Research Article

Seasonal Distribution of Arsenic and Iron In Ground Water of Lower Subansiri District, Arunachal Pradesh

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ABSTRACT
The present research has been undertaken to present a statistically meaningful water quality database on iron and arsenic content of groundwater and their seasonal distributions if any in Lower Subansiri district of Arunachal Pradesh. For the present study, fifteen groundwater samples were collected from bore wells at different sites from each of the three blocks, namely Ziro-I, Ziro-II and Tamen-Raga of Lower Subansiri district during dry and wet seasons to assess the qualitative changes in metal concentrations. Arsenic was analysed by using Atomic Absorption Spectrometer (Perkin Elmer AA-Analyst 200) with Flow Injection Analyze Mercury Hydride Generation System (Model – FIAS-100). Iron in water sample is measured by Phenanthroline Method. Univariate statistics were used to test distribution normality for each metal. During the study, the concentrations of iron in some sampling sites are found to be slightly elevated as compared to WHO recommended levels in the study area. In the present investigation, the arsenic concentrations were found to be within the permissible limit of W.H.O. Statistical observations indicates that the distribution of arsenic and iron in the study area is asymmetric in both the dry and wet season.

Keywords: Groundwater, Seasonal variations, Arsenic, Iron.

INTRODUCTION

Water supplies in India are no longer unlimited and as such the study of groundwater contamination and its future management has received tremendous momentum in recent times. As most of the population of our country depends heavily on groundwater for drinking and other domestic uses, there is a need to monitor the groundwater sources for metal contamination in national as well as regional context. Arsenic in drinking-water is a hazard to human health. The research on arsenic contamination of groundwater received much attention just after 1990, when wide occurrence of arsenic was detected in well-water in Bangladesh. There have been a few review works covering the arsenic-contamination scenario around the world[1-3]. Arsenic contamination of water is also reported from North Eastern India. [4-8]. This study has been carried out at a local scale to monitor the groundwater arsenic distribution. Since there is no earlier information available for arsenic and iron content of groundwater in Lower Subansiri district of Arunachal Pradesh, the present research has been undertaken to present a statistically meaningful water quality database on iron and arsenic content of groundwater and their seasonal distributions if any in the study area.

STUDY AREA

The study area comprises the Lower Subansiri district of Arunachal Pradesh which lies within the 27.63^{o} N and 93.83^{o}E at an elevation of 1688 meters (5538 feet) to 2438 metres (8000 feet). The district headquarter is located at Ziro. The district occupies an area of 3,460 km^{2}. It is bounded on the north by the Upper Subansiri district of Arunachal, on the south by Papum Pare District of Arunachal Pradesh and Assam, on the east by West Siang and some part of Upper Subansiri, and on the west by East Kameng district of Arunachal Pradesh. There are 6 administrative circles in this district, namely, Ziro (Sadar), Yachuli, Pistana, Raga, Kamporijo and Dollungmukh.

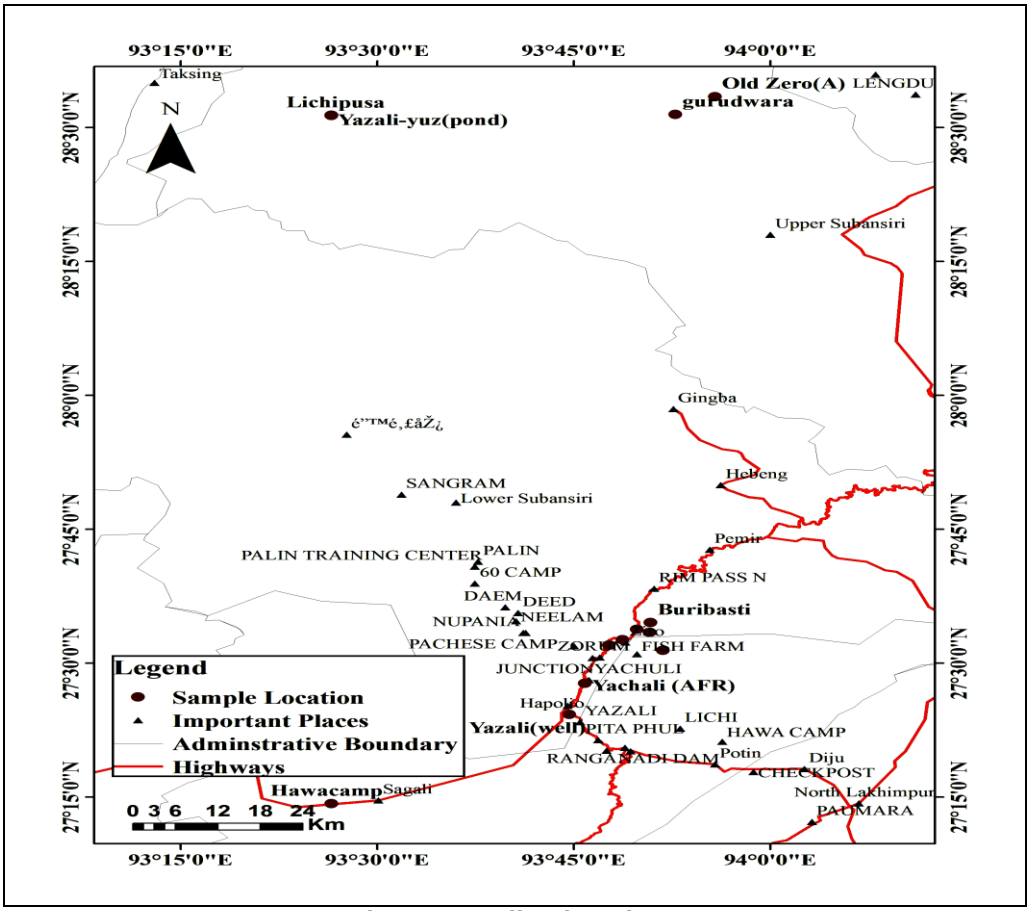

Fig. 1: Sampling locations

MATERIALS AND METHODOLOGY

For the present study, fifteen groundwater samples were collected from bore wells at different sites from each of the three blocks, namely Ziro-I, Ziro-II and Tamen-Raga of Lower Subansiri district during dry and wet seasons to assess the qualitative changes in metal concentrations. Samples were collected once in a week in both dry and wet seasons in April 2013 and December 2013. All possible safety measures were taken at every stage, starting from sample collection, storage, transportation and final analysis of the samples to avoid or minimize contamination. Samples were protected from direct sun light during transportation to the laboratory. pH was measured immediately after collection of the samples. Arsenic was analysed by using Atomic Absorption Spectrometer (Perkin Elmer AA- Analyst 200) with Flow Injection Analyze Mercury Hydride Generation System (Model – FIAS-100) as per the standard procedure[9]. Iron in water sample is measured by Phenanthroline Method[9]. The ferric form of iron is reduced to ferrous form and then 1,10 phenanthroline is added to form a soluble chelated complex of orange red colour which is measured colorimetrically at 510 nm.

Univariate statistics were used to test distribution normality for each metal. Simple correlation analysis was used to relate the metal concentrations among themselves. Moment coefficients of skewness and kurtosis were calculated to express how the shapes of sample frequency distribution curves differ from ideal Gaussian (normal). Details of these may be found in standard books on statistics and software packages[10].

RESULTS AND DISCUSSION

The experimental results are presented in **Table 1 and 2**. Descriptive statistics based on normal distribution has been summarized for both dry and wet season in **Table 3** and **Table 4** respectively. Correlation analyses were performed by Pearson's product moment correlation and are presented in **Tables 5 and 6.**

Table 1: Arsenic and Iron content of groundwater of Lower Subansiri district during dry season

Sl. No	Sampling station	pH	Fe In mg/L	As in mg/L
1	Hawacamp	7.2	0.29	0.0022
2	Lichi (well)	8	0.2	0.0012
3	Pusa (well)	8	0.33	0.0019
4	Yazali(yuz-p)	7.8	0.38	0.0017
5	Yazali(well)	7.7	0.2	0.0019
6	Yachuli (well)	7.6	0.3	0.0002
7	Yachuli (NR-well)	7.5	0.21	0.0018
8	Old zero(B)	7	0.25	0.0021
9	Hapoli-zero (well)	7.8	0.27	0.0018
10	Buribasti (well)	8	0.22	0.0011
11	Hung(tekhey) (well)	10	0.31	0.0014
12	Pamluk -raga(pond)	7.9	0.32	0.0015
13	Gurudwara hapoli	7.5	0.28	0.0008
14	Jaramtop (well)	8	0.29	0.0008
15	Old Zero (A)	7.5	0.11	0.0003

Table 2: Arsenic and Iron content of groundwater of Lower Subansiri district during wet season

Sl. No.	Sampling station	pH	Fe In mg/L	As in mg/L
1	Hawacamp	6.7	0.342	0.002
2	Lichi (well)	8.9	0.123	0.0022
3	Pusa (well)	8	0.297	0.0031
4	Yazali(yuz-p)	9	0.322	0.0011
5	Yazali(well)	8.8	0.212	0.0023
6	Yachuli (well)	7.8	0.111	0.0019
7	Yachuli (NR-well)	8.5	0.132	0.0021
8	Old zero(B)	8.2	0.234	0.0017
9	Hapoli-zero (well)	8	0.145	0.0031
10	Buribasti (well)	9	0.234	0.0016
11	Hung(tekhey) (well)	8.2	0.213	0.0011
12	Pamluk -raga(pond)	8.1	0.1	0.0018
13	Gurudwara hapoli	7.8	0.287	0.0004
14	Jaramtop (well)	7.4	0.116	0.0006
15	Old Zero (A)	8.7	0.099	0.0009

Table 3: Comparison of statistical data of different metals in dry season

Descriptives	pH	Fe	As
Mean	7.8	0.264	0.0014
Standard Deviation	0.67153	0.067061	0.000629
Standard Error	0.173388	0.017315	0.000162
Minimum	7	0.11	0.0002
First quartile	7.5	0.215	0.00095
Third quartile	8	0.315	0.0019
Maximum	10	0.38	0.0022
Range	3	0.27	0.002
Skewness	2.25378	-0.5429	-0.57329
Kurtosis	8.551963	3.123026	2.182858
Median	7.8	0.28	0.0015
Mode	8	0.2	0.0008
Inter quartile range	0.5	0.1	0.00095

Table 4: Comparison of statistical data of different metals in wet season

Descriptives	pH	Fe	As
Mean	8.2	0.199	0.0017
Standard Deviation	0.641946	0.085052	0.000863
Standard Error	0.16575	0.02196	0.000223
Minimum	6.7	0.1	0.0003
First quartile	7.9	0.1195	0.0011
Third quartile	8.85	0.292	0.00225
Maximum	9	0.342	0.0031
Range	2.3	0.242	0.0028
Skewness	-0.67423	0.33822	-0.04138
Kurtosis	3.086458	1.660954	2.253235
Median	8.2	0.212	0.0018
Mode	7.8	0.234	0.0011
Inter quartile range	0.95	0.1725	0.00115

Table 5: Pearson Correlation among different metals in dry season

	pH	Fe	As
pH	1	*	*
Fe	0.2474	1	*
As	-0.0947	0.2712	1

Table 6: Pearson Correlation among different metals in wet season

	pH	Fe	As
pH	1	*	*
Fe	-0.2118	1	*
As	-0.0342	0.2008	1

In the study area the values for pH were slightly towards alkaline side and variations for pH was found to be wide in both the dry and wet seasons.

The values of As were ranging from 0.0002 mg/L to 0.0022 mg/L in dry season and 0.0003 mg/L to 0.0031 mg/L in wet season. Most of the water samples in the present study meets or falls below the current WHO standard for arsenic, which is 0.05 ppm. Positive kurtosis and negative skewness value in both the season point towards sharp arsenic distribution with a long left tail from its median in the study area. Asymmetric distribution of arsenic in the study area is also evident from the quartile values as the width of the third quartile is significantly greater than the second quartile, which for a symmetric distribution should be equal.

Iron shows higher concentration during dry season. Positive kurtosis and skewness value for iron in wet season season is indicative of its sharp asymmetric distribution with a long right tail from its median. However in the dry season its distribution is sharp with a left tail from its median. With few exceptions as is seen from table 1 and 2, the iron content on groundwater is below the WHO guideline value of 0.3 mg/L.

Pearson's correlation analysis was carried out to study the correlation between arsenic, and iron with one another in both dry and wet seasons. It is seen that some of both arsenic and iron are positively correlated.

CONCLUSION

During the study, the concentrations of iron in some sampling sites are found to be slightly elevated as compared to WHO recommended levels in the study area. In the present investigation, the arsenic concentrations were found to be within the permissible limit of W.H.O. Statistical observations indicates that the distribution of arsenic and iron in the study area is asymmetric in both the dry and wet season. The present study only fulfills the limited purpose of strengthening the groundwater arsenic and iron database and is hoped that this study will encourage further work on monitoring in other sampling sites not covered in this study.

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