Journal of Chemical Health Risks

www.jchr.org

JCHR (2025) 15(5), 1292-1297 | ISSN:2251-6727

Assessment of Physical and Chemical Quality of Drinking Water in Urban and Rural Areas of a District in Lower Assam

Ahmed M[1], Mohan RS[2], Deka AJ[3], Bordoloi K[4]

1. Dr Mustaque Ahmed, MD, Associate professor, Community Medicine, FAAMCH, Barpeta, Assam.
2. Dr Roopshekhar Mohan, MD, DCH, Associate professor, Community Medicine, DMCH, Dhubri, Assam.
3. Dr Ashok Jyoti Deka, MD, Associate professor, Community Medicine, NMCH, Nalbari, Assam
4. Dr Krishangee Bordoloi, MD, Associate Professor, Pathology, NMCH, Nalbari Assam

(Received: 16 July 2025 Revised: 20 August 2025 Accepted: 20 September 2025)

KEYWORDS

Water quality, arsenic, iron, Assam, rural, urban, drinking water

ABSTRACT:

Background: Access to safe drinking water remains a critical public health issue in India. Chemical contaminants, particularly arsenic and iron, are prominent threats in Assam.

Objective: To assess physical and chemical quality of drinking water in selected rural and urban households of Barpeta district, Assam.

Methods: A cross-sectional community-based study was conducted (Dec 2023 – Feb 2024). Fifty water samples were obtained (25 rural, 25 urban) and analysed in a NABL-accredited laboratory for physical parameters (pH, turbidity, colour, odour, TDS, hardness) and chemical contaminants (iron, arsenic, fluoride, chloride, nitrate, sulphate). Data were analysed using SPSS v21.

Results: Tube wells were the main water source in both rural (64%) and urban (72%) areas. Urban households more frequently used filtration methods (92%), compared to rural households (84%). Physically, most samples met standards. Chemically, arsenic exceeded WHO limits (>0.01 mg/L) in 36% of urban and 32% of rural samples. Iron levels were high in 60% of urban and 52% of rural samples. Though Fluoride content remained low in majority, the chloride, nitrate, and sulphate remained within limits. Hardness was higher in urban water samples.

Conclusion: Drinking water in Barpeta district is generally safe in terms of physical quality but fails in chemical safety due to arsenic and iron contamination. Regular monitoring, community education, and government interventions are urgently needed.

1. Introduction

Water is a necessity for human survival and access to safe drinking water is a required cornerstone of public health. In concert with improved pasteurisation and refrigeration of foods and childhood immunizations, modernised sanitation methods and access to potable water have increased the lifespan and improved the general health of Indian citizens to a great extent. However, safe drinking status for all is yet to be achieved throughout the country. People are still dependent on unprotected water sources such as rivers, streams, springs and hand dug wells. Safe drinking water is a basic need for good health, and it is also a basic right of humans. Drinking water quality is a relative term that relates the composition of water with effects of natural processes and human activities. An estimated 80% of all diseases and over one third of deaths in developing countries are caused by the consumption of contaminated water and on an average as much as one tenth of each person's productive time is sacrificed to water related diseases.

The quality of water is affected by an increase in anthropogenic activities and any pollution either physical or chemical causes changes to the quality of the receiving water body. Chemical contaminants occur in drinking water throughout the world which could possibly threaten human health.

Diseases related to contamination of drinking-water constitute a major burden on human health. Interventions to improve the quality of drinking-water provide significant benefits to health. Every effort should be

Journal of Chemical Health Risks
www.jchr.org
JCHR (2025) 15(5), 1292-1297 | ISSN:2251-6727

made to achieve a drinking-water quality as safe as practicable.

In Asia, the maximum arsenic contamination is found in India and Bangladesh[1]. Arsenic is responsible for various neurological, reproductive, cardiovascular immunological disease, endocrine effect, skin cancer etc [2]

The present study, was conducted in few urban and rural pockets of Barpeta district situated in lower part of Assam. This district is one of the arsenic affected districts of Assam. A study[3] conducted in Barpeta district found that groundwater samples are contaminated with high amount of arsenic and ground water was moderately hard with high amount of iron. Only few such studies were previously done in this region to assess drinking water quality. The current study was done to assess drinking water quality parameters (pH, hardness, turbidity, colour, iron, chloride, fluoride, arsenic etc.) in urban and rural areas of Barpeta district.

2. Objectives

- To assess the physical and chemical quality of drinking water from urban and rural households in Barpeta, Assam, using standard parameters and to compare values with national/international drinking-water standards
- To identify the main sources of drinking water (tube well, piped supply, wells, etc.) used by households in urban and rural areas and examine their association with water quality.
- To provide evidence-based recommendations for improving household drinking-water safety in urban and rural settings.

3. Methods

Approval of Ethics Committee: The study was approved by the Institutional Ethics Committee of Fakhruddin Ali Ahmed Medical College (FAAMC),Barpeta on 21/11/2023.

Type of study: It is a community based cross-sectional study.

Duration of study: The study was conducted between December 2023 and February 2024.

Sampling size and Study area: Water samples were collected randomly from 25 urban households and 25 rural households in catchment areas of Urban Health Training Centre (UHTC) & Rural Health Training Centre (RHTC) under department of Community Medicine, FAAMCH, Barpeta, Assam.

Study Method:

The study was conducted in catchment areas of Urban Health Training Centre and Rural Health Training Centre, FAAMCH. Prior to sample collection, consent was taken from the respondents. We used pre tested pre designed questionnaires for collection of data. Two field workers trained in collecting water samples accompanied the study team for water sample collection. Two water samples from each selected household were collected in sterile containers with capacity of 500 ml each and samples were transported to Public Health Laboratory (NABL accredited), Barpeta in vaccine carriers with ice-packs.

Parameters analyzed:

Water quality was assessed in terms of colour, odour, turbidity, pH, total dissolved solids (TDS), total hardness, iron, arsenic, fluoride, chloride, nitrate and sulphate by standard methods.

Data analysis:

Microsoft Excel (2019) and SPSS 21.0 software packages were used for data entry and analysis.

4. Results

A total of 50 households were selected for the study.

Table 1 shows the socioeconomic status of families that participated in the study based on BG Prasad's Classification which was modified for January 2024. Most of the respondents of urban areas belonged to upper middle and middle classes (72%) whereas most of the respondents of rural areas were in middle and lower middle classes (64%).

Table 2 shows the sources of drinking water and methods of water purification by the families. Most of the respondents depend upon tube well & piped water supply for drinking water. Majority of urban families (92 %) use candle filter or RO for disinfection of drinking water whereas in rural areas 64% use candle filter for water purification and 16 % drink water without purification.

Table 3 shows physical quality parameters of drinking water in urban and rural areas. All water samples were free from colour. All water samples had normal taste and odour. Only one water sample from rural area had high turbidity.

Journal of Chemical Health Risks

www.jchr.org

JCHR (2025) 15(5), 1292-1297 | ISSN:2251-6727

Table 4 shows chemical quality parameters of drinking water in urban and rural areas. Except in 2(8%) water samples in rural areas, all had normal pH. Total dissolved solids (TDS) were found exceeding the normal range in 16 % and 8 % samples in urban and rural areas respectively. Hard water was found more in urban areas (72 %) than rural areas (52 %). Iron was found in high concentration (>0.3 mg/l) in more than 50 % of the water samples collected from the district. More than 30 % households consume water with high arsenic in both urban and rural areas. More than 60% water samples had low fluoride level in both urban and rural areas. All the samples had normal nitrate, sulphate, and chloride.

Table 1: Per capita income of the families (based on revised BG Prasad Socio-economic Status Classification, January, 2024)

Socio-economic classes	**Per capita Income (INR)**	**Urban**	**Rural**
Upper	>8220	4(16 %)	2(8%)
Upper middle	4110-8119	9(36 %)	4(16 %)
Middle	2465-4109	9(36 %)	8(32%)
Lower middle	1230-2464	1(4 %)	8 (32 %)
Lower	<1230	2(8%)	3(12%)

Table 2: Sources of drinking water and methods of water purification

	Variable	**Urban**	**Rural**
Sources of drinking water	Tube well	18(72%)	16(64%)
	Piped water supply	6(25%)	5(20%)
	Wells	2(3%)	4(16%)
Methods of water purification	Candle filter	14(56%)	16(64%)
	Boiling	2(8%)	3(12%)
	Reverse Osmosis	9(36%)	2(8%)
	Consume without purification	0	4(16%)

Table 3: Physical quality of drinking water

Parameters	**Variable**	**Urban**	**Rural**
Colour, taste & odour	Normal	25(100)	25(100%)
	Abnormal	0	0
Turbidity	Desirable (O-1 NTU)	25(100)	23(92 %)
	Maximum permissible limit (1-5 NTU)	0	1 (4 %)
	Exceeding maximum permissible limit (>5 NTU)	0	1(4 %)

Journal of Chemical Health Risks
www.jchr.org
JCHR (2025) 15(5), 1292-1297 | ISSN:2251-6727

Table 4: Chemical quality of drinking water

Parameters	**Value**	**Urban**	**Rural**
	Normal (6.5-8.5)	25	23 (92%)
pH	<6.5	0	2(8 %)
	Normal (<500mg/l)	21(84%)	23 (92%)
TDS	High (>500 mg/l)	4(16 %)	2(8 %)
Total hardness	Normal (50-200mg/l)	7 (28 %)	16 (64%)
	High (>200 mg/l)	18(72%)	9 (36%)
Iron	Normal (≤0.3 mg/l)	10(40 %)	12(48%)
	High (>0.3 mg/l)	15(60 %)	13(52%)
Arsenic	Normal(0.001-0.01 mg/l)	16 (64 %)	17 (68%)
	High (>0.01 mg/l)	9 (36%)	8(32%)
	Normal (0.5-0.8 mg/l)	7(28%)	9(36%)
Fluoride	Low (<0.5 mg/l)	18(72%)	16(64%)
Nitrate	Normal (<45 mg/l)	25(100%)	25(100%)
Sulphate	Normal (<200 mg/l)	25(100%)	25(100%)
Chloride	Normal (<250 mg/l)	25(100%)	25(100%)

5. Discussion

Study by Biswas P.K. and Mandal K[4] found that major sources of drinking water in Assam were tap water, tubewell and wells. All these three sources together catered to 85% of the households. In our study, we found that 32% of urban households and 64% of rural households use tube wells as their primary source of water. Majority (60%) of urban households and 20% of rural household use Municipal water supply as their primary source of water. Only 8% of urban households and 16% of rural households use water from well as their primary source of water.

In a study[5] conducted on determination of hardness of drinking water of Kalyaniarea, West Bengal in 2018 noticed that the hardness of drinking water was found to be in range from 210.3 to 625.7 ppm (1ppm~1mg/L). In our study of Barpeta district we found that 28% of the urban and 64% of the rural households consume water with total hardness of 50-200 mg/l and 72% of the urban and 36% of the rural households consume water with total hardness of more than 200 mg/dl.

Mahendra Singh et al[6] found in a study conducted on water quality status of upper Kosi River of central Himalayan region in 2020, that the average concentration of turbidity in the Kosi River water was 1.24 NTU which varies between 0.96 NTU in the month of July as the minimum and 1.63 NTU in the month of December as the maximum. In our study of Barpeta district we found that all urban and 92% of the rural households consume water with turbidity between 0-1 NTU.

In a study conducted by Singh AK[7] in Barpeta district, arsenic was found in between 0.1-0.2 mg/l in all ground water samples. In another study[8] conducted in Golaghat district of Assam, out of 222 groundwater samples 67 % were found contaminated with higher Arsenic level. Another study[9] conducted in different parts of the country, found almost 50 % water samples had arsenic above the WHO recommended level for drinking water. In the present study, we found that arsenic level exceeded 0.01 mg/L in 36% of urban and 32% of rural households.

Shanti Lal Choubisa in his study[10] found that in 22 out of 33 districts in Rajasthan, the level of fluoride in drinking water was found to be greater than 10 mg/L. Contrary to that study, we found that the fluoride level was less than

Journal of Chemical Health Risks

www.jchr.org

JCHR (2025) 15(5), 1292-1297 | ISSN:2251-6727

0.5 mg/L in majority (72% of the urban and 64% of the rural) of households, while rest of the households had fluoride content within normal limits.

Devarajan RS et. al.[11] in their study area of Allura, Andhra Pradesh, India found pH range between 5.8 to 6.9. In our study area, we found pH less than 6.5 in only 8% of rural areas of Barpeta.

Islam M et al.[12] in his study conducted in Dhaka, Bangladesh found TDS to be alarmingly low i.e., 9.44 mg/dl in drinking water samples. Contrary to that study, we found TDS more than 500 mg/L in 16% and 8% of water samples from urban and rural areas respectively.

Kapil Parihar et. Al[13]. Found out iron concentration in different sites and different months between January and April 2020 in Yamuna River, Delhi, to be in the range of 0.1 to 3.9 mg/L. But in our study, iron concentration was found below or equal to 0.3 mg/L in 40% of the water samples in urban areas and 48% of water samples in the rural areas. Iron concentration was found above 1 mg/L in only 8 % of samples collected from rural areas.

Unlike the present study, high amount of nitrate, sulphate & chloride was found in many drinking water samples in a study conducted in an affluent country[14].

6. Conclusion:

The study highlights the majority of drinking water sources in Barpeta district being physically acceptable but raises concerns about chemical contamination, specifically of iron and arsenic. The natural fluoride content of water also remained low in majority. Public health efforts should prioritize both monitoring and mitigation of these contaminants while promoting water purification practices, especially in rural households. This research reinforces the need for regular surveillance of water quality, targeted interventions, and continued education programs in arsenic and iron-affected regions to ensure access to safe drinking water and reduce health risks.

Acknowledgement

Authors acknowledge the wholehearted support of staff of Public Health Laboratory, Barpeta and medico-social workers of the department of Community Medicine, FAAMCH, Barpeta.

References

1. Mukherjee et al. Groundwater systems of Indian Sub-continent. Journal of Hydrology: Regional Studies 2015; 4(A): 1-14
2.Prakash S, Ashok V. Arsenic: Its toxicity and impact on human health. Int J Biological Innovations 2021;3(1) :38-47
3.Jain CK, Sharma S, Singh S. Physico-chemical characteristics and hydrogeological mechanisms in groundwater with special reference to arsenic contamination in Barpeta District, Assam(India).Environmental Monitoring and Assessment 2018.190(7)
4.Biswas PK, Mandal K. Drinking water in rural India: A study of deficiency, quality and some social implications. Water Policy; 12(2010): 885-97
5. Pal A, Pal M, Mukherjee P, Bagchi A,Raha A. . Determination of the hardness of drinking packaged water of Kalyani area, West Bengal. Asian Journal of Pharmacy and Pharmacology. 4. 203-206. 10.31024/ajpp.2018.4.2.17.
6.Singh M, RawatJ, Parihar, D. Analysis of Water Quality Status of the Upper Kosi River of Central Himalaya, India. 2021.International Journal of Science and Research (IJSR). 10. 1262-1266. 10.21275/SR211125091311.
7.Singh A. K, 'Arsenic contamination in the groundwater of North Eastern India', In: Proceedings of National Seminar on Hydrology, Roorkee, India; (2004)
8.Chetia Met al. Groundwater arsenic contamination in Brahmaputra River basin: A water quality assessment in Golaghat (Assam), India. Environmental Monitoring and Assessment2010, 173. 371-85. 10.1007/s10661-010-1393-8.
9.Sengupta M et al. Groundwater Arsenic Contamination in the Ganga-Padma-Meghna-Brahmaputra Plain of India and Bangladesh. Archives of environmental health 2003.58. 701-2. 10.3200/AEOH.58.11.701-702.
10.ChoubisaS. Fluoride Distribution in Drinking Groundwater in Rajasthan, India 2018. Current Science. 114. 1851-1857. 10.18520/cs/v114/i09/1851-1857.
11.Ramu L, Devarajan R. Study of ph and conductivity of water with detailed survey of water bodies at Alluru Mandalam, Nellore district, Andhra Pradesh, India 2019.Multilogic in Science,IX(XXIX). 45-7
12.IslamM et al. A Study on the Total Dissolved Solids and Hardness Level of Drinking Mineral Water in Bangladesh. American Journal of Applied

Journal of Chemical Health Risks

www.jchr.org

JCHR (2025) 15(5), 1292-1297 | ISSN:2251-6727

Chemistry. 2016.4. 164-169. 10.11648/j.ajac.20160405.11

13. PariharK et al.Assessment of Copper and Iron Concentration in Water of Yamuna River, Delhi, India 2020. Letters in Applied NanoBioScience. 10. 2251-2257. 10.33263/LIANBS102.22512257.
14. D'Alessandro, W., Bellomo, S., Parello, F. et al. Nitrate, sulphate and chloride contents in public drinking water supplies in Sicily, Italy. Environ Monit Assess **184**, 2845–2855 (2012). https://doi.org/10.1007/s10661-011-2155-y
15. Chakraborti D, Sengupta M. K, Rahman M.M, Ahmed S, Chowdhury U.K, Hossain M.A., 'Groundwater arsenic contamination and its health effects in the Ganga–Meghna– Brahmaputra plain', J Environ Monit; 6(6): 74N–83N (2004)
16. Das S, Bora SS, Lahon JP, Chetia M, Barooah M. (2015). Groundwater arsenic contamination in north eastern states of India. Journal of Environmental Research And Development. 9. 621.
17. Chetia M et al. Groundwater arsenic contamination in BrahmaputraRiver basin: A water quality assessment in Golaghat (Assam), India. Environ. Monit. Assess.,173 (1-4), 371-385.
18. Bordoloi R., Existence of arsenic in ground water and its effect on health. Int. J. Comput. Appl. Eng. Sci.,2 (3), 270-272, (2012).
19. Park K . Park's Text book of Preventive and Social Medicine. 27th ed. Jabalpur: M/S Banarsidas Bhanot Publishers; 2023:846-54
20. WHO. Guidelines for Drinking Water Quality 4th Edn (World Health Organization,Geneva,Switzerland,2022).https://iris.who.int/bitstream/handle/10665/352532/9789240045064-eng.pdf?sequence=1