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Ground Water Contamination in Tea Gardens Area: A Case Study in Gohpur Sub-Division, Biswanath, (Assam), India

Dr. Joydev Dutta

Associate Prof. Dept. of Chemistry

Chaiduar College, Gohpur, Biswanath, (Assam), India

Pin. No.784168

Abstract:

Assam is one of the major tea production state, 60% of tea is produced in India only Assam. In the tea gardens a huge amounts of agrochemicals is used for high yield but the effect of agrochemicals in soil and water is ignore, the agrochemicals from soil leashes to drinking water sources and contaminant the water sources. Safe drinking water is a basic need of every human being despite of any socio-economic status. Ground water extracted from the deep aquifers in tea gardens area of Gohpur Sub-Division, Biswanath district Assam can no longer be considered safe for drinking. Report says that, the residents of the area have been chronically exposed to low to moderate levels of heavy metals like arsenic and iron. The ground water quality of this area has been assessed to see the suitability of ground water for drinking purposes. Ground water samples were collected to study the various water parameters. The data was analyzed with reference to BIS and WHO standards.

Key Words: Ground water, Seasonal variation, Tea garden, W.H.O,

INTRODUCTION:

Water is not only the most important essential constituent of all animals, plants and other organisms but also it is pivotal for the survivality of the mankind in the Biosphere. But most of our natural water bodies are gradually becoming degraded to a great extent due to rapid progress of industrialization, urbanization and modern agricultural activities. [1]The hydro biological cycle stores about 0.6% of water as ground water. The ground water level increases by percolation which is extensively used for bio drinking and pedosphere irrigation. [2]The pesticide and inorganic manure in the chemical elements present causes artificial and natural ground water pollution. Retention and release reaction of pesticides and inorganic manure in to drinking water sources may convert contaminated water sources. Assam is the land of tea. The 60% of tea in India is produced in Assam only. In Assam the tea is cultivated in Brahmaputra and Barak valley covering the area 2,29,843ha, The big gardens are under multinational companies as well as the small tea gardens are under small tea growers. [3]For increasing production a large number of agrochemicals are use in these gardens. As a result soil and water pollution becomes conspicuous . So it is very important to monitoring the quality of the drinking water sources in the tea gardens area. Good drinking water quality is essential for the well being of all people.

In the tea gardens excess amount of fertilizers- containing phosphate and nitrates and pesticides containing health hazard chemicals are used. [4]The excess fertilizers and hazard chemicals leaching in to pools and ponds and wells. Animal wastes also contribute to phosphate and nitrate in runoff water. The main responsibility of eutrophication is phosphate and nitrate. The nitrate in drinking water can cause methemoglobinemia in infants. In numerous studies, exposure of high levels of nitrate in the drinking water has been linked to a variety of effects ranging from enlargement of thyroid to 15 types of cancer and two kind of birth defects an even hypertension. [5]Research shows a definite relationship between increasing rates of stomach cancer with increasing nitrate intake. Agriculture is a major source of nitrogen loss to the environment. Modern agriculture practice, which involves the application of fertilizer coupled with pesticides, contributes the fluoride to the ground water, which increasing incidence of fluorosis in recent days.

[5]According our literature review, there has been no published report concerning the nitrate, phosphate and fluoride contaminants in drinking water sources in the tea gardens of Gohpur sub division Biswanath district Thus may me the reason to concern about to study the water quality of tea gardens of this area.

Materials and methods

Study area

Gohpur is the sub-division of Biswanath district of Assam, India. It is a historical place of Assam, where the famous freedom fighter Kanaklata Barua was born. Gohpur is located at 26.88°N 93.63°E.It has an average elevation of 269 m (883 feet). The distance between Guwahati and Gohpur is 299 km by road. As of 2001 India census, Gohpur had a population of 121,380. Males constitute 53% of the population and females 47%. Gohpur has an average literacy rate of 72%, higher than the national average of 59.5%: male literacy is 77%, and female literacy is 66%. In Gohpur, 13% of the population is under 6 years of age. There are six big tea gardens and a large number of mall tea gardens are present.

Sampling methodology:

Sampling methodology

Total 60 numbers of water samples were collected from different drinking water sources of the tea gardens of Gohpur Sub-division. The sources of the water samples were shallow hand tube wells (HTW ~60ft deep, deep tube wells (DTW) like Tara pump (~120ft deep) and mark tube well (~180ft deep), ponds and open wells. Tube wells were operated at least 10 minutes before collection to flash out the stagnant water inside the tube and to get fresh ground water. The water samples were collected in clean 1L Poly propylene bottles.

Sample analysis: pH of the samples was measured at the site of collection by using Pocket pH meter (Merck, India). After determination of pH, 1:1 HNO_3 solution was added to the each water samples collected (to pH less than 2) and sealed the bottles which were carried out to the laboratory for further analysis of water quality parameters.[6] The analyses of TH, SO_4^{2-}, Ca, and Mg were determined following standard methods. Na and K in the water samples were determined by flame photometer whereas TH, Ca and Mg were determined by EDTA titrametric methods. SO_4^{2-} content present in the water samples were analysed by turbidimetrically at 450 nm using UV-spectrophotometer (SPECORD 40, Analytic Jena, Germany). [7]The concentration of the heavy metals namely Fe and Mn were determined using atomic absorption spectrometry (AAS; model Perkin Elmer 200, USA) at their respective wave length and slit width. Hydride Generation-Atomic Absorption Spectrometry (HG-AAS) was used for analysis of As in water samples. All the reagents and standards were prepared freshly at the time of analysis. For better sensitivity, As^{5+} was pre-reduced to As^{3+} before analysis. Pre-reduction was carried out following the standard method. Briefly, a mixture of 5 ml of potassium iodide & ascorbic acid solution, 10 ml of 5 mol/L HCl solution and 10 ml of water sample was added in 50 ml volumetric flask. The volume was made up to the mark of the flask adding 0.15 mol/L HCl solution. Time given for pre-reduction was 30 minutes. 10 ml of pre-reduced water sample was analyzed using AAS (Perkin Elmer 200, USA) with MHS-15 (Mercury Hydride System) at 193.7 analytical wavelengths and 0.7 nm slit width. Radiation source was electrode less discharge lamp (EDL) for arsenic with 20 sec. pre reaction purge time and 10 sec. post reaction purge time. [8]The argon gas and sodium borohydrate were used for hydride generation. Oxy-acetylene flame was used for determination of heavy metals.

Result and Discussion:

The average results of the physic-chemical parameters for water samples in the tea gradens including pH, TH, SO_4^{2-} , Na, K, Ca, Mg, Fe, Mn, As were given in the table 1. The water samples were collected different ground water sources of Ghagara tea estate, total thirty samples were collected from north , south, east , west and middle direction of the tea gardens and six samples were collected from each side. Average is taken to each side, the Arsenic concentration in the water samples in different sides are under WHO guide line value of 0.01ppm. The iron concentration value in many samples were found above the WHO guide line value (1ppm). Lowest is 0.52 ppm to highest 5.4ppm. which are shown in the Table 1. The WHO guideline value of Mn is 0.3ppm, in my study the Mn concentration was found that minimum is 0.10 ppm and maximum 3.01ppm. So Fe and Mn in drinking water sources in this tea garden is significant.

Table1: Concentration of Iron, Manganese and Arsenic

Gardens side	Fe ppm (Min.-Max.)	Mn ppm(Min-Max.)	As ppm(Min-Max)
North	1.32-4.21	0.1-2.45	0.002-0.003
East	1.67-3.90	1.25-2.58	0.001-0.002
South	2.38-5.4	2.22-3.01	0.005-0.006
West	3.12-4.85	1.11-2.14	0.001-0.002
Middle	0.52-2.3	0.45-3.00	0.003-0.004

In Table 2 the water quality parameters like pH, TH, Ca, Mg, Cl^- and SO_4^{2-} are shown

Table2: Concentration of pH, TH, Ca, Mg, Cl^-, SO_4^{2-} in ppm except pH

Gardens side	pH	TH	Ca	Mg	Cl^-	SO_4^2
North	7.8-8.0	75-110	8.1-41.9	3.8-4.2	11.5-15.6	4.8-20.5
East	7.5-8.0	105-205	15.7-22.3	4.8-4.9	25.7-27.2	12.8-35.7
South	6.7—6.9	109-339	13.9-31.4	3.8-15.9	27.6-38.1	17.2-2.1
West	6.2-8.0	204-436	50.14-85.3	21.7-31.0	21.1-50.5	36-47.1
Middle	7.1-7.8	75-405	101.-130.8	5.8-15.8	80.1-85.9	21.9-28.6

Table 3. Minimum, maximum and average of the water parameters (except pH all parameters in ppm)

Sl.No.	Parameters	Min.	Max.	Average	WHO(1993)	ISI(10500-91)
1	pH	6.2	8.0	7.1	7-8.5	6.5-8.5
2	TH	75	436	255.5	200	-
3	Ca	8.1	130.8	69.45	75	300
4	Mg	3.8	31.0	17.4	30	75
5	Cl	11.5	85.9	48.7	250	250
6	SO_4^{2-}	4.8	47.1	25.95	250	200
7	Fe	0.52	5.4	2.96	1	-
8	Mn	0.1	3.01	1.55	0.3	-
9	As	.001	0.006	0.0035	0.01	-

pH

pH is a term used universally to express the intensity of the acid or alkaline condition of a solution pH ranges from 6.2 to 8.0. Minimum pH 6.0 was observed in west direction of tea garden which is in ring well and maximum pH was observed 8.0 in north east and west directions which is in hand tube well , deep well, etc. The pH is tend to acidic. For drinking water, a pH range of 6.0 -8.5 is recommended. The pH is some extent influence of fertilizers like ammonium sulphate and super phosphate in agriculture.

TH (Total Hardness)

Hardness is the property of water which prevents the lather formation with soap and increase the boiling points of water.]9]Hardness exhibits a minimum content of 75ppm to 436ppm in the study area. Hardness is mainly depends upon the amount of calcium and magnesium salts or both. Though the hardness is not harmful to health, it has been suspected to be playing some role in heart disease.[10] The minimum value 75ppm is found in North direction of the tea garden and maximum value 436 ppm is found in west direction water sources of the tea garden. The dissolution of salts and minerals present in soil and nearby tea gardens enhances its concentration in ground water. [11]The agrochemicals applied in the tea gardens directly or indirectly affect the concentrations of a large numbers of inorganic chemicals in ground water such as NO_3^-, Cl^-, SO_4^{2-}, PO_4^{3-}, K^+, Mg^{2+}, Ca^{2+} etc. which adds the hardness of water .

Calcium and Magnesium (Ca^{2+}, Mg^{2+})

[12]Calcium and magnesium are directly related to hardness. In fact 98% of all world ground water are dominated by Calcium and bicarbonate ions due to lime stone weathering in the catchments and underground water beds. [13] Calcium is very essential for nervous systems and for formation of bones. In this study the range of calcium concentration is 8.1 ppm to 130.8 ppm. Some samples have above the ISI limit. Although the sources of Ca in water samples mainly the lime stone weathering, the prolonged agrochemicals activities prevailing in the tea gardens may also directly or indirectly augment the mineral dissolution in ground water.

The content of Mg is comparatively less than that of Ca. Mg tolerances by human body are lower than that of Ca. High concentration of Mg in drinking water gives unpleasant taste to the water. The range of Mg in the water samples are from 3.8 ppm to 31.0 ppm.[14] The minimum value 3.8 ppm is found in North direction of the garden and the maximum value 31.0 ppm is found in west direction of the garden. Almost all the samples have Mg concentration above the ISI limit. The geochemistry of rock types may have an influence in the concentration of Mg in ground water.

Chloride(Cl^-):

Chloride occurs in all types of waters. People accustomed to higher chloride in water are subjected to laxative effects. The chloride contents normally increases as the mineral contents increases. The range of chloride concentration is 11.5 ppm to 85.9 ppm. The minimum concentration 11.5 ppm is found in Nort side of the garden and the maximum concentration 85.9 ppm is found in Middle area of the garden. The ISI limit is 250 ppm, all the samples have chloride concentration is within ISI limit. In natural waters, the probable sources of chloride comprise the leaching of chloride-containing minerals (like apatite) and rocks with which the water comes in contact, inland salinity and the discharge of agricultural, industrial and domestic waste waters. [15]Agricultural application of K as a plant nutrient commonly results in chloride contamination of recharging shallow groundwater.

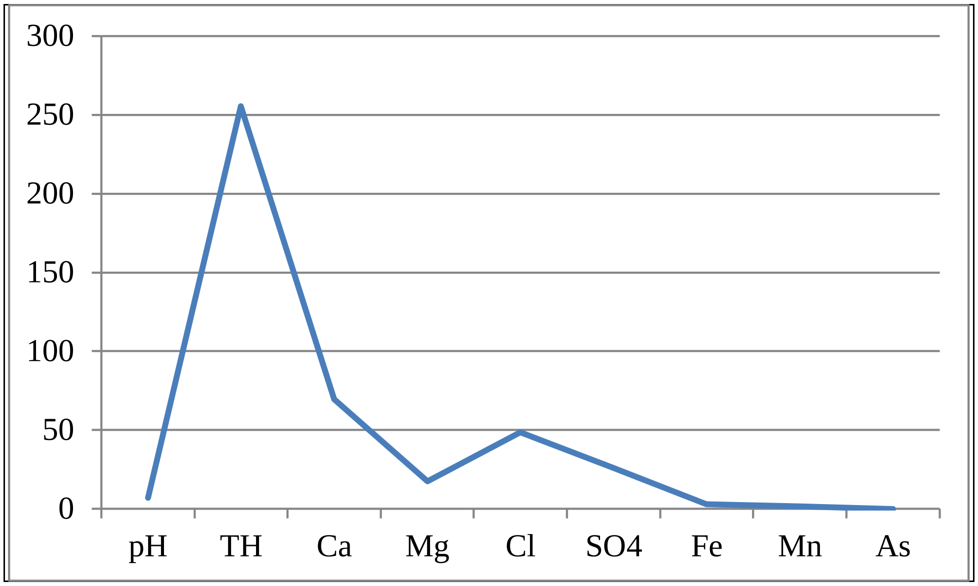
Sulphate(SO_4^{2-}):

It is the common ion in water. Sulphate can produce bitter taste at high concentration. Sodium and magnesium sulphate exert a cathartic action in human beings. It is also associated with respiratory diseases. Sulphate occurs naturally in waters as a result of leaching from gypsum and other common minerals. Sulphate form soluble and insoluble salt with various cations. The ISI limit of sulphate is 200ppm. [16]In the study area the variation of sulphate is 4.8 ppm to 47.1ppm, all are below ISI permissible limit. The lower sulphate value in the drinking water samples could be because sulphate easily precipitates and settles to the bottom sediment of the water sources.

Iron (Fe), Manganese(Mn) and Arsenic(As):

In the table 1 represents the concentration of Iron, Manganese and Arsenic. All the samples except one sample in the middle part of the garden had iron concentration above the WHO limit. The minimum value is 0.52 ppm and highest value is 5.4 ppm Most of the Manganese level were found above the WHO permissible limit lowest is 0.1 and highest is 3.01 for this reason the odour of the water are foul smell. Arsenic in the samples were found below the WHO permissible limit. So no arsenocosis was seen.

Fig:1 Variation of Concentration of Parameters (in average)



In this line diagram X axis represents the water parameters and Y axis represents the average value the concentration of this parameters all are in ppm except pH

Conclusion:

From this study it was found that the drinking water quality in this area was poor in respect to heavy metals like iron and manganese. pH value shows slightly alkaline to acidic nature but it is within the specified limit. TH (Total Hardness) calcium and magnesium were not harmfull for drinking purposes. Major anions Chloride and sulphate were found to be lowere than that of tolerance limit as suggested for drinking water sources by WHO.[17] Arsenic were found below the WHO limit.- All parameters are shown concisely in the Fig. 1.

Bibliography:

[1]. Sharma, B.M. 2000: Environmental Studied. Manipur University,Imphal.

[2]. APHA (1989). Standard method of examination of water and waste water, 17th edition

[3]. Acharyya, S. K. And Shah, B. A., As-contaminated groundwater from parts of Damodar fan- delta and west of Bhagirathi River, West Bengal, India: influence of fluvial geomorphology and Quaternary morphostratigraphy. Environmental Geology, 52, 489– 501,2007

[4]. Appelo, C. A. J. and Postma, D., Geochemistry, Groundwater and Pollution, 2nd edition. Balkema publishers, Leiden, the Netherlands, 404, 2005.

[5]. Bhuyan, B. and Sarma, H.P.,Public health impact of pesticide use in the Tea-Gardens of Lakhimpur District, Assam. Ecology, Environment and Conservation, **10(3)** 333-338 ,(2004).

[6]. Chakraborti, D., Ahamed, S., Rahman, M. M., Sengupta, M. K., Lodh, D., Das, B., Hossain, M.

A., Mukherjee, S. C., Pati, S., Das, N. K. (2004). Risk of arsenic contamination in groundwater. Environmental Health Perspective

[7]. Dutta, J. et all J. Environ. Science & Engg. Vol. 53, No. 4, p. 443-450, October 2011

[8]. Dinesh Chand., Rajiv Gandhi National Drinking Water Mission, Ministry of Rural areas and employment, CGO complex Lodhi Road, New Delhi, Fluoride and Human Health cause for concern Indian J. of Env. Prot. 1998, 19(2), 81-89.

[9]. Eatson, A.D., Clesceri, L.S., Rice, E.W., and Greenberg, A.E., Standard Methods For The Examination of Water and Wastewater, 21st Edition, (Centennial Edition, USA), 4-138, 2005.

[10]. Gupta, S., Banergee, S., Saha, R., Dutta., J.K., Mondal, N., Fluoride geochemistry of ground water in Nalhati-1 Block of the Birbhum district, West Bengal, India, Research Report Fluoride, 2006, 39(4), 318-320.

[11]. Indian Standard Specification for Drinking Water, ISI. 1991.

[12]. Kulshreshtha, S. N., 1998, A Global Outlook for Water Resources to the Year 2025. Water Resources Management 12 (3), pp. 167–184.

[13]. Kumar, R., Singh, R.D., and Sharma, K.D., 2005, Water resources in India. Curr. Sci., 89, pp. 794–811.

[14]. Lomborg, B., 2001, The Skeptical Environmentalist, Cambridge University Press. pp. 22. ISBN 0521010683, downloaded from http://www.lomborg.com on 10.12. 2009.

[15]. Murulidharan, D., Nair, A.P. and Sathyanarayana, U., Curr. Sci., 2002, 83, 699-702.

[16]. Murulidharan, D., Nair, A.P. and Sathyanarayana, U., Curr. Sci., 83, 699-702, 2002.

[17]. WHO, 2004, "Guideline for Drinking Water Quality", 3rd Edition, World Health Organisation, Geneva.