epidemiological investigations in the USA and European countries that drinking water hardness, i.e., concentration of calcium and magnesium, is associated to cardiovascular mortality in particularly adult mortality (Schroeder, 1960; Crawford *et al.*, 1968; CEC, 1976; Sonneborne *et al.*, 1983).

Present investigation, reports that calcium values ranged from minimum of 63 to a maximum of 156mg/l.the lowest was recorded in the month of jan .the mean values recorded as 101 mg/l The BIS (1998) acceptable limit for calcium 200 mg/l.

Magnesium (Mg^{2+})

Magnesium is a necessary constituent of chlorophyll without which no ecosystem could operate. The concentration above 500 mg/l of magnesium reduces the utility of water for domestic use and imparts water an unpleasant taste and renders it unfit for drinking purpose. High amount of magnesium has been proved to be health hazardous if present in excess quality in drinking water (Agarwal and Raj, 1978; Schroeder *et al.*, 1960). High concentration of magnesium proves to be diuretic and laxative.

In the present study, the values of magnesium values ranged from 40 to 90mg/l The acceptable limit for magnesium is 100 mg/l and in the present study 8.33% of the water samples in all the sampling stations crossed the permissible range.

Chloride (Cl^-)

Chlorides occur in natural water in varying concentrations. The chloride content increases as the mineral contents increases. It is commonly found in soils and rocks. The primary source of chloride is sedimentary rocks and saline water intrusion and the minor sources are igneous rocks. High concentration of chloride makes water unpalatable and unfit for drinking and other purposes.

The chloride concentration serve as an indicator by sewage. Chloride in water are subjected to laxative effects . in the present analysis , chloride concentration was found in the range of 112.0mg/l to 467.6mg/l , the study areas chloride level is above and below the permissible limits of WHO (200ppm) which indicates high concentration of chloride present in chittapur taluka shahabad s1 and Tengali S2and S6 Khajuri & Attur S7 remaing station indicates that below the permissible limits .

Fluoride (F^-)

Fluoride is widely dispersed in nature and is common constituent of most soils, rocks, plants and animals. Due to its high electronegativity, it forms only fluorides and no other oxidation state are found (Hem, 1992).

Fluorine is a common element representing about 0.38 gm/kg of the earth crust, which exists in the form of fluorides in a number of minerals. Fluorides are used in the production of alluminium, brick, tiles, ceramics, phosphate fertilizers and toothpaste (GCDWK, 1979).

The high concentration of fluoride causes mottling of teeth, skeletal fluorosis, bending of vertebral column, deformation of knee joints and other bone disorders of the body and even causes paralysis.

Fluoride enters the environment through natural as well as anthropogenic sources. The chief source of fluoride are minerals viz., (fluorite, fluorapatite, micas and hornblend) rocks and sediments. Fluoride bearing minerals occur in all geological factors such as sedimentary, metamorphic and igneous deposits (Korting, 1979 and Hemm, 1985).

Robinson *et al.* (1996) had reported the main source of fluoride in ordinary soil that contains clay minerals. Natural concentration of fluoride in groundwater depends on the availability of fluoride in rocks and minerals encountered by the water as it moves along the flow path. The distribution of fluoride in groundwater depends on number of factors, such as amount of soluble and insoluble fluorine in source rocks, rainfall, vegetation, redox potential, pH and ion exchange process. Fluorides are more common in groundwater than in surface water. The main sources of fluoride in water are various fluoride bearing rocks. Fluoride occurs in traces in many waters but higher concentration is observed in groundwater. The highest natural level of fluoride in groundwater was 2800 ppm (WHO, 1994). High concentrations of fluorides have been reported in India in the states of Tamil Nadu, Andhra Pradesh, Kerala, Karnataka, Gujarat, Rajastan, Punjab and Bihar (Pathak and Badre, 1999).

Fluoride ions have dual significance in water supplies. High concentration of fluoride causes dental fluorosis (disfigurement of the teeth). At the same time, concentration less than 0.6 ppm results in dental caries and dental mottling (Rao *et al.*, 1994). Hence, it is essential to maintain fluoride concentration between 0.6- 1.2 ppm in dinking water (WHO, 1994).

In the present investigation, fluoride values varied from a minimum of 0.12 mg/l to a maximum of 1.68 mg/l .all the samples were shown above the permissible limits it cross the limits .

Alkalinity;

The present study it could be observed that alkalinity values in the ground water indicate that similar pattern of fluctuation through with minor differences ,in this study the values of it in ground water ranged between 300 to 560 mg/l during study period .

Temperature

Gulbarga district lies in the northern plains of Karnataka and has semi – arid type of climate. Dry climate prevails for most part of the year. December is the coldest month with mean daily maximum and minimum temperatures being 29.5^{o}C & 15^{o} to 10^{o}C respectively.

Table: 1: Sampling location in chittapur and Aland taluka

S/NO	sample location	Source	Sample number
1	Shahabad	Borewell	S1
2	Tengali	Borewell	S2
3	Itga	Borewell	S3
4	Allure	Borewell	S4
5	Bhaggodi	Borewell	S5
6	Khajuri	Borewell	S6
7	Attur	Borewell	S7
8	Bhusnoor	Borewell	S8
9	Sarsambha	Borewell	S9
10	Mogha	Borewell	S10

Table No 2: Average result of the physical –chemical parameters of different sites in Aland & Chittapur taluka surrounding villages :

Parameters	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
Temp										
pH	7.12	6.78	7.38	7.7	6.72	6.78	7.2	6.78	8	7.5
EC	1880	2107	1278	956	1980	1910	2250	1265	980	1910
TDS	1410	1520	692	580	1528	1610	672	675	612	1520
Turbidity	1.8	6.4	3.2	3.4	5.6	6.4	3.6	1.5	5.3	3.6
DO	14.5	9,37	14.4	13.24	7.65	7	14.05	8.2	9.42	7.23
TH	362	408	292	280	393	410	318	309	370	400
Calcium	48	40	18	6.8	102.4	112	110	118	130	128
Magnesium	23.4	36.1	27.7	76	83	55.6	81	20	27.328	41.13
Chloride	96.5	234	213	112.2	156.8	114.7	467.6	250	298	420
Flouride	2	1.5	2.2	1.7	1.8	1.2	2	2.1	2.2	1.9
Alkalinity	300	250	350	240	340	360	530	400	370	520

Fresh water is limited and a precious resource is often taken for granted. While many areas of the developing world has lack supply of safe drinking water. Water has become a major issue for the 21st century and an international and national conflict.

In most part of our country, extraction of water from rivers and underground aquifers is being a severe environmental problem. It is therefore important that adequate supply of water is necessary to sustain the life. Development of water supply services be undertaken in such a way as to preserve the hydrological balance and the biological functions of the ecosystem. The development of water sources must be with in the capacity of nature to replenish and to sustain. If this is not done, more mistakes can occur with serious consequences.

Recently, due to climatic changes and demographic pressure, there is an increasing demand for water resources. India is one of those very few countries in the world, which are facing an extremely severe water scarcity problem. The available information indicates that groundwater resources have been severely over exploited and in most cases it has exceeded safe yield level.

Physico-chemical parameters

Water analysis was carried out, by taking 12 parameters, which are very essential to know the water qualities for drinking purpose. The parameters are differentiated as physical and chemical. The physical parameters includes colour, turbidity, pH, electrical conductivity, total dissolved solids, while chemical parameters includes dissolved oxygen, total hardness, calcium, magnesium, Fluoride ,Akalinity. chloride. The standard values of various physico and chemical parameters for drinking water as per BIS and WHO are presented.

Conclusion

- In this study area ,an attempt has been made to identify the pathway and contamination of major ions ,nutrients in the groundwater of some of talukas of Gulbarga Districts and Sarrounding area .The prominent sources of Polluntants and natural agencies that are responsible for contamination in the study area are Domestic/ Muncipal sewage and over exploitation of Ground water to meet the demand for fresh water are the prominent causes for decreasing quality of Ground water . Hence ,the following reccomendation need to minimize or reduce the further deterioration of Ground water quality in the present investigation
- The study revealed that the Gulbarga District and Sarrounding talukas .Comprising lack of adequate sanitary and drainage facilities .Therefore ,an attention of concerned authorities must be made to take appropriate steps in providing the necessary facilities to supply safe drinking water to the people of this area.
- An artificial recharge of Ground water may be adopted to reduce higher concentration of chemical parameters where it is necessary .

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