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Physico-Chemical Analysis of Selected Groundwater Samples of Tumkur District, Karnataka

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Abstract: Water is most important commodities and mainly most misused one. This paper presents groundwater quality of Tumkur district Karnataka city. Ten different locations were selected for the study and compared. The parameters studied were pH, total alkalinity, total hardness, chloride, fluoride, total dissolved solids and conductivity. From overall analysis, it was observed that there was a slight fluctuation in the physico-chemical parameters among the water samples studied. Comparison of the physico-chemical parameters of the water sample with WHO and ICMR limits showed that the groundwater is highly contaminated and account for health hazards for human use.
Keywords: Groundwater, Physico-Chemical parameters, TDS, hardness, Tumkur.

1. Introduction:

Water is essential in human life. The main reason of water contamination is urbanization and industrialization[1]. In rural areas where the water sources like dam, canal, or river is not available, ground The quality of water is vital concern for mankind since it is directly linked with human welfare. In India, most of the population is dependent on groundwater as the only source of drinking water supply. Potable water is the water that is free from disease producing microorganisms and chemical substances that are dangerous to health[2,3]. Water is explored for agricultural purposes. As per current analysis, this is observed that the ground water get polluted drastically because of increased human activities, because of which, water borne diseases has been seen which a cause of health problems a lot. Therefore, basic concentration is needed to monitor the quality of water as well as to find out various sources which increased ground water pollution. The objective of this study is to investigate qualitative analysis of some physicochemical parameters of ground water.

2. Materials and methods:

2.1 Study area:

Tumkur Taluk is located in the south eastern corner of Karnataka state between 13º 06'30" to 13º 31' 00" North latitude and 76º 59' 00" to 77º 19' 00" East Longitude. The Taluk spreads over an area of 1043 sq.km falling within the semiarid region and frequently facing water scarcity as well as quality problems.

The major sources of employment are agriculture, horticulture and animal husbandry, which engage almost 80% of the workforce. The major industries, are that of chemicals, oil, cotton, soap, tools, food processing, rice mills, stone crushing and mining. Occurrence, movement and storage of groundwater are influenced by lithology, thickness and structure of rock formations.

2.2 Sample collection:

The samples were collected in plastic canes of two liter capacity without any air bubbles as per standard procedure. The temperatures of the samples were measured in the field itself at the time of sample collection. The water was pumped out from bore wells a few minutes before sample collection.

Water samples from ten sampling points situated at different places were collected during monsoon period from July 2012 to September 2012. The sampling locations are given in Table 1. All the samples are from residential area.

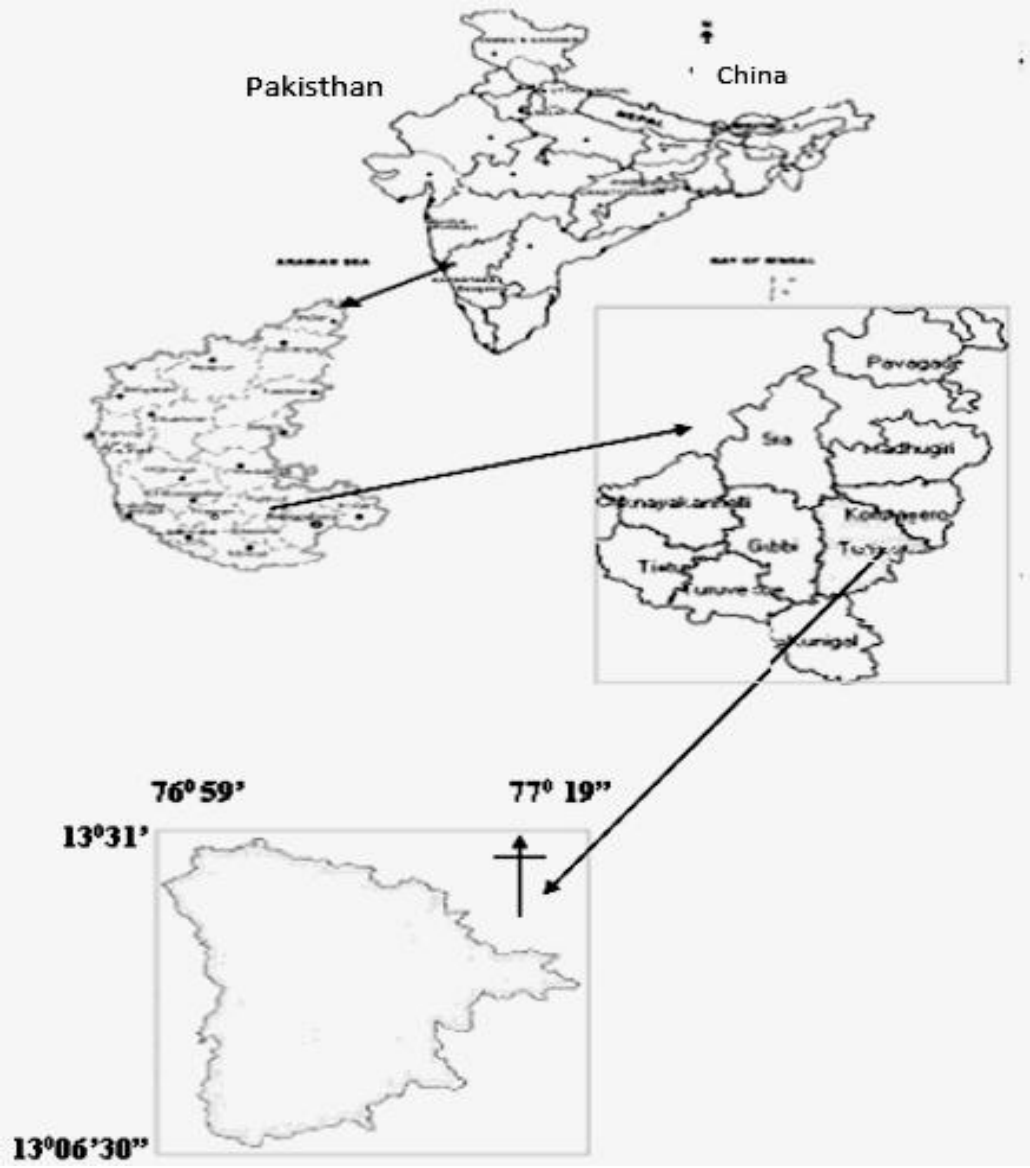

Figure 1. Location map of the study area.

Table 1: Sampling Locations

Sample no.	Sampling location	Source
S1	Janatha Colony C T Kere	Bore well
S2	Gmhps School C T Kere	Bore well
S3	2ND Bus Stop C T Kere	Bore well
S4	HIVAMUKAMBIKA NAGAR.	Bore well
S5	5TH A Cross Batawadi	Bore well
S6	Nalanda School Shettihalli	Bore well
S7	Shanthinagar Near Chamundi Temple	Bore well
S8	3RD Cross Vijayanagar	Bore well
S9	Sit Gokula Extension	Bore well
S10	Hurulithota Kothithopu	Bore well

Materials And Methods

Samples were analyzed for different physico-chemical parameters such as, pH, electrical conductivity (EC), total dissolved solids (TDS), total alkalinity (TA) ,total hardness (TH), Calcium (Ca^{2+}), magnesium (Mg^{2+}), Chloride (Cl^-), Fluoride(F^-), Iron(Fe),Phosphate(PO_4^{3-} as per standard procedures (APHA,Standard methods)[4]. The quality of ground water has been assessed by comparing each parameter with the standard desirable limit of that parameter in drinking water as prescribed by ISI 10500-91.

Results And Discussion

The average results of the physicochemical parameters for water samples are presented in Table 2.

pH:

pH is a term used universally to express the intensity of the acid or alkaline condition of a solution[5,6]. All chemical and biological reactions are directly dependent upon the pH of water system[7]. Most of the waters are slightly acidic. The pH values of water samples varied between to and were found within the limit prescribed by ISI.

Electrical Conductivity (EC):

Electrical conductivity is a measure of water capacity to convey electric current. The conductivity of water depends upon the concentration of ions and its nutrient status. Based on electrical conductivity values the water quality can be classified as poor, medium or good[8]. EC values are in the range of 0.52 to 2.62 indicating the presence of high amount of dissolved inorganic substances in ionized form.

Total Dissolved Solids (TDS):

Total dissolved solids are composed mainly of carbonates, bicarbonates, chlorides, phosphates and Nitrates of Calcium, Magnesium, Sodium, Potassium, Manganese, organic matter salt and other particles[9]. Total dissolved solids indicate the salinity behaviour of groundwater. Water containing more than 500 mg/l of TDS is not considered desirable for drinking water supplies, but in unavoidable cases 1500 mg/L is also allowed[10]. TDS values varied from 1.0 mg/l to 2.0 mg/l.

Total Alkalinity

Alkalinity of water is its capacity to neutralize a strong acid and it is normally due to the presence of bicarbonate, carbonate and hydroxide compound of calcium, sodium and potassium. The alkalinity values in the study area found to vary from 100 to 275 mg/l. Alkalinity around 150 mg/l has been found conductive to higher productivity of water bodies [11.]

Chloride (Cl^-):

Chloride contents in fresh water are largely influenced by evaporation and precipitation. Chloride ions are generally more toxic than sulphate to most of the plants and are best indicator of pollution[7] . Chloride is a widely distributed element in all types of rocks in one or the other form. Its affinity towards sodium is high. Therefore, its concentration is high in ground waters, where the temperature is high and rainfall is less. Soil porosity and permeability also has a key role in building up the chlorides concentration[12]. People accustomed to higher chloride in water are subjected to laxative effects[13]. In the present analysis, chloride concentration was found in the range of 80 mg/l to 250mg/l. All the values are within the limit.

Total hardness (TH):

Hardness is the property of water which prevents the lather formation with soap and increases the boiling points of water[14]. Hardness of water mainly depends upon the amount of calcium or magnesium salts or both. The hardness values shown range from 125 mg/l to 500 mg/l.

Calcium and magnesium (Ca^{2+},Mg^{2+}):
Calcium and Magnesium are directly related to hardness. Calcium (Ca^{2+}) and Magnesium (Mg^{2+}) ions are both common in natural waters and both are essential elements for all organisms. Calcium and Magnesium, when combined with bicarbonate, carbonate, sulphate and other species, contribute to the hardness of natural waters. The effect of this hardness can be seen as deposited scale when such waters are heated. Normally hardness due to calcium predominates although in certain regions, magnesium hardness can be high. Calcium or Magnesium salts or both cause almost all the hardness of water. Hardness below 300mg per litre is considered as potable but, beyond this limit causes gastrointestinal irritation. Hardness concentration more than 300mg per litre may cause heart and kidney problems[15-16]. In the present study, it is found that 90 to 300 mg/l.

Fluoride (F^-):
The major natural source of fluoride is amphiboles, apatite, fluorite and mica. Its concentration in natural waters generally should not exceed 10 mg/l.
The factors responsible for ground water contamination with fluoride are geological factors such as weathering of minerals, rock dissolution and decomposition containing fluoride over a long period of time resulting in the leaching it into ground water (2) An anthropogenic factor such as industrial process liberates higher concentration of fluoride into atmosphere. Excess of fluoride results in the destruction of enamel and causes fluorosis leading to dental disorder, retinal disorder, decalcification, mineralization of tendons, digestive and nervous disorders. The excess of fluoride (more than 1.5 mg/litre) is dangerous to health. Hence excess fluoride should be removed from water and this process is called defluoridation.
All the water samples analysed in the present study had fluoride content 1.0mg/l and are safe to drinking purpose.

Phosphate (PO_4^{3-}):
Phosphate may occur in ground water as a result of domestic sewage, detergents, agricultural with fertilizers and industrial waste water. The phosphate content in the study area was found to be 0 mg/l.

Iron (Fe) :
The major natural sources of iron ($Fe^{2+)}$ in igneous rocks are amphiboles, ferromagnesium, ferrous sulphide, oxides, carbonates and sulphides of iron clay minerals. Its concentration in natural waters is less than 0.5mg/l in fully aerated water. Ground water having a pH less than 8.6 may contain 10mg/l and rarely as much as 50mg/l may occur. More than 0.1mg/l precipitates after exposure to air causes turbidity and may impact objectionable tastes and colors to foods and drinks[17].
Iron is an essential element for human health but the presence of excess iron in ground water causes attaining of plumbing mixtures, clothes after laundering, and imparts an astringent taste to drinking water. The estimation of iron in ground water is very helpful in assessing the extent of corrosion. Iron occurrence in ground water is influenced by microorganisms which catalytically help either its oxidation to ferric ion (under aerobic conditions) or reduction to divalent iron (under anaerobic condition).

Table2: Physico-Chemical characteristics of water samples

Sample No	pH	EC	TDS	TH	Ca^{2+}	TA	Cl^-	F^-	Fe	PO_4^{3-}
S1	6.17	1.35	1.0	275	090	100	100	0.0	0.3	0.0
S2	6.52	2.62	2.0	500	300	445	250	0.0	0.3	0.0
S3	6.45	1.61	1.0	200	115	190	200	1.0	1.0	0.0
S4	6.71	1.65	1.0	235	125	200	200	0.0	0.0	0.0
S5	6.69	1.48	1.0	225	150	200	180	0.0	0.3	0.0
S6	6.77	2.63	1.0	250	125	275	180	0.0	0.3	0.0
S7	6.76	1.41	1.0	225	110	150	200	0.0	0.0	0.0
S8	6.95	0.52	1.5	300	185	150	080	0.0	0.3	0.0
S9	6.38	1.87	1.0	250	100	150	150	0.0	0.0	0.0
S10	6.56	2.15	1.0	350	200	230	210	0.0	0.0	0.0
Indian Standard	6.5-7.5	-	500	300	75	200	250	1.0	0.3	-
WHO standard	7.0-8.0	-	1000	200-600	96	120	97	30.0	0.5	-

The most common type of iron dissolved in ground water is divalent iron. High iron content can thus be associated with the oxidation of reduced iron minerals such as FeS in the boundary zone between reducing and oxidizing environments. The oxygen content of ground water is completely used up sooner or later by oxygen consuming reactions underground. In the anaerobic environment the presence of organic matter can lead to reducing conditions, in which the oxidized iron compounds are reduced so that in the ground water much divalent iron exists. In the present study ,it is in the range of 0.3 to 1.0 mg/l.

Conclusion:

A physico chemical analysis of groundwater samples were carried weekly, considering certain important parameters like pH, TDS, Conductivity, PO_4^{3-}, F^-, Fe, Ca^{2+},Mg^{2+} and Hardness.

The present study reveals that maximum parameters of the study area sample do not exceed the permissible limit prescribed by WHO.

Deviations were observed by S2 ground water samples indicating ground water pollution.

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References:

1. Ramakrishnaiah C.R. et al, Assessment of Water Quality Index for the Groundwater in Tumkur Taluk, Karnataka State, India, E-Journal of Chemistry 2009, 6(2), 523-530.
2. Lamikaran A , Essential Microbiology for students and Practitioners of Pharmacy, Medicine and Microbiology , 2nd Edn. , Amkra books, 1999, 406.
3. Shittu O.B et al, Physico-Chemical and Bacteriological Analyses of Water Used for Drinking and Swimming Purposes in Abeokuta, Nigeria, African Journal of Biomedical Research, 2008, Vol. 11, 285 -290 .
4. APHA, Standard methods for the examinations of water and wastewater, American Public Health Association, Washington, DC, 1998, 18th Ed.
5. Chapolikar A. D., Chamargore J. J., Bharad J V. and Ubale M. B., Biochemical science 2011, Vol 1(1) .
6. Nisha, A.R., Vineetha C. B., Dhanya V.R. & Sreelata, K.P Asian *Jour of Chem & Env. Res*, 2010 Vol 3(3), 92-94.
7. Chapolikar A.D., Bharad J.V., Madje B.R., Chavan F.R.,& Ubale M.B Int. J. chem sci, 2009, 7(1), 475-480.
8. Chapolikar A.D. and Ubale M. B., A correlation study on physico-chemical characteristics of ground water in Thane-Belapur industrial area, Mumbai, Current World Envir. 2010**,** vol 5 (1), 67-71.
9. Mahananda, M. R., Mohanty B. P., Behera, N. R., Physico-chemical analysis of surface and ground water of Bargarh district, Orissa, India, *IJRRAS*, 2010, 2(3) 284-295.
10. Shrinivasa Rao B and Venkateswaralu P, Physicochemical Analysis of Selected Groundwater Samples, Indian J. Environ Prot., 2000, 20 (3), 161.
11. Ball R C, Fertilization of lake, good or bad, Michigen, Conserv. 1994, pp 714.
12. Chanda D K, Hydrology Journal, 1999, 7(5), pp 431439.
13. Sudhir Dahiya and Amarjeet Kaur, physico chemical characteristics of underground water in rural areas of Tosham subdivisions, Bhiwani district, Haryana, J. Environ Poll. , 1999, 6 (4), 281.
14. Trivedy R. K. and Goel P. K., Chemical and Biological methods for water pollution studies Environmental Publication, Karad, 1986.
15. Ponangi, R.Shyam, Asolkar and S.G.Joshi Trace Pollutants in drinking water, J.IAEM, 2000, 27, pp.16 -24,
16. Dilip B P, Rajendra V Tijare and Rewater S.B, Physico Chemical characteristics of ground water of Armori town of Gadchiroli district, Maharashtra, India, 2001, 20 (2**)** PP 207-209,
17. Biswajit Raj A.K, Bandyopadhya and Chatterjie S.K, Removal of Iron from drinking wáter – An easy and appropriate technology, Nat.Envt. and poll Tech., 2002,1(4), 369-374,.

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