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Research Article

Groundwater quality assessment of the BDP aquifer in rural area of India

Pinaki Ghosh[1]*, Debashis Chatterjee[2]* and Samir Kumar Mukherjee[1]

[1]Department of Microbiology, University of Kalyani, Nadia-741235, West Bengal, India

[2]Department of Chemistry, University of Kalyani, Nadia-741235, West Bengal, India

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***Corresponding authors:** Debashis Chatterjee, Department of Chemistry, University of Kalyani, Nadia-741235, West Bengal, India, Tel: 09433506839; E-mail: debashis.chatterjee.ku@gmail.com

Pinaki Ghosh, Department of Microbiology, University of Kalyani, Nadia-741235, West Bengal, India, Tel: +91 9433506839; E-mail: pinakimicro51@gmail.com

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Abstract

Groundwater is gradually more used worldwide for domestic, industrial and agricultural production. The presence of natural Arsenic (As) release of ground water is a global issues and notably more severe in south East Asia particularly India and Bangladesh. The high occurrence of As in ground water in India and Bangladesh is a challenging public health issue because As is one of the carcinogen metalloid. A full scale ground level study will be required to find out the precise role of these local land-use patterns. In the present work few As affected village of Nadia district has been studied. The most significant matter specially derived fresh organic matter is an important issue to release As to ground water. Finally the study suggests that Fe reduction link with microbial mobilization of As is important process.

Introduction

Fresh water is essential for survival of life on mother earth. The resources are extremely crucial for human health and well-being for human civilization. The supply of cleaned and safe water is mainly essential component in rural areas for economic development and livelihood. The fresh water demand is continuously increasing to meet up the need for agricultural purposes, industrial activity and domestic supply. Moreover, the large scale ground water development has been done for crop production and industrial activities (Table 1) Surface water is most widely used for the water consumption among the population of urban areas in Nadia district as well as rest of Bengal. Now a day the unfettered and abandoned disposal of waste (even raw municipality waste) into this surface water bodies has made a serious risk (water- borne diseases along with gastro-intestinal disorder) to the water quality which is commonly supply to the ordinary people.. As a result, a shift in

Table 1: Few Asian countries ground water recharge as well as withdrawal scenario (Data source: World Resources, OUP, New York (https://books.google.co.in/books).

Country	Yearly Ground Water Recharge				Yearly Ground Water Boost			
	Tota(cubickm)	PerCapita (cubic m)	Total (cubic km)	% of Capita (cubic m)	PerCapita (cubicm)	Domestic use (%)	Industry Use (%)	Agriculture Use (%)
china	870	693	75	9	70		46	54
India	350	359	150	43	222	3	1	96
vietnam	84	1078	-	-	-	-	-	-
Japan	185	1469	13	7	104	29	41	30
Nepal	-	-	-	-	-	-	-	-
Bangladesh	34	274	3	10	40	13	1	86
Thailand	43	721	1	2	15	60	26	14
Laos	350	359	150	43	222	3	1	96
Cambodia	30	2790	-	-	-	-	-	-

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water supply system has been observed in the entire Bengal. Millions of hand operates tube wells (both shallow and deep) have been installed. Groundwater supply from the sedimentary aquifers has been considered to be safer for community supply. The use of groundwater has been preferred among the common rural people and an agricultural purpose has been increased during the implementation of the 'Green Revolution' Unfortunately this BDP (Bengal Delta Plain) ground water is contamination due to micro-organism [1-3].

In BDP, the origin and cause of mobilization of high arsenic have been attempted by several researchers and spatial patchy distribution pattern. In shallow aquifers, the spatiotemporal heterogeneity of arsenic has also been reported in Nadia. The geomicrobiol desorption of As from the secondary mineral phases (principally Fe/Mn oxides and hydroxides, microbial) are another understanding way of As release mechanism. Moreover, controlling factors are (nature of host sedimentary environment, characteristics of organic matter, groundwater flow pattern, local land use pattern, Microbial population) need a lot of attention [1,4].

Geological overview

The central part of BDP (especially Nadia District, West Bengal, India) lies within Bengal Aquifer System. This proto-Ganges basin developed with the break-up of the Gondwanaland during the early Cretaceous (126 Ma).

This alluvial delta continuous sequence of sands, sandy silt, silt and mud. The BDP is also significantly fed by the Himalayan Rivers flowing down through the Garo-Rajmahal Gap to the Bay of Bengal. Central part of BDP (Nadia) litho logy shows that the sedimentary successions comprise sand (channel facies) and silt as well as clay (overbank faces) and generally display a typical fining upward sequence. The succeeding Holocene deposits of iron rich clastic minerals and finer sediments (sand, silt with abundant mica and heavy minerals). These sediments are generally un oxidized and grey in color Fine-grained overbank facies are rich in organic matter (Gault et al.,2005) A typical litho logy from arsenic contaminated area (Chakdaha block) of Nadia district is offered to outline the simplified litho logical faces (Figure 1) [1,5].

Results and discussion

The current study reveals that As concentration are often exceeding WHO guide line values (<10 µgL-1) and also exceeded the current national safe limit (< 10 µgL-1). The As concentrations in ground water vary over wide range of magnitude (sub milligram to milligram level). Arsenic concentrations demonstrate regionally along with many other dissolved elements and also display a significant short range spatial changeability.

The chemical composition of the ground waters from study area (Nadia district) varies both regionally and between aquifers. The individuality chemical features are many such as high As ground waters are high alkalinity (>250 mgL^{-1}), Fe (>0.15 mgL^{-1}), Ca (>80 mgL^{-1}), Mg (>20 mgL^{-1}), silicate (7.15-29.0 mgL^{-1}), Cl^{-} (6-123 mgL^{-1}), and $PO4^{3-}$ (1.1-7.79 mgL^{-1}), and

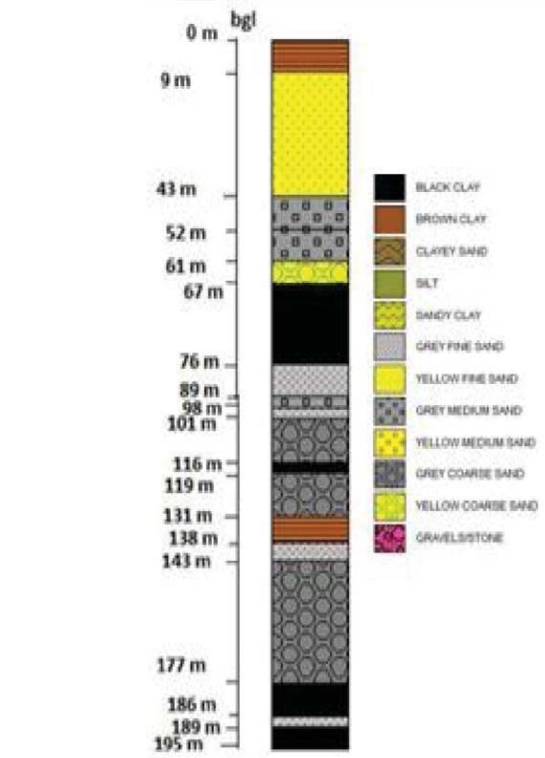

Figure 1: A typical lithology from arsenic affected area (Chakdah block) of Nadia district.

low NO3- (<1 mgL^{-1}), SO42- (1-13 mgL^{-1}) and F- (<1 mgL^{-1}) concentrations. The ground water also reveals the low Eh (generally less than 100mV), low to very low D.O. (<1 mgL-1, often absent), moderate conductivity and nearly neutral pH (6.5-7.5). The water is generally Ca – HCO3 type and fresh (conductivity 580 – 1100 µs / cm). The maximum observed As (III) concentration is 820 µgL-1 for an AsT concentration of 1186 µgL-1 [1,5].

The shallow aquifers of the study area are usually contaminated with geogenic As. Currently the As concentration in ground water is a while spread phenomena along with microbial contamination. The study indicates that ground water often contamination. The scale of the problem is serious and local people unaware. The microbiological quality of sample of ground water has been judiciously review monitor and it was found that several wells are contaminated with As and microorganism. The results indicates that both the TC (range 125 to 107 counts) as well as FC (range 72 to 12 counts) are also been found in a sample ground water. The both results (TC and FC counts) indicate the bacteriological quality of the sampled ground water is often questionable with regards to WHO guide line value and nation drinking water standard [2,4].

Conclusion

Supply of safe water to areas with high As groundwater contamination is a major challenge to protect human health. The important host sedimentary environment is the As-rich fine-grained Fe-oxyhydroxides of the present in the contaminated shallow (> 50 m) aquifer sediments. Reductive dissolution of Fe oxide/hydroxides is interpreted as the principal cause of As

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release in the environment under local reducing conditions. However, several other mechanisms (biogeo-chemical) have also put forward to explain the elevated levels of As in shallow aquifer of Nadia district. In the study area, shallow aquifer along with several land-use and land coverage pattern (pit -latrine, local pond, platform broken tube well, agricultural field, animal waste dumping) have been identified for the source of the microbial contamination. A full scale ground level study will be required to find out the precise role of these local land-use patterns. Moreover, a stable isotopic signature study will be really usefully to find out the exact role of land-use pattern including their impact with regards to their variation in shape, size and nature. It is also important to note that the seasonal variation (wet and dry) has some impact on the microbial quality of ground water along with variation of As contamination. These aspects of seasonal variation have to be further explored to study the phenomena in different season particularly monsoon season when microbial contamination is usually high.

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