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A STUDY ON SPATIAL DISTRIBUTION OF ARSENIC IN GROUND WATER SAMPLES OF DHEMAJI DISTRICT OF ASSAM, INDIA BY USING ARC VIEW GIS SOFTWARE

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ABSTRACT

The groundwater arsenic problem has raised wide spread concerns in different parts of the world and results reported by various agencies is alarming. The latest WHO evaluation concludes that arsenic exposure via drinking water is causally related to cancer in the lungs, kidney, bladder and skin, the last of which is preceded by directly observable precancerous lesions. The elevated level of arsenic in groundwater is a new public concern in rural district like Dhemaji. In this study forty water samples representing the study area were collected from five development blocks of Dhemaji districts over a period of three years from 2007 to 2010 and analyzed for arsenic by using AAS. Spatial distribution maps for arsenic in different seasons were prepared using curve fitting method in Arc View GIS software. It may be seen from our results that most of the groundwater samples of the study area were found unsafe with regard to arsenic.

Key words: Spatial distribution, GIS, AAS, Arsenic, Groundwater.

INTRODUCTION

Access to safe drinking water is essential to health, a basic human right and a component of effective policy for health protection. Before arsenic was identified as the unambiguous cause of wide-scale health problems in Bangladesh, such occurrences were considered relatively isolated. However, since the 1990s, efforts by governments, external support agencies, and academic institutions to identify other potential contamination areas have dramatically increased[1]. Although it is far too early to outline definitively the extent of the problem globally, it is clear that there are many countries in the world where arsenic in drinking water has been detected at concentrations greater than the WHO guideline value (10 µg/L) or the prevailing national standard[2]. Approximately 20 incidents of groundwater arsenic contamination have been reported from all over the world[3]. Over the past two or three decades, occurrence of high concentrations of arsenic in drinking-water has been recognized as a major public-health concern in several parts of the world. There have been a few review works covering the arsenic-contamination scenario around the world[4,5]. The extent of the arsenic contamination worldwide is as yet unknown. Presumably, there are areas where this problem still remains to be recognized in India. Therefore, the first priority to remediate the crisis should be

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early identification of the affected sources, and the next hurdle is to provide arsenic-safe water to the affected masses.

Study area

Dhemaji district in one of the districts situated in the remote corner of North East India on the north bank of river Brahmaputra, is located between the latitudes of $27^{0}05^{/}27^{//}$ N and $27^{0}57^{/}16^{//}$ N and longitudes of $94^{0}12^{/}18^{//}$ E and $95^{0}41^{/}32^{//}$ E (Fig. 1). The district is divided into 2 sub-divisions viz. Dhemaji and Jonai, comprising of 5 development blocks (Dhemaji, Sissiborgaon, Bordoloni, Machkhowa and Morkong selek).

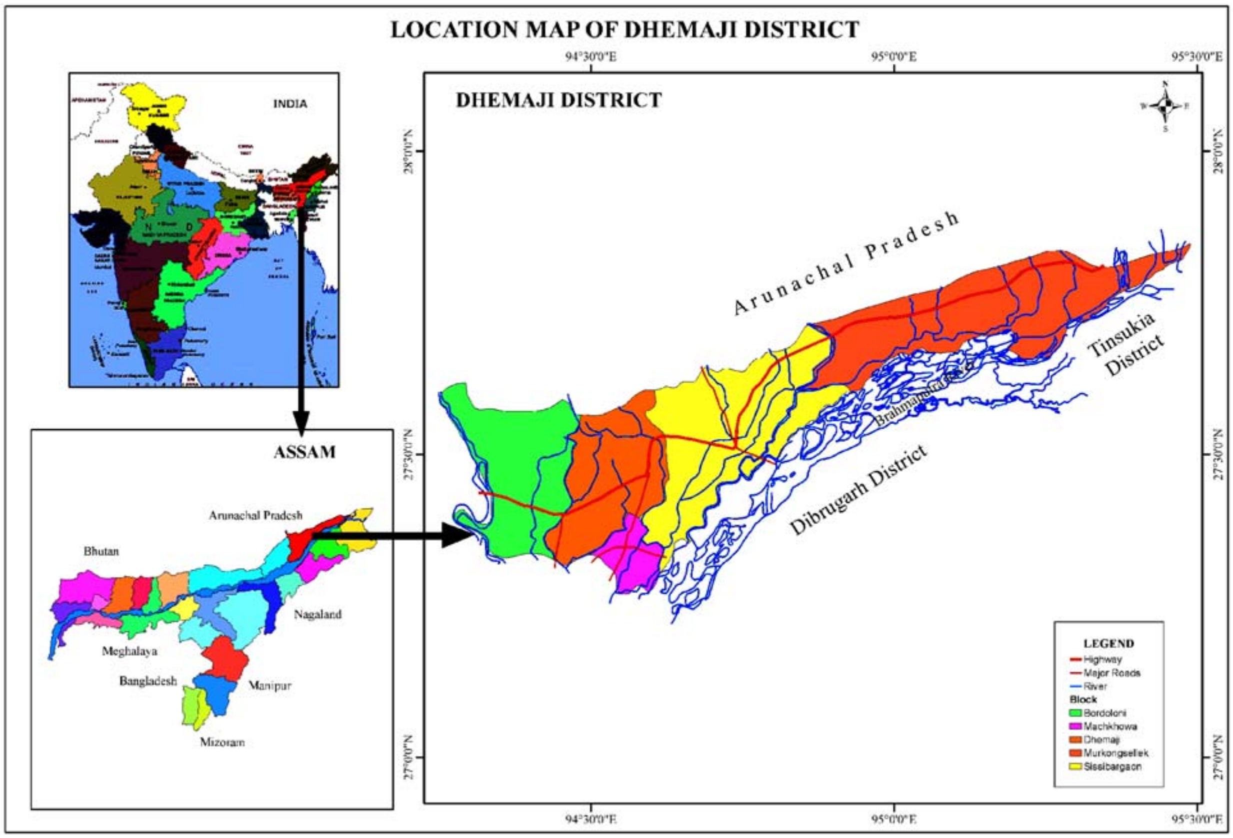

Fig. 1: A cross sectional view of the study area, Dhemaji district in Assam, India

EXPERIMENTAL

In this study forty groundwater samples representing the study area were collected (Fig. 2) from tubewells, ringwells, public water supplies and rivers at different sites from each of the five development blocks of Dhemaji district spreading over a period of three years (November 2007 – October 2010) and this is repeated over two seasons – dry (November - April) and wet (May - October) to assess the qualitative changes in arsenic loads in the district. Arsenic was analysed by using an atomic absorption spectrometer (Perkin Elmer A Analyst 200) with flow injection analyze mercury hydride generation system (Model FIAS-100) at 189 nm analytical wavelengths as per the standard procedures[6]. The spectrometer has minimum detection limit of 0.002 µg/L for arsenic. The locations of the groundwater points were obtained with a hand held Global Positioning System (GPS, Germin 72 model) with position accuracy of less than 10 m. Spatial distribution maps for arsenic in different seasons were prepared using curve fitting method in Arc View GIS software.

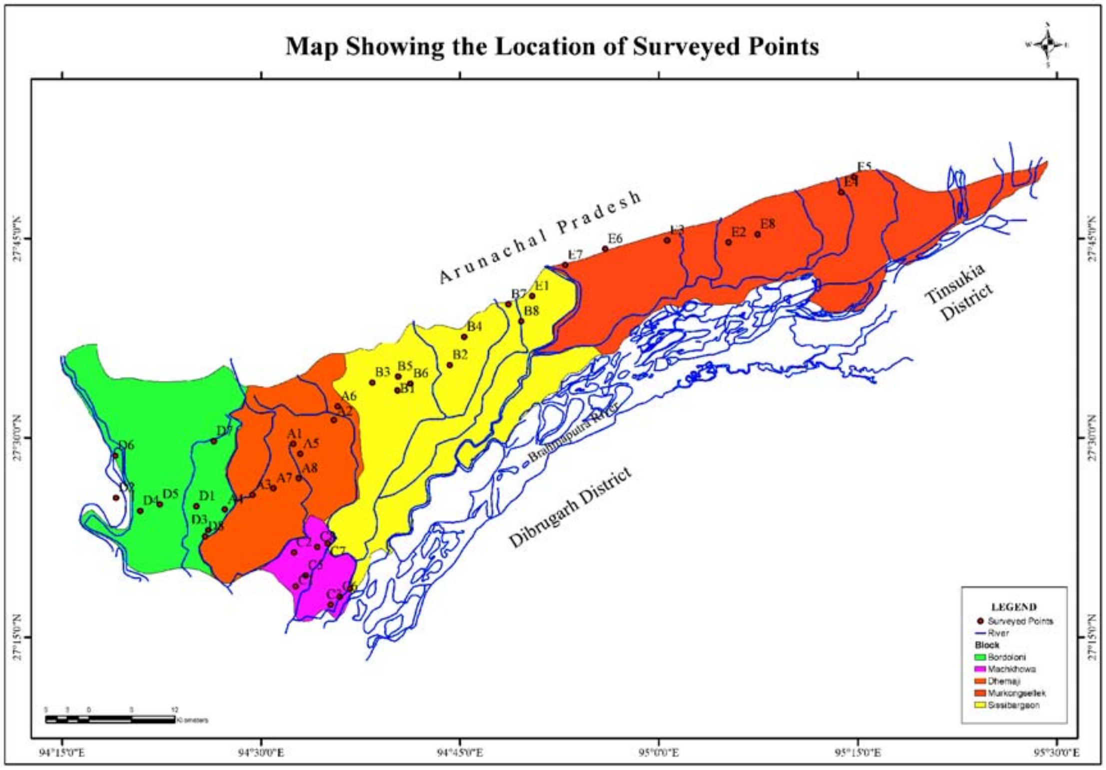

Fig. 2: Sketch map of Dhemaji district showing 40 sampling points

RESULTS AND DISCUSSION

The GIS map of arsenic distribution in groundwater of Dhemaji district season wise are shown in Fig. 3 and Fig. 4. Physiographically, the Dhemaji district is more or less flat and can be divided into high-level plain of Brahmaputra river and flat flood plain area. The area bordering the north of the district is a hilly terrain. Groundwater in the area occurs under phreatic condition in the shallow aquifer zone and under semi-confined condition in the deeper aquifer. The flow of groundwater is from north to south.

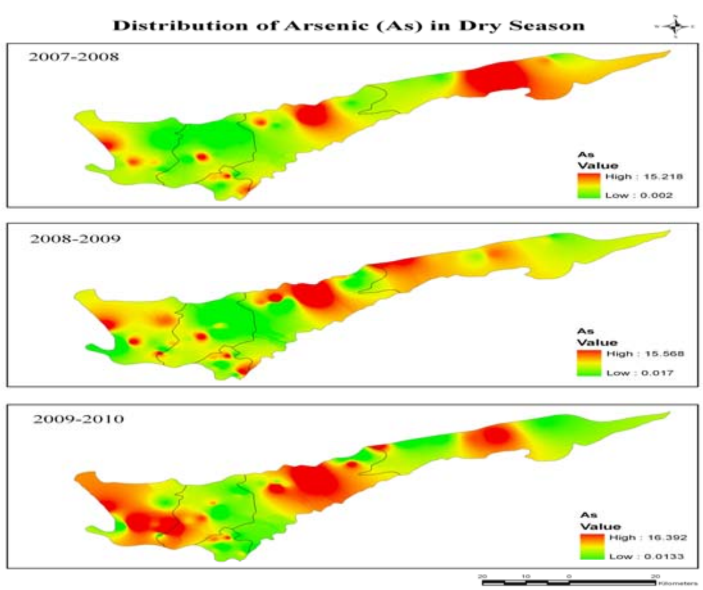

Fig. 3: Spatial distribution maps for arsenic in dry season

It is observed that groundwater samples of Dhemaji district fall under toxic and alert categories with respect to arsenic as some of the samples exceed and some are approaching the WHO guideline value of 0.01 ppm[7]. It has also been observed that groundwater samples adjoining to foothills contain arsenic at a toxic level. As the study area lies within an alluvial basin, the most probable natural sources of arsenic in groundwater may be heavy deposition of sediments due to surface erosion from surrounding hills and creating aquifers. However, it can be claimed that the study area is undisturbed by anthropogenic sources compared to industrialised countries, where river basins are generally affected by industrial activities.

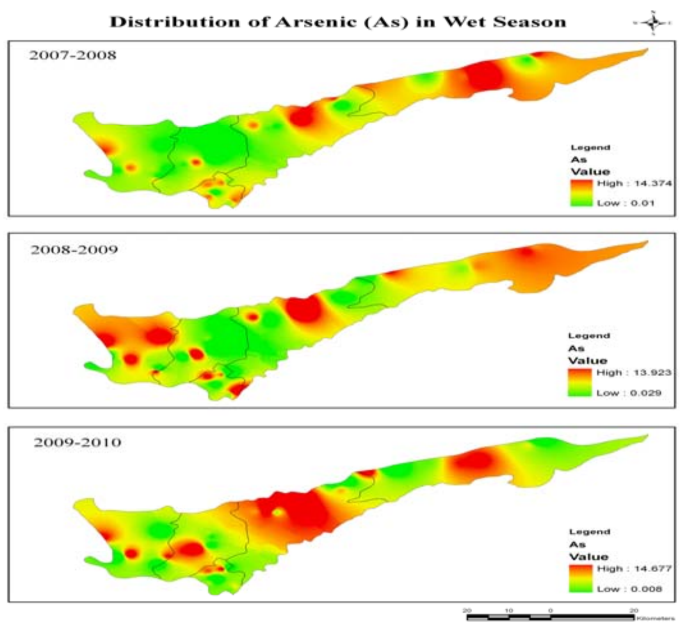

Fig. 4: Spatial distribution maps for arsenic in wet season

CONCLUSION

A comprehensive analytical and spatial analysis of distribution of arsenic in groundwater of five development blocks of Dhemaji district, Assam has been presented. This study reinforced the extensive nature of arsenic contamination of groundwater in the area under study. Populations in the study area are likely to be affected through drinking arsenic contaminated tubewell waters for a long time. However, the bio-availability of arsenic through consumption of cooked foods and their risks to human health remain to be determined. The key recommendations of this study are to take a more strategic approach to the water quality indicators in the study area at project, regional and national levels. This study outlines that academia is needed to make water related research more strategic and effective at a regional level. At national as well as provincial and state levels, governments would benefit from supporting and originating further research on arsenic occurrence in their localities making sure that arsenic is taken into account when water-related investments are made and that trade-offs are adequately analyzed. The present study, however, fulfilled the limited purpose of strengthening database which may be helpful in formulating strategy for future protection of soil and water in the area.

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