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ASSESMENT OF HEAVY METAL IN DRINKING WATER: A CASE STUDY IN THE MUNICIPALITY AREA OF LAKHIMPUR DISTRICT OF ASSAM, INDIA

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ABSTRACT

The present study was carried out to determine water quality parameter such as pH, and the presence of heavy metals such as As, F, Fe, Hg and Pb. Total 42 samples of drinking water were collected from different sources such as tube well, tap water, ring well etc. of Lakhimpur municipality area of Lakhimpur district in the month of October 2022. This study aims at detecting the possibilities of ground water quality deteriorations due to improper solid waste dumping with special reference to heavy metal pollution. From the data collected in this study, it is seen that except Fe, the other heavy metals are present within the permissible limit. Some preventive measures which are to be adopted to control the contamination of excess Fe present in the ground water around this region are also.

KEY WORDS : Ground water, Heavy metals pollution, Contamination.

INTRODUCTION

Contamination of water bodies by heavy metals leads to severe water pollution and is a serious environmental concern as hundreds of millions of people are affected around the world. Below natural and man-made sources are responsible for such contamination. Some heavy metals play an important rules in human body because they are involved in a variety of major functions, enzyme activities, receptor sites, normal functions and protein transports at specific concentrations. There are also several acute and chronic toxic effects of heavy metals on human health and exposure to this metals has been increasing by industrial and anthropogenic activities and modern industrialization.

Ground water is the principal source of drinking water for all human beings. The quality of ground water is important for agriculture, industry, domestic purpose, etc. Agricultural activities and domestic release of large number of pollutants into the water bodies are some of the principal causes of water pollution. In India, ponds, rivers and ground water are used for the domestic and agriculture purposes (Pramod *et al.*, 2011). The major sources of water are rain water, surface water involving rivers, lakes and ground water such as ring well, tube wells, ponds, deep tube wells etc. The growth of industry, technology, increasing number of medical facilities, restaurant-hotels, and the increasing human population has increased the stress upon both our land and water resources. Locally, the quality of ground water has been degraded. Industrial waste, chemical fertilizers, municipal waste, pesticides and herbicides have entered the soil and degraded the ground water quality.

The source for ground water supply depends upon rainfall and percolation of water into the earth. Heavy metals play a vital role in normal function of human body. Imbalance of heavy elements will disturb the normal functioning of human beings (Adepoju-Bello and Alab, 2005). Natural and man-made sources are the main cause of increase in the presence of heavy metals in water system (Musa, *et al.*, 2013). The major anthropogenic sources of heavy metals are domestic waste water, municipal garbage etc. Some heavy metals are toxic and tend to

accumulate. Such metals are commonly referred to as trace metals. Many of these trace metals are highly toxic to humans such as Hg, Pb, As, F and Fe. The presence of heavy elements in surface and underground water at above background concentration is undesirable (Josephine Sharmila and Rajeswari, 2015).

Heavy metals are hazardous due of their toxicity, as well as tendency, to accumulate in organisms thereby increasing its concentration in the growing food chain. Moreover they are non-degradable. Heavy metals damage the cardiovascular system, gastrointestinal tract and CNS of humans and also harm the endrocrine glands, kidneys, liver, lungs and bones. It is not possible to fully avoid contact to toxic metals. People who are not occupationally exposed to heavy metals also gain exposure to these toxic heavy metals from sources such as food, beverage, air, and water (Josephine Sharmila and Rajeswari, 2015). Metals from dietary intake and environmental exposure eventually reach their target various organs such as kidney, liver, heart and brain. The fate these metals inside the body is determined by its ability to modify the metabolic system. Excess intake in our body are excreted through urine and faeces or accumulated in various tissues. Higher concentration of heavy metals are toxic to human (USGAO, 2000). Heavy metal can cause major health problems (Pramod *et al.*, 2011). According to a report by UNICEF about 1 million of children die of diarrhea due to contaminated drinking water and unhygienic living condition (Vodela *et al.*, 2001). The present study deals with assessment of the presence of heavy metals in the Municipality area of Lakhimpur district and its toxic effect on human health.

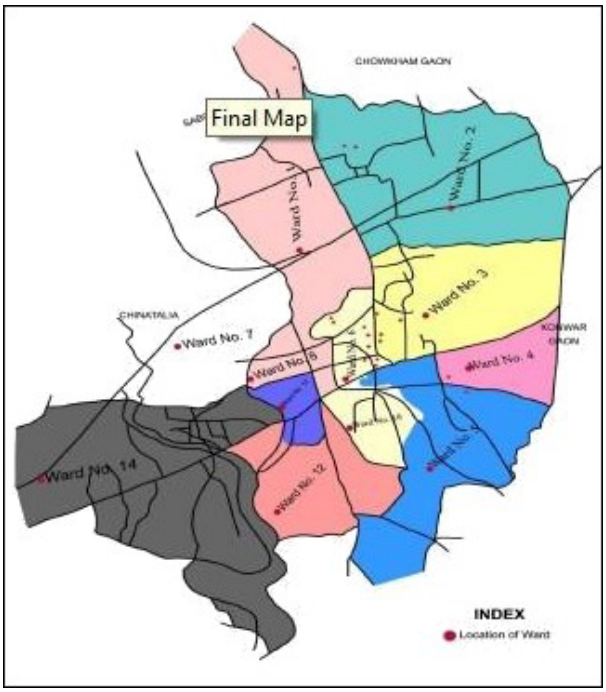
MATERIALS AND METHODS

Study area

Lakhimpur district is situated in the North-East part of Assam. The district Head Quarter of Lakhimpur is North Lakhimpur. It is also a Municipal Board in the district of Lakhimpur. North Lakhimpur consists of total 14 wards, with a population of 59,814 of which 30,847 are males and 28,967 are females as per report by Census India 2011. Municipal Board has total administration over 13,993 houses. North Lakhimpur is about 394 kilometers from Guwahati. It has a total area of 14 Km (13·74 Km) and Latitude 27016' 03 N and 94007 22" E as Longitude. The map of North Lakhimpur town is shown below.

Water samples were collected from tube well, ring well and tap water of the study area and parameters were investigated to what extent heavy metals have polluted groundwater, within and around the study area.

Map of municipality area of North Lakhimpur district



Sample Collection

The samples were collected in 1 l sterilized plastic cans from 42 selected areas of Lakhimpur town from different sources such as ring well, tube well and tap waters.

The pH of water is measured with digital pH meter. Water samples were collected during monsoon period from the month of October to December 2022. The exact sampling locations are given in Table 1.

METHODS

Water samples have been collected during the monsoon at different locations of municipality area of Lakhimpur town. Parameters such as Arsenic (As), Fluoride (F), Iron (Fe), Lead (Pb) and Mercury (Hg) were estimated in the laboratory using standard procedure by APHA (1998).

RESULTS AND DISCUSSION

The analysis of heavy metals in water samples are

given in Table 1. pH of the samples were measured on spot. The five other parameters, that is the presence of Arsenic, Fluoride, Iron, Lead and Mercury were analyzed in the laboratory and viewed against the standards as prescribed by the world Health Organization (WHO).

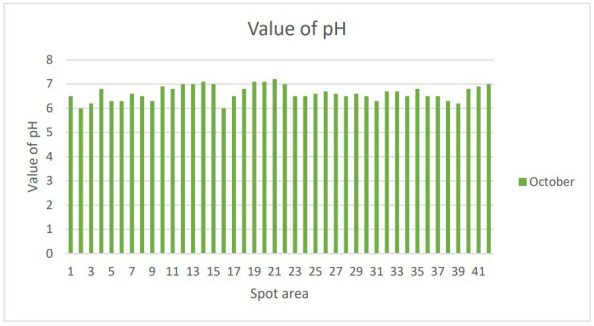
pH

pH value of water is a measure of the hydrogen ion concentration in water. It indicates whether the water is acidic or alkaline (Shah and Patel, 2011).

Most of the biological and chemical reactions are influenced by the pH of water system. In the present study, all the ground water samples were found to have pH value from 6.0 to 7.2. According to world Health organization the permissible limit of pH is 7.0-8.5. Thus, all the sampling locations were found to have pH within the permissible limit set by WHO (Shah and Patel, 2011).

Table 1. Value of parameters (mg/l)

Spot area	pH	Fluoride	Iron	Arsenic	Lead	Mercury
1	6.5	0.51	0.36	0	0.0726	0.00066
2	6	0.35	0.18	0	0.1283	0.00058
3	6.2	0.26	0.12	0	0.0701	0.00015
4	6.8	0.34	0.16	0	0.0631	0.000009
5	6.3	0.51	0.14	0	0.2514	0.00006
6	6.3	0.35	0.13	0	0.0685	0.0005
7	6.6	0.27	0.18	0	0.0653	0.000006
8	6.5	0.09	0.12	0	0.0653	0.00001
9	6.3	0.12	0.47	0	0.1174	0.00006
10	6.9	0.2	0.04	0	0.0688	0.00002
11	6.8	0.29	0.09	0	0.0838	0.00002
12	7	0.25	0.38	0	0.0841	0.000003
13	7	0.56	0.28	0	0.0823	0.000012
14	7.1	0.34	0.19	0	0.1217	0.000007
15	7	0.38	0.22	0	0.0823	0.00003
16	6	0.28	0.16	0	0.1229	0.00002
17	6.5	0.49	0.11	0	0.1238	0.00002
18	6.8	0.5	0.2	0	0.1253	0.00003
19	7.1	0.39	0.16	0	0.0855	0.00003
20	7.1	0.18	0.18	0	0.1295	0.00002
21	7.2	0.29	0.26	0	0.0858	0.00001
22	7	0.34	0.11	0	0.1319	0.000006
23	6.5	0.62	0.53	0	0.1311	0.00002
24	6.5	0.44	0.09	0	0.0391	0.000002
25	6.6	0.42	0.39	0	0.1357	0.000006
26	6.7	0.34	0.11	0	0.1419	0.00008
27	6.6	0.43	0.19	0	0.1504	0.00001
28	6.5	0.51	0.15	0	0.0401	0.00001
29	6.6	0.19	0.22	0	0.1458	0.000001
30	6.5	0.26	0.31	0	0.0457	0.00007
31	6.3	0.11	0.09	0	0.0529	0.00008
32	6.7	0.26	0.11	0	0.0657	0.00006
33	6.7	0.05	0.12	0	0.0522	0.00008
34	6.5	0.08	0.19	0	0.06923	0.00008
35	6.8	0.16	0.22	0	0.0765	0.00008
36	6.5	0.39	0.5	0	0.0926	0.00008
37	6.5	0.22	0.18	0	0.0886	0.00003
38	6.3	0.29	0.15	0	0.0906	0.00001
39	6.2	0.18	0.39	0	0.0978	0.00001
40	6.8	0.29	0.24	0	0.095	0.00002
41	6.9	0.32	0.52	0	0.0995	0.00002
42	7	0.31	0.18	0	0.1083	0.00002



Heavy metals in water and its effect on human health

Arsenic (As)

AS_2O_3 is more toxic than AS_2O_5. As toxicity (greater than 25 ml) creates vomiting, diarrhea, nausea, severe, irritation of nose and throat, abdominal pain and skin eruptions (Kudesia, 2002).

Arsenic is one of the most significant heavy metals affecting both nature and human health. Arsenic is apparently toxic and carcinogenic. Arsenic toxicity in human arises mainly due to consumption of contaminated food or drinking water solutions (Sirajudean and Jameel Abdul, 2006).

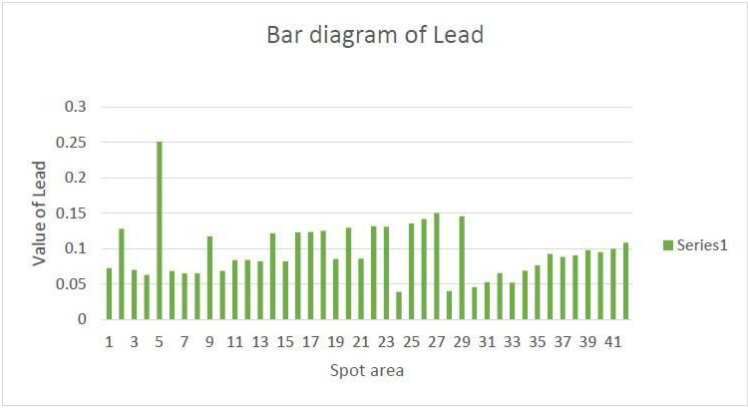
Arsenic accumulation in human leads to hypertension and also impacts the cardiovascular system as well as the kidney (Kudesia, 2002). From the analysis of our samples, the value of Arsenic was found to be 0.00 mg/l which falls below the maximum permissible limit of 0.01 mg/l, set by WHO.

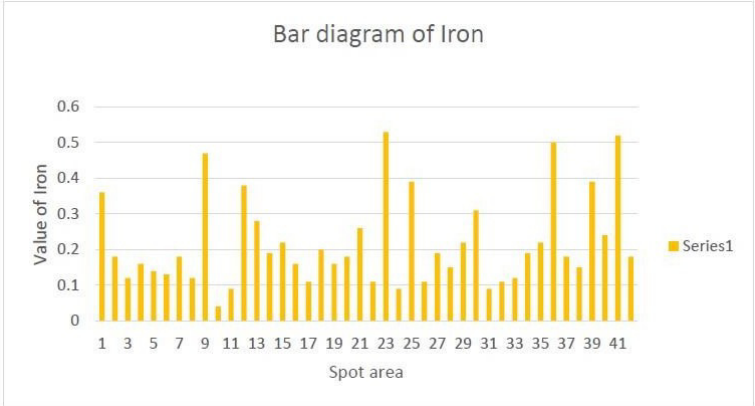
Lead (Pb)

Pb is deposited mostly in bone and some soft tissues. About 800 mg Pb creates toxicity in human beings. The toxicity sympotoms are mild Anemia, Brain damage, vomiting, Loss of appetite, uncoordinated body moment and producing coma and death when Pb is greater than 500 mg. Pb toxicity is duo to concentration of diffusible Pb is soft tissues and formation of metallothioneins (Kudesia, 2002).

Results reveal the concentration of Lead in all the study area to be in the range from 0.0391 mg/l to 0.2514 mg/l which is below the limit set by WHO (0.4 mg/l).

Lead is a very toxic element, which accumulates in the skeletal structure of animals and human beings. It is injurious even in minor quantities. Lead may enter the human body through water and food. Lead is present in paints and petroleum products. In





minor quantities lead is also present in several water bodies and in old iron household water pipes. Extreme level of lead absorptions in the human body can cause death or harm to the brain, central nervous system and kidneys (Kathandaraman and Swaminathan Greetha, 1997). Major lead toxicity affects the brain and lead to psychological and neurological disorders, and probably Alzheimers disease, parkinsons disease and schizophrenia (Saint, 1995).

Iron (Fe)

Fe (more than 10 mg per kg level) causes rapid increase in respiration, pulse rates, congestion of blood vessels, hypertension and drowsiness (Kudesia, 2002).

Iron is one of the most abundant metals in the earth's crust. The values obtained for Iron in our study areas ranges from 0.04 mg/l to 0.53 mg/l which is far below the desirable limits set by the World Health organization (1.0mg/l – 3.0 mg/ml).

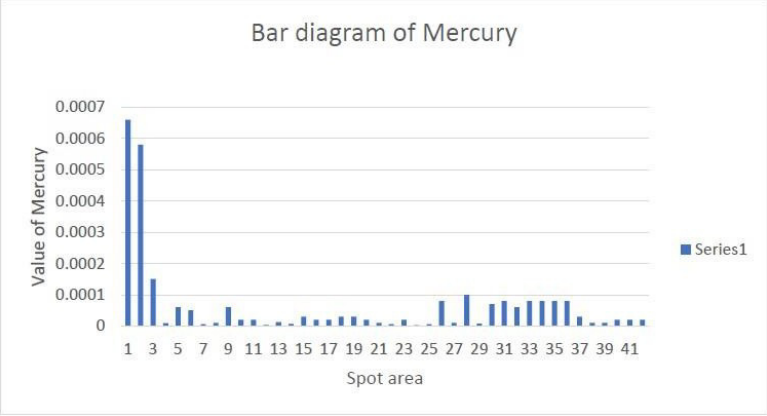
Iron is important for human health. If the level of iron in water exceeds the level of 0.3 mg/l the taste and colour of water changes. Such water stains clothes and damages household appliances. Surface water is generally found to contain 1 mg/l of Fe. Some ground water contains much higher level of Fe. Water containing Fe>2mg/l, causes staining of clothes. Fe deficiency in human leads to anemia. The daily iron requirement is 1-2 mg with dietary ranges of 7-25 mg/day with an average of 16 mg/day (APHA, 1998).

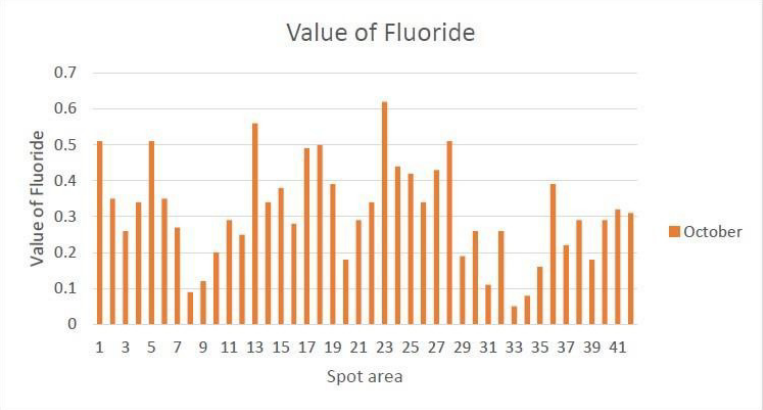
Mercury (Hg)

Hg toxicity is a worldwide problem as Hg and its salt are industrial health hazards. Hg is found in water due to disposal of industrial Hg waste (Kudesia, 2002)

Mercury concentration levels were found to be in the range between 0.000002 mg/l to 0.00066 mg/l which is far below the desirable limit set by WHO (0.001 mg/l).

Mercury toxicity is a major problem. Higher level of mercury is toxic to the kidney and central nervous system. Moreover excess level of mercury is also a major source of environmental contamination. Fatal dose for human varies between 3-30 g (Marcovecchio *et al.*, 2007). Hg causes hyper coagulability in blood. Excessive Hg leads to its retention in renal tissue and causes death. Mercury has been partially present in fetuses of women suffering from Minamata disease (Lee *et al.*, 2003).





Hg has been found in water due to disposal of industrial mercury waste. More than 100 mg of mercury may cause headache, abdominal pain, diarrhea, hemolytic, digital and tremors (Sarkar *et al*., 2003).

Fluoride (F)

Fluoride concentration in our study samples is found to be in the range from 0.09 mg/l – 0.62 mg/l. According to the standard permissible limit of Fluoride in water set by WHO Fluoride concentration should be between 1-1.5 mg/l (Marcovecchio *et al.,* 2007).

Fluorine exists in the form of Calcium and Aluminum fluorides in the Earth's crust. Fluorides are used in the manufacture of tiles, bricks, pottery, glass etc. Pollution from aluminum smelters and fertilizer run off is also possible. Overdose of Fluorides causes molting of enamels and bones which is known as fluorosis. It is characterized by hyper mineralization of the skeleton, calcification of ligaments and painful joints. High doses can cause respiratory failure and paralysis. A small amount of fluoride is however recommended in the drinking water to prevent carries.

CONCLUSION

From our present study it has been seen that water quality parameters are well within the permissible limit. Slight deviation was observed in iron content in tubewell water samples due to the absence of general filtration technique. All other parameters such as pH, As, F, Fe, Hg and Pb values are also within the permissible limit which indicates the presence of very lower levels of contaminants in the water levels of the North Lakhimpur municipality area Ground water quality should be periodically monitored to prevent further contamination.

REFERENCES

Adepoju-Bello, A.A. and Alab, I.O.M. 2005. Heavy metals: A review. *The Nig. J. Pharm.* 37: 41-45.

APHA, *Standard Methods for the Examination of Water and Wastewater,* 1998. American Public Health Association/American water works association / water environment Federation, Washington DC, 20th edn.

Josephine Sharmila, R. and Rajeswari, R. 2015. A study on physico-chemical characteristics of selected ground water samples of Chennai city, Tamil Nadu, International journal of Innovative. *Research in Science, Engineering Technology*. 4(1): 95-100.

Kudesia, V.P. 2002. *Water Pollution*. Pragate Prakashan, Meereet, and ed· pg:331-335.

Kathandaraman, H. and Swaminathan Greetha, 1997. Principles of Environmental chemistry; B.I. Publicatio. 13BN 81-7225-124-G; pg 249.

Kumar, R., Tripathi, R.M. and Gupta, A.K. 2014. Seasonal variation of heavy metal concentration in water of River yamuna, Allahabad, Uttar pradesh, India. *Int J curr Microbial App. Sci.* 3 (7) : 45-949.

Lee, M.Y., Jring, B.T. Chung, S.M., Bae, O.N. and Lee, J.Y. 2003. Arsenic induced -dysfunction in relaxation of blood Vessels. *Environ. Htealth Perspect*. 111 (4) : 513-517.

Marcovecchio, J.E., Botte, S.E. and Freije, R.I.I. 2007. Heavy Metals, Major Metals, trace. Clements. In: Noilet LM (Ed), *Hand Book of Water Analysis* (2nd edn), CRE Press, London, pg-215-231.

Musa, O.K., Shaibu, M.M., Kudamnya and Agayena Ebenzar, 2013. Heavy metal concentration in ground water around Obajana and its environs, Kogi state North Central Nigeria. *American International Pournal of Contemporary Research.* 3(8): 170-177.

Maite, S.K. 2001. *Hand Book of Methods in Environmental Studies*. ABD Publisher, Jaipur (India Vol) 1, 2001. ISBN-81-8577-34-0. pp. 185-189.

Mohamed Hanipha, M. and Zahir Hussain, 2013. A study of ground water. quality at Dindigul town, Tamilnadu, India. *Int. Res. J Environmental Sci.* 2(I): 68-73.

Pramod N. Kamble and Viswas, B. Gaikwad and Shashikant R. Kuchekart. 2011. *Der Chemica Simica*. 2(4): 229-234.

Shah, D.G. and Patel, P.S. 2011. *Der Chemica Sinica.* 2(5): 8-11.

Sirajudean, I.I. and Jameel Abdul, 2006. *J. Ecotonical, Environ Monit.* 16(5) : 443-446.

Saint, M. 1995. UNICEF, Emerging Fresh water crises in India, water sanitation and Environment. Section, 3. United Nations Playa, TA -2.6A, New York, 10017.

Sarkar, M., Chaudhuri, R., Chattopadhyay, A. and Biswas, N.M. 2003. Effect of sodium arsenite in spermatogenesis, plasma gonadotrophins and testosterone in rate. *Asian J Androl.* 5(1): 27-31.

Sanders, T., Liu, Y. Buchner, V. and Ichounnou, P.B. 2009. Neurotoxic effects. and biomarker's of lead exposure: a review. *Rev. Environ. Health.* 24(1) : 15-45.

USGAO, 2000. Health Effect of lead in. drinking water U.S. General accounting office reports.

Vodela, J.K., Render, Lenz, S.D. Mehel, Henney Wit and Kemppainen, B.N. 2001. Drinking water contaminants. *Poult Sci.* 76: 1474-1492.

Yoshida, T., Yamauchi, H. and Fan Sun 2004. Chronic health effects in people exposed to Arsenic.