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HEAVY METALS IN THE WATER OF A DEVELOPING TOWN OF DHUBRI DISTRICT OF ASSAM, INDIA

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Abstract

Water is the most essential compound for living organism. Excess heavy metal causes health problems though some of them are essential in trace amounts. In this work, water samples were collected from 10 different locations of rapid developing Bilasiparatown. The water samples are then analyzed with standard methods for the determination of heavy metals namely As, Cr, Fe, Ni, and Pb. Arsenic concentrations of all the sample were within the WHO permissible limit (10µg/L). The average concentration of Cr, Fe, Ni, and Pb was found higher than the prescribed limit of WHO in most of the sources. The town is industrially underdeveloped, chemical contamination from industrial sources is insignificant, yet the water cannot be categorized as pollution free. Contaminated water is generally responsible for the spread, recurrence, and fatal consequences of various diseases.

Keywords: Heavy metal, contamination, pollution, health problem, standard methods.

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Introduction

Groundwater is an important source of water throughout the world and for many rural and small communities; it is the only source of drinking water. As water penetrates downward, it picks up minerals and chemicals from the soil and rock layers. Chemical elements naturally exist in the earth's crust. But human activities have increased these constituents in the environment, making it now somehow difficult to differentiate between natural and anthropic contributions [1]. Trace metal contamination which impacts ecosystems is man-made it may be industrial, agricultural, or urban development. Many studies have shown the heavy metal contamination of drinking water in different parts of the world [2-6]. A study for the seasonal variation of trace metals like Al, As, Cd and Pb, in the groundwater of Dhemaji district of Assam, India obtained higher concentration of the Metals [7]. Arsenic contamination in groundwater of several districts of Assam were reported by researchers [8, 9]. Although trace metals at low concentrations are essential to life, at high concentrations, may become hazardous. Consumption of polluted water directly from the sources may cause waterborne diseases like diarrhea, dysentery, typhoid and paratyphoid fever, hepatitis, gastroenteritis, liver and intestinal infection, skin rash, etc. Chemical contamination of drinking water may not cause immediate health problems, but their long-time intake.

Materials and methods

The Study Area

Bilasipara is a rapid growing town in Dhubri district of Assam, India (Fig 1). The population of the town is 37,410 as per population census 2011 of Govt. of India. The town is located at 26°14/0// N latitude and 90°14/0// E longitudes. The town and its surrounding areas are affected by flood every year. The town has a mild subtropical climate. Its principal characteristics are slightly cool and foggy winter, a moderately cool spring and a fairly hot and humid summer. The climate of the district may be divided into three periods. February to May (Pre-Monsoon): The weather is dry and moisture less and the heat is not oppressive during this season. Rain along with thunder storms are common feature during April to May. June to October (Monsoon): There is sufficient rainfall but the heat is oppressive till about

August. November to January (Post-monsoon): The Weather is cool and foggy. Real winter steps in December and lasts for about a month.

Selection of the sampling site

The main sources of drinking water of the people of the town are ring well and tube well. In this work an attempt has been made to detect the heavy metal present in the water of 10 of the most used shallow tube well (Table1).

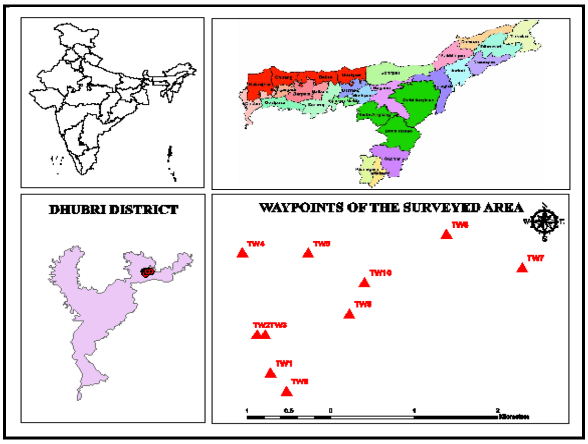

Fig 1. Map of study area

Collection of simples

Water samples for physical and chemical analysis were collected in pre-cleaned polyethylene containers and were brought to the laboratory immediately after collection.

Table 1. Locations of the sampling sites

Sample No.	Location name	Latitude (N)	Longitude (E)
TW1	Ward No. 1	26^{0}13/16.9//	90^{0}13/33.1 //
TW2	Ward No. 2	26^{0}13/33.4//	90^{0}13/27.1 //
TW3	Ward No. 3	26^{0}13/33.3//	90^{0}13/30.3 //
TW4	Ward No. 4	26^{0}14/07.7//	90^{0}13/19.7 //
TW5	Ward No. 5	26^{0}14/08.2//	90^{0}13/48.1 //
TW6	Ward No. 8	26^{0}14/16.9//	90^{0}14/47.8 //
TW7	Ward No. 10	26^{0}14/3.6//	90^{0}15/20.4 //
TW8	Ward No. 12	26^{0}13/43.4//	90^{0}14/06.9 //
TW9	Ward No. 14	26^{0}13/9.8//	90^{0}13/39.9 //
TW10	Ward No.7	26^{0}13/56.5//	90^{0}14/12.8 //

Standard methods were followed in collection; storage and analysis of water samples [10]. In this work, nitric acid digestion technique was used. For this, a volume of 100 mL of each acid-preserved, well-mixed water sample was taken in a beaker, 5 mL of conc. HNO_3 was added and the mixture was slowly evaporated on a hot plate in a fume-hood to a volume of 10 – 20 mL of clear solution. The beaker walls were washed with double-distilled water and the volume was made to 100 mL in a volumetric flask. The solution was then used in the analysis for the metals with AAS. The heavy metals As, Cr, Fe, Mn, Ni and Pb were measured in each water sample with atomic absorption spectrometer (Perkin-Elmer A Analyst 200 Atomic Absorption Spectrophotometer). Three-point calibration was done for each metal with certified AAS standards of 1000 mg/L (Merck, Germany).Arsenic was determined by hydride generation atomic absorption spectrometry (HGAAS) using Varian VGA-77 vapour generation assembly with ETC-60 temperature controller as a heat source to atomize the hydride generated with the reducing agent NaBH4 (Merck) and 8M HCl. Here Varian SpectrAA-220 Atomic Absorption Spectrophotometer was used. All the other metals were estimated in the air-acetylene flame.The data quality is checked by careful standardization, procedural blank measurements, and using spiked and duplicate samples.

Results and Discussion

The arsenic concentration of the water sample was within the range of BDL (below detectable level) to 0.01µg/L (Table 2).The arsenic content of all the sources was below the WHO permissible limit (10 µg/L) [11]. The results indicate that arsenic is not a problem in the study area till now. Prolonged arsenic exposure is detrimental to human health being associated with cancer of the skin, lung, liver, urinary bladder, and kidney and other diseases, including cardiovascular and peripheral vascular diseases, diabetes, peripheral neuropathies, portal fibrosis, and adverse birth outcomes [12-13].

Table 2. The concentration of heavy metals

Sample No.	As (µg/L)	Cr (mg/L)	Fe (mg/L)	Ni (mg/L)	Pb (mg/L)
TW1	BDL	0.347	0.700	0.049	0.170
TW2	BDL	0.346	0.450	0.049	0.130
TW3	BDL	0.303	0.300	0.048	0.100
TW4	BDL	0.276	1.440	0.148	0.110
TW5	BDL	0.273	0.270	0.058	0.220
TW6	0.010	0.280	0.940	0.050	0.070
TW7	BDL	0.260	0.870	0.053	0.110

TW8	0.005	0.240	0.570	0.062	0.140
TW9	BDL	0.240	0.500	0.060	0.170
TW10	BDL	0.250	0.270	0.067	0.190
Min	BDL	0.240	0.270	0.048	0.070
Max	0.010	0.347	1.440	0.148	0.220
Mean	BDL	0.282	0.630	0.064	0.141

The highest value of 0.347 mg/L chromium was observed in sample no.TW1 and the lowest value of 0.24 mg/L were obtained in samples no. 8 and 9. The chromium content of all the water samples was found higher than the WHO limit (0.05 mg/L). The station-wise variation of Cr is shown in Fig 2. The respiratory problems are prevalent among common people in the study area may be due to presence of Cr in water bodies. A study mentioned that gastrointestinal ulceration and perforation of the nasal septum and a number of other respiratory problems and skin effects have been reported to be caused by chromium (VI) [14].

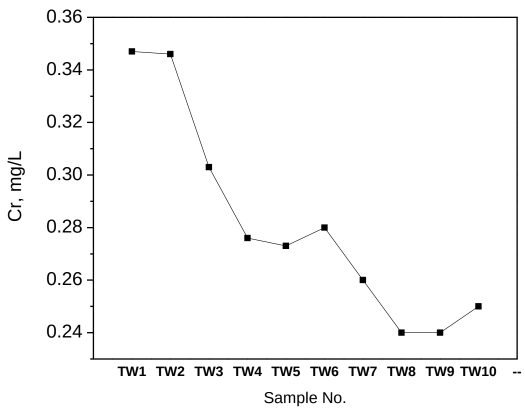

Fig 2. Station-wise variation of Cr.

The iron contents of the water samples were obtained in the range of 0.031 to 1.509 mg/L (Table 2). The concentration of iron exceeds the WHO guideline value of 0.3 mg/L in all the sampling stations except sample number TW9.Variations of iron in the sampling stations were obtained (Fig 3). Iron in excess of 0.3 mg/L is known to cause staining of clothes and utensils. Iron in higher concentrations may also cause vomiting.

The water from the study area had a mean Ni concentration in the range of 0.048 to 0.148 mg/L. The average Ni concentration of the water sources of the study area monitored in this work is higher than the WHO permissible limit (0.07 mg/L) and is a matter of concern. Allergic contact dermatitis is the most widely found effect of nickel in the general population [15].

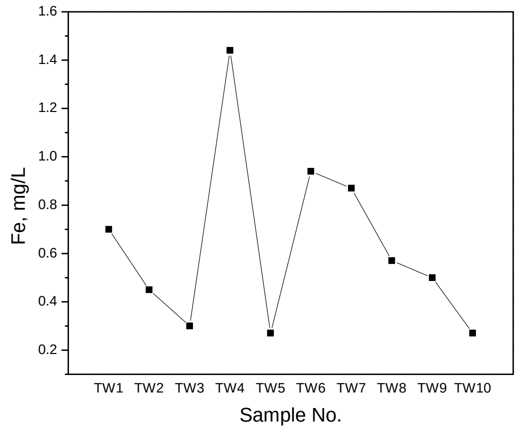

Fig 3. Station-wise variation of Fe

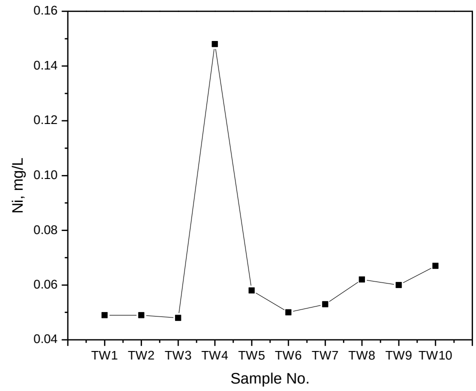

Fig 4. Station-wise variation of Ni

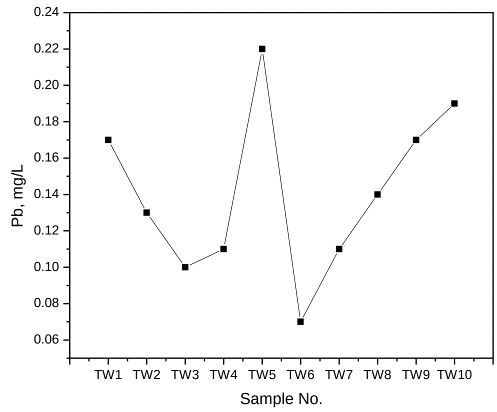

Fig 5. Station-wise variation of Pb

The concentrations of lead in the water samples were in the range of 0.07 mg/L to 0.22 mg/L. WHO has recommended 0.05 mg/L lead in drinking water. Thus, the concentration of lead in the present study area was observed higher than WHO permissible limit. Sample-wise variation of Pb was observed. Prolonged exposure to lead causes weight loss, constipation, and loss of teeth, and gums may show a blue line due to the deposition of colloidal lead phosphate [16].

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Funding

Nil

Conflict of Interest

Yes

Informed Consent

Yes

Ethical Statement

In this work, water samples were collected from 10 different locations in the study area and analyzed following the standard methods for the determination of heavy metals namely As, Cr, Fe, Ni, and Pb. The data were compared with WHO permissible limits. The work is jointly done by the two authors and not submitted to any other journal for publication.

Author Contribution

The work is done by the two authors namely Basanta Kumar Das and Ebrahim Ali. The contribution is equal.

Conclusion

From the analysis, it was found that the excess concentration of Cr, Fe, Ni, and Pb in all the sampling sites is the cause of undesirable quality for drinking purposes. Although the possible source of origin of the heavy metals has been ascertained to be geogenic in nature the possibility of anthropogenic sources cannot be ignored. Besides the presence of Cr, Ni, and Pb at an alarmingly higher concentration in almost all the samples than the prescribed WHO limits require immediate attention. The detection of these toxic metals in the drinking water samples is a cause of concern to the health of people, especially in those cases where the water is consumed usually without any form of treatment.

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