STATISTICAL ANALYSIS OF HEAVY METALS FROM WATER SAMPLES OF TEZPUR SUB-DIVISION IN SONITPUR DISTRICT, ASSAM, INDIA

Pranab Sabhapandit [1] *, [2]Prasanta Saikia, Abani Kr. Mishra[3]

1*Sr. Lecturer, Department of Chemistry, Chaiduar College,Gohpur, Sonitpur, Assam, India
2 Lecturer, Department of Statistics, Chaiduar College, Gohpur, Sonitpur, Assam,India
3 Professor, Department of Chemistry,Gauhati University, Guwahati, Assam,India
Email : sabhapandit_pranab@rediffmail.com

ABSTRACT: Analysis of heavy metals of water samples from Tube wells, Ring wells, Ponds and Rivers were carried out during year 2008 and 2009. Samples were analyzed using standard methods. To assess the quality of drinking water, each parameter was compared with the standard desirable limit of that parameter in drinking water as prescribed by different agencies. The results from the analysis of water show that the highest P^H was recorded in pre-monsoon season, but lowest value recorded in monsoon season. All the sources have P^H within the maximum limit. The copper and zinc concentrations in all sources were below the permissible limit but in case of nickel all the sources have its value exceed the limit. Chromium was detected during post monsoon and winter seasons. Two sources have chromium values exceed the permissible limit. In the present study, maximum amount of arsenic in all seasons is recoded from Ring wells only. The statistical parameters such as Mean, Variance, Standard deviation (SD) and Coefficient of variation (CV) were calculated. Correlation Coefficient Matrix among the parameters was calculated and correlations between various parameters were worked out. Significant positive and negative correlations among the parameters were determined.
Key words: drinking water sample; heavy metals; Correlation Analysis; Tezpur Sub-division; Sonitpur.

INTRODUCTION

From the time immemorial, water is being considered as most important raw material of civilization. It is one of the vital resources for all kind of life. Comprising over 71% of the Earth' surface, water is unquestionably the most precious natural resource that exists on our planet (Tyler, 1991).Groundwater has historically been considered as reliable and safe source of water protected from surface contamination by geological filters that remove pollutants from water as it is percolate through the soil (Prasad and Chandra, 1997).. Pollution of fresh water occurs due to three major reasons which are excess nutrients from sewage, wastes from industries (Jamode *et al.*, 2004), mining and agriculture. Groundwater is threatened with pollution from the sources of domestic wastes, industrial wastes, runoff from urban areas, suspended and dissolved soils, organics and pathogens other potential sources of groundwater contamination are waste water treatment lagoons, mine spills, urban and rural garbage's, earthen septic tanks, refuse dumps, barnyard manures etc. Textile process employs variety of chemicals depending upon the nature of raw material and products. Environmental problems by these industries are mainly caused by the discharge of effluents(Rathore.J *et al* 2009) . The problem drinking water contamination, water conservation and water quality management has assumed a very complex shape(Bodhaditya Das *et al.*, 2008).Attention on water contamination and its management has become a need of the hour because of its far reaching impact on human health(Sinha *et al.*, 1995). Drinking water-specification study has been reported in the publication of Bureau of Indian standards (BIS, 1993). Adak and Purohit (2001) studied on status of surface and ground water quality of Mandiakudar-part-1; physio-chemical parameters**.** In the North Eastern region of India, natural springs and dug wells are the only cost effective viable means of fulfilling the needs of fresh water for present population. Information on groundwater quality of North East India is scanty (Singh A.K*,* 2004, Bhagwan *et al.* , 2004). Available literature shows that groundwater of North East Valleys are highly ferriginous (Owal, 1981).

The incidence of high fluoride (Sushella, 2001). and Arsenic (Sengupta ,1999) in groundwater of Karbi Anglong and Nagaon district of Assam and its manifestation in the form of fluorosis was already reported.
Recognizing the enormity and severity of the problem, groundwater quality survey was conduct for the Biswanath Sub- division of Sonitpur district, Assam to identify the suit ability or otherwise of groundwater quality for drinking purpose.
Study area: The Sonitpur district is situated at the middle part of Assam and is located on the right bank of river Brahmaputra within 26° 30' - 27° 01'North latitude and 92° 16' - 93° 43' East longitude. Land use in the district is divided primarily among tropical semi evergreen, moist deciduous, grass land, agricultural land and tea garden. The temperature ranges from 7^{o} c in January and 38^{o} c in July. Sonitpur district falls in 9A and 9B biogeography zone. The District is economically backward and practically has no large scale industry. The District is largely plain. There are three Sub-division (Tezpur Sub-division, Biswanath Sub-division and Gohpur Sub-division). People of rural area of Sonitpur district generally use Tube well, Ring well, River and Ponds as the sources of water for drinking purpose. Lifestyle of the inhabitants and their economic positions effect the water used within the home in different parts of the district.

MATERIALS AND METHODS

The water samples were collected from the various sources in separate container for heavy metal analysis during pre- monsoon, monsoon, and post monsoon and winter season within two years from 2008 to 2009. The Eight Seasons were covered in the following way.

Pre- Monsoon season	(A) March2008- to -May2008	(E) March2009-to -May2009.
Monsoon season	(B) June 2008- to – Sept 2008	(F) June 2009-to-Sept 2009.
Post Monsoon Season	(C) Oct 2008 – to- Nov 2008	(G) Oct 2009-to-Nov 2009.
Winter season	(D) Dec 2008- to- Feb 2008	(H) Oct 2009-to- Feb 2010.

The samples were collected from Tube wells, Ring wells, ponds and River. The depths of every wells were varies from 30-350 feet in the month of July-August in the year 2008 and 2009. Tube wells were operated at least 10 minutes before collecting to flash out the stagnant water inside the tube and to get fresh groundwater. The heavy metal were analyzed by Atomic Absorption Spectrophotometer (AAS) technique with the help of an instrument AAS-VARIAN SPECTRA, AA 220.The wavelength and flame composition for different metals were as shown in Table-1.

Table-1: The wavelength and flame composition

Metal	Wavelength (HCL) in nm	Flame composition HG-ASS
As	193.7	Air-C_2H_2AAS
Cu	324.8	do
Cr	217.0	do
Zn	213.0	do
Ni	232.0	do

RESULTS AND DISCUSSION

Temperature: The season wise average values are shown in Table-**3**. In the present studies, Ponds and Rivers are large water bodies, they tend to warm and cool off slowly due to surface heating and cooling during day and night. The water temperature in Ponds and Tube wells was found to be closely related to ambient air temperature. The temperature of the Ring well and River are slightly low. pH. Their season wise average values are shown in Table-3. The highest pH values (8.0 mg/l) were recorded in the RW during Pre monsoon season and the lowest pH values (5.9mg/l) was recorded in the RW during the monsoon season. WHO has recommended the minimum and maximum permissible limit of pH as 6.5 and 8.5mg/l.

In the present study water from 11th sources has pH below the minimum permissible limit and remaining others are within the range. Here no sources have pH exceed the maximum permissible limit. Water with low pH corrodes metal pipes and releases toxic ion (APHA 2005). Copper: The season wise copper concentrations are given in Table- 3. It could be observed from the table that many of the sites did not have copper in the Ground water. The guideline value describing the maximum permissible limit for Cu in drinking water is 2.0mg/l (WHO 2004). In the present study, the values of Cu in all sources below the permissible limit. Copper is detected some high in monsoon season. Copper in water of Delhi (khan *et al* 2005) varied from 0.2mg/l to 0.04mg/l and the values are within the permissible limit Nickel: The season wise average concentrations of nickel are shown in Table-3. It could be observed from the Table that two of the sources RW and TW have Ni in ground water are below detection level or <0.02mg/l in all seasons. Since the WHO maximum permissible limit of Ni for drinking water is 0.02mg/l, in the present study all the sources their values did exceed their limit. Zinc: The concentrations of Zinc in season wise are shown in Table-3. Since the maximum permissible limit for Zn in drinking water is 3mg/l, it is observed that all the sources have Zinc much below the limit. In the present study the maximum value of Zn was found in sources RW and TW.Adak *et al* (2001) have found Zn content in water of Rajgangpur in the range of 0.375 to 2.65mg/l with all the values less than the permissible limit. Nair *et al* (2005) also found Zn in water within the permissible limit in N.E.Libya. These results are in conformity with the result in the present work. The Zn concentrations of TW were comparatively higher than the other sources. This may be due to pipes and pumps used for the purpose. Chromium:

Table 2: Descriptive Statistics

The season wise chromium concentrations are listed in Table-3. The maximum permissible limit of Cr in drinking water is 0.05mg/l. In the present study, Cr was detected during the post monsoon and winter seasons. The sources RW and TW have Cr values which exceed the permissible limit.

Season/ Source	Tem. (^{0}C)	P^H	Cu	Zn	Ni	As	Cr	Season/ Source	Tem.	pH	Cu	Zn	Ni	As	Cr
A								E							
TW	25.4	6.6	.024	.435	.065	.014	.000	TW	24.8	6.5	.025	.425	.063	.015	.000
RW	25.7	6.8	.031	.268	.044	.025	.000	RW	25.3	6.7	.027	.256	.046	.027	.000
POND	26.4	7.5	.006	.223	.052	.003	.043	POND	24.4	7.2	.048	.232	.051	.004	.041
RIVER	25.1	7.2	.037	.056	.040	.000	.042	RIVER	22.6	7.1	.038	.056	.043	.000	.018
B								F							
TW	25.6	6.3	.024	.425	.065	.016	.000	TW	27.7	6.5	.022	.418	.064	.012	.000
RW	30.0	6.5	.032	.168	.046	.028	.000	RW	28.5	6.3	.032	.171	.044	.031	.000
POND	26.0	7.2	.043	.264	.055	.005	.037	POND	25.2	7.7	.042	.235	.051	.003	.037
RIVER	25.6	6.7	.038	.064	.047	.000	.013	RIVER	25.2	6.7	.037	.052	.047	.000	.012
C								G							
TW	26.0	7.2	.023	.404	.056	.014	.033	TW	26.4	7.2	.023	.405	.053	.008	.032
RW	27.3	6.7	.028	.165	.043	.023	.038	RW	27.9	6.9	.032	.167	.041	.027	.035
POND	24.2	6.8	.045	.262	.058	.004	.041	POND	24.8	6.7	.044	.262	.056	.003	.038
RIVER	24.6	6.6	.034	.043	.046	.000	.020	RIVER	25.1	6.4	.032	.067	.052	.000	.016
D								H							
TW	21.2	7.2	.021	.395	.054	.015	.022	TW	20.7	7.4	.022	.373	.054	.006	.024
RW	24.0	6.5	.023	.152	.043	.023	.018	RW	23.2	6.5	.024	.152	.042	.021	.015
POND	21.4	6.7	.042	.261	.056	.003	.042	POND	21.4	6.9	.042	.252	.056	.004	.042
RIVER	21.7	6.8	.027	.058	.037	.000	.017	RIVER	22.4	6.7	.025	.067	.043	.000	.017

Arsenic: The season wise As concentrations are listed in Table-3**.** Arsenic is generated from fossil fuel burning. Fertilizer plant's liquid effluent contains elemental arsenic. Its compounds had been used as insecticides and herbicides.. In the present study RW contains maximum amount of As in all seasons. As was not detected in two tube well , one RW, one Pond and in River.

Table-3: Seasons wise average value of different parameters.

	Temp	PH	Cu	Zn	Ni	Cr	As
Mean	23.8200	6.8000	.0288	.2732	.0505	.0179	.0154
Std. Error of Mean	.14301	.05429	.00322	.05813	.00510	.00240	.00416
Std. Deviation	.63957	.24279	.01442	.25996	.02280	.01074	.01861
Variance	.409	.059	.000	.068	.001	.000	.000
Range	2.70	.80	.05	.70	.11	.04	.06

The concentrations of Zn were found maximum in every season and every source (Figure1, Figure 3 and Figure 4). Chromium was not detected in TW and RW in Pre-monsoon (A and E) and monsoon season (B and F) (Fig 1 and Figure 3) but its concentration were found maximum in post monsoon season for RW only (Figure 3). The P^H values were fluctuated for every sampling point during my studies (Figure 2).

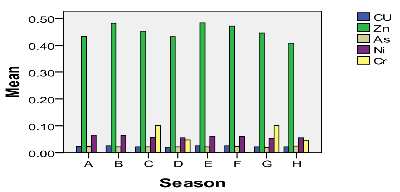

Figure-1 Season wise average values for TW

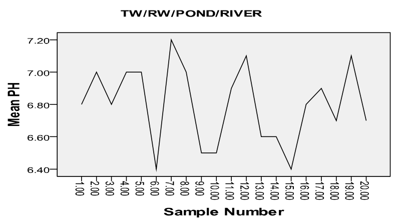

Figure-2 all season average values of pH

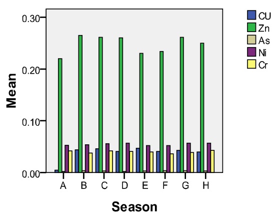

Figure. 3 Season wise average value for RW

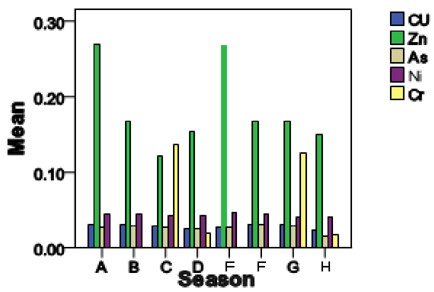

Figure 4 Season wise average value for Pond.

*Significant at α =0.4% level, r >0.245

Table-4: Correlation Matrix for the water quality Parameters

		Temp	P^H	Cu	Zn	Ni	Cr	As
Correlation	Temp	1.000	.085	-.106	-.245*	-.361	.400	-.350
	P^H		1.000	.051	-.132	-.030	.365	-.028
	Cu			1.000	.037	-.085	.368	-.045
	Zn				1.000	.073	-.150	-.132
	Ni					1.000	.002	.006
	Cr						1.000	-.422
	As							1.000

The significance of the observed correlation coefficients have been tested by using't-test'. Out of a total of 20 correlations between water quality parameters, 7 were found to have significant(r>0.245). The negative (inverse) correlations were found in 12 cases between Temp and Cu (r = -0.106), between Temp and Zn (r = -0.245), between Temp and Ni (r = -0.361), between Temp and As (r = -0.350), between P^H and Zn (r = -0.132), between P^H and Ni (r = -0.030), between P^H and AS (r = -0.028), between Cu and Ni (r = -0.085), between Cu and As (r = -0.045), between Zn and Cr (r = -0.150), between Zn and As (r = -0.132), between Cr and As (r = -0.442). There were no highly significant correlations between the parameters.

Conclusion

From above result and discussion it may be concluded that drinking water quality of Sonitpur district varies from site to site depending upon the geological and ecological condition. Since some of the sources contains maximum amount of Ni, Cr and As So, there is very chance of major problem of heavy metal contamination. In view of the safe drinking water of rural areas, the assessment and monitoring of water quality for physico-chemical and bacteriological parameters, heavy metals need to be under taken. People awareness regarding water disinfection, hygienic condition and prevention and remedial measures with respect to water quality and causes are of prime importance. In addition, water quality surveillance programs, infrastructure set up and public participation is the need of present day.

The values of correlation coefficients and their significance levels will help in selecting the proper treatment to minimize the contaminations of drinking water of Tezpur Sub-Division.

REFERENCES

Adak M D , K M Purohit, (2001). Status of surface and ground water quality of Mandiakudar-part-1;physico-chemical parameters. *Poll.Res*. 20(1): 103--110.

APHA (American Public Health Association), AWWA (American Water Works Association), and WEF (Water Environment Federation), 2005. *Standard methods for the examination of water and wastewater* (20th ed.). Washington DC, USA.

Bhagwan *et.al.,*(2004) Ground water analysis in industrial zone chikalthanna (Aurangabad) *Poll. Res*. 23(4), 649--653.

BIS, Bureau of Indian standards. Drinking water Specification IS: 10500,1993

Bodhaditya D, Umlong I M, Saikia L B, Borah K, Kalita H, Srivastava R B, 2008 . A study on the physico-chemical characteristics of ground and surface water of North and south district ofTripura , *proceedingof 53th Annual Technical Session of Assam Science Society* , vol-9

Dinesh kumar M, Shah T,2004 . *Ground Water pollution and contamination in India* , Indian Water Work Association, South Asia Regional Programme. India project office, Vallash Vidya Nager. 388, 120(online).

Djanagam M, Jeyamani . M, Ramesh Kumar M, 2009. Evaluation of ground water quality around the solid waste dumping site in Salem, *India Poll.Res*, 28 (3):415--418

Jamode A V, Sapkal V S, Jamode V S,. 2004 Uptake of Fluoride ions using leaf powder of Ficus religlius , *Journal of Indian Water Work Association*, 53--61.

Karunakaran K, Samson N A, Manjunathan S, Dorothy A, Raja M , Srividhya D, 2005. A study on the Physico-Chemical characteristics of groundwater in Salem corporation , *Indian journal of Environmental Protection*, 2516:510--51.

Khan, Naseem, Mathur, Asha and Mathur.R,2005,Astudy on drinking water quality in Lashkar(Gwalior).Indian J.Env.Prot.25(3)222—224.

Nair et al, 2005. Physico-chemical parameters and correlation coefficients of ground water of North-East Libya . *Poll.Res*. 24(1) :1--6.

Owal A A.F.S.A ,1981. Design of Iron Eliminator for Hand Tube well, *Journal of Indian water work Association.*1, 65.

Paderson E, Anderson.A,Hogeveit.G, 1978.Second study of the incidence and mortality of cancer of respiratory organs among workers at a Nickel refinery. Annals of clinical and laboratory Sci.8,503—510.

Prasad B.V , P. R Chandra , 1997. Ground water quality in an industrial zone. *Poll. Res* . 16(2):105--107.

Rathore J , Jain S, sharma S , Choudhary V , Sharma A, 2009. Ground water Quality Assessment at Pali, Rajasthan (India). *JESE* ,51(4):269--272.

Sengupta A, 1999. In workshop on *ground water pollution and protection*, Central Ground water Board, Science City, Calcutta, 69 .

Singh A K, 2004. Arsenic Contamination in Ground Water of North East India, proceeding of National seminar on *Hydrology with focal Theme on "Water quality*, Roorkee, nov 22--23.

Sinha D K, Srivastava A K , 1995. Physico-chemical characteristics of river Sai at Raeareli, *Indian journal of environmental Health*, 37(3):205--210.

Sushella A K A, 2001.*Treatise on fluorosis, fluorosis research and rural development foundation*, New-Delhi, 15.

Tyler Miller G. jr 1991. Environment Science : Sustainining the earth: Wordsworth, B element, California, p. 232 .

WHO, 2004, Guidance for Drinking Water Quality,3rd edition, Genava.

****