Contamination of Ground water by Arsenic in Ballia & Ghazipur Districts of Eastern U. P.

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Abstract
Arsenic, a notable and a well-known cancer-causing agent, is perceived as one of the world's most hazardous synthetic compounds. Soil & groundwater are contaminated by arsenic due to weathering or disintegration of rocks containing arsenic sediments and its dissolution into water floods which carry it to affected areas. Location of U. P. is in middle Ganga plain and it has tropical monsoon climate. It has 75 districts which are further divided into divisions and tehsils. Eastern part of U. P. is severely affected by As contamination . Many investigation agencies like U. P. Jalnigam, UNICEF AND WHO have reported more than 63 ppb As in drinking water of inhabitants which is very fatal for human life. Water sampling data reported high level of As contamination in many districts of eastern U. P. like Ballia, Ghazipur, Varanasi, Chandauli, Siddharthnagar, Gorakhpur, Basti, Lakhimpur Khiri etc. Study of contaminated water samples from villages Haldi, Bairiya, Belhari, Dubhad, Mohan Chapra, Sikandarpur, Dipran kalan, Premchapra & Suremanpur (Ballia district) and villages of Ghazipur district Reotipur, Deokali, Mohammadabad, Karanda, Ghazipur city etc. show variation of As concentration during Pre and Post monsoon seasons.

Keywords: *Hazardous, Groundwater, as contamination, Pre and Post monsoon seasons, As concentration.*

Introduction

Groundwater is the principal and fundamental wellspring of savoring water townships and furthermore in the greater part of the towns. In this way, pollution of groundwater is taken as a factor of genuine misery. It is the first noteworthy wellspring of water for horticultural, household, business and mechanical purposes in more nations. The age and reason for water contamination are for the most part a direct result of human different exercises on the encompassing which prompts contamination. All things considered, the key reason for contamination is a direct result of the improvement of the human populace, agrarian and modern practices. The contamination or sullying happens likewise arsenic or fluoride components. Water contamination turns out to be terrible because of the over-burdening of urban locales. The main toxins of agnatic natural surroundings are to a great extent because of residential, agrarian and mechanical squanders. The biggest

contaminant of crisp water is sewage and which remains a waterborne idler of society. The release of natural sewage going into a waterway is extremely immense and destructive. While the debased water streams into the ground and reach aquifer and prompts groundwater contamination. The groundwater contamination happens just when poisons are discharged into the ground and make their own way into groundwater. Groundwater contamination can happen from landfills, release from wastewater treatment plants, spilling sewers, on location sanitation frameworks, petroleum fillings stations or because of the use of manures in farming. The impact of groundwater contamination is enormous. The fundamental extreme impact of water contamination is that causing of infectious sickness in people. The use of contaminated groundwater likewise makes peril general wellbeing through harmful activities and spreading of infection. This sort of groundwater contamination can likewise occur physically because of the presence of a slight and disposed of constituent, contaminant or debasement in the groundwater. Contamination is the beginning phase of sullying into the encompassing. The contamination normally builds a contaminant peak inside the aquifer. The preparation of water and its dissipating inside aquifer broadens the contaminant over a bigger region. The examination of groundwater contamination may focus on soil highlights, hydrogeology, hydrology, site topography and furthermore the character of the contaminants.

Arsenic, a notable and a well-known cancer-causing agent, is perceived as one of the world's most hazardous synthetic compounds. Soil & groundwater are contaminated by arsenic due to weathering or disintegration of rocks containing arsenic sediments and its dissolution into water floods which carry it to affected areas. Arsenic mostly exists in two types of oxidation states which are arsenate (As^{5+}) and Arsenite (As^{3+}). These two oxidation states are inter convertible by oxidation of As^{3+} into As^{5+} and reduction of As^{5+} into As^{3+}. Arsenic also exists in another form, i.e., organic form and it is formed by biomethylation of Arsenic. Different living organisms like plants, aquatic animals like fish, crab and human body contain organoarsenic compounds. Microorganisms like Bacteria or Fungi which lack of chlorophyll undergo biological conversion of inorganic arsenic into organic arsenic and it is called as biomethylation process.

2. Materials and Methods

2.1 Geographical Study of Sampling area of Eastern U. P.

Ballia and Ghazipur districts are eastern part of state U. P. Geographical location of Ballia district is between 25° 23' - 26 ° 11' N and 83 ° 38'- 84 ° 39' E (Fig. 1.1 a) and district Ghazipur is arranged between 25° 19' to 25° 54' N and 83° 4' to 83° 58' E (Fig. 1.2). Ghazipur district is surrounded by four rivers Ganga, Gomti, Karmnasha and Saryu. Landmass of district is topographically flat and it has average rainfall 945 mm.

Climate condition is sub humid. A large variation in average maximum and minimum monthly temperature has been found which range is 42° C in month of May and 16°C in month of January.

Agricultural exercises are essentially impact by the blend of normal ecological conditions and along these lines adjusted by the mix of human conditions .the yields delivering probability of a zone depends principally on the predominant climatic and soil conditions. Of all the climatic parameters, precipitation and temperature are the most prominent as the extraordinary conditions capture plant development. Be that as it may, the fundamental elements of the dirts in farming terms, is to give mechanical help to plants and store and supply the required supplements and water for plant development. The dirts in this manner must be rich and have extensive potential for yield development. Simultaneously, the very much adjusted blend of specialized, social, financial, religious and political components are essential to make a dynamic and dynamic condition helpful for by and large rural improvement. Of the non – physical components, water system is the most imperative in those huge rural zones which are possibly rich yet experience the ill effects of the notions of regular precipitation.

Ballia is situated at the border of Bihar state and it is eastern most district of U.P. The boundary between Ballia and Bihar is determined by rivers Ganga and Ghagra. The district lies between the parallels of 25° 33' and 26° 11' North latitude and 83° 38 'and 84° 39' East longitudes. Mau is at western side, Deoria is on the north side, Bihar is on the north east and south east side and Ghazipur on the south west side. Total area is 2988 square km and the district headquarter is located at Ballia. **Fig. 1.1 (A) & 1.1 (B)**

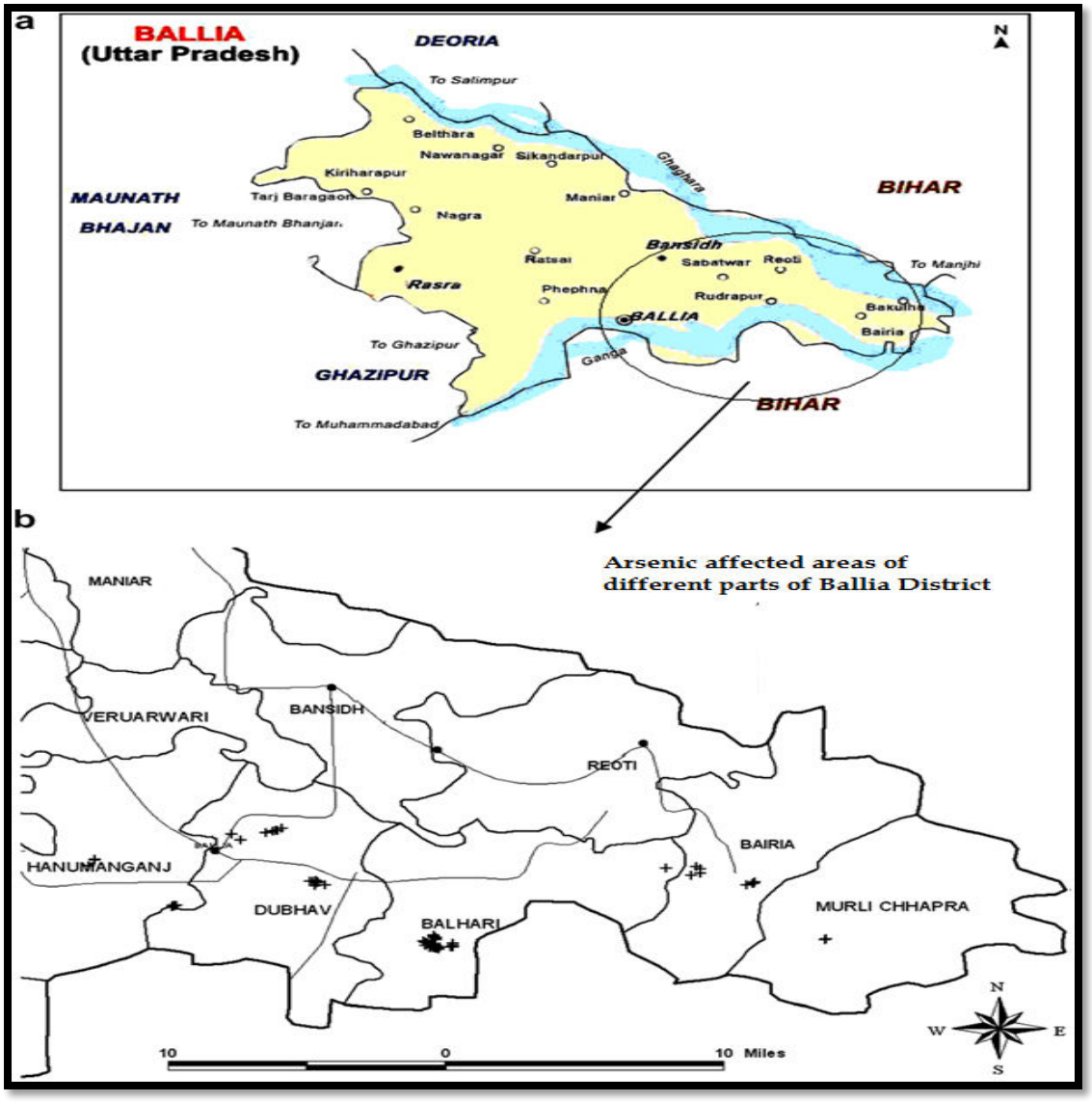

Fig. 1.1 (a) Water channels of Ganga & Ghaghara rivers flowing through District Ballia

Fig. 1.1 (b) Arsenic Contaminated villages of Ballia

Ghazipur lies in the eastern district of the Varanasi division. It is nearly at a height of 235c.m. above the mean sea level. The Ganga River is on one side of Ghazipur while on the other side there is Karamnasa river which separates Ghazipur from the Bihar state. The extreme length of this district from east to west is about 90 kilometers and the maximum breadth from north to south some 60 kilometers. As a whole, the district is of fertile plain except few. The total area of the district is 3377 square kilometers. The district headquarter is located at Ghazipur. The district at present comprises of 4 tehsils and 16 community development blocks. It has 8 towns and

2661 villages (2583 are inhabited and 78 uninhabited villages). This district is agricultural based; accordingly 83% of the total population is engaged in agricultural activities for their sustenance. **Fig. 1.2**

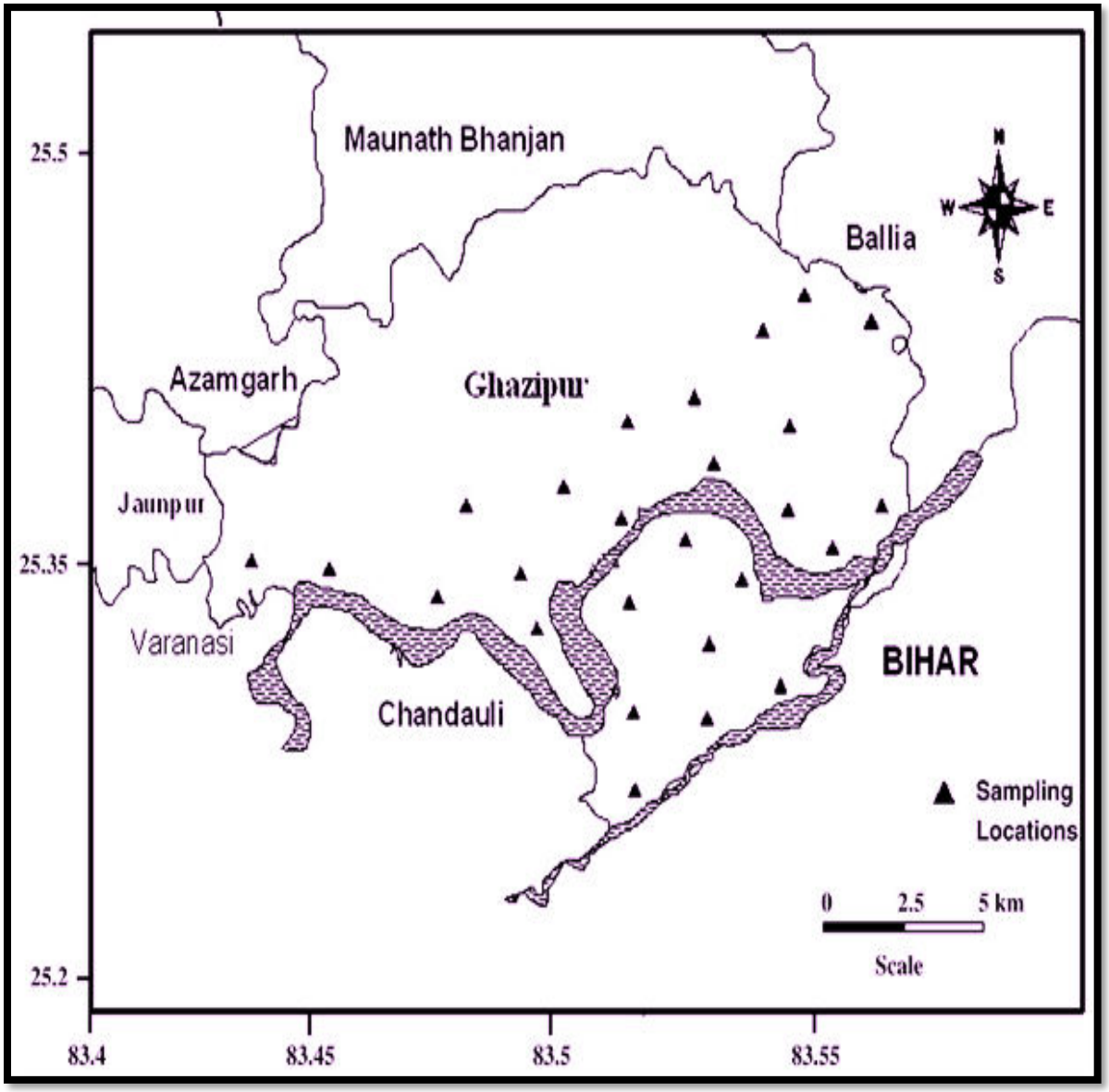

Fig. 1.2: Map of Sample collection area of Ghazipur district

3. Results & Discussion

3.1 Temporal and seasonal variability of arsenic in groundwater

It was reported a clear temporal and seasonal variability of As concentrations in different samples. During post monsoon season As concentration decreases in Samples. The variability in As concentrations is likely to be associated with the seasonal fluctuations in groundwater recharge and the impact of irrigation drawdown (Mac

Arthur et al). Difference in Arsenic concentration during pre and post monsoon seasons is correlated in terms of its concentration. A definite relationship exists between the behavior of arsenic and rainfall intensity. With increasing rainfall intensity rate of dilution increases which minimizes the arsenic concentration in the groundwater (Farooqet al., 2010). During monsoon period there is considerable decrease in the arsenic concentration. Thus it can be said that there is a strong correlation exists between rainfall condition, dilution effect and arsenic concentration. Contrary to this, during winter season and pre monsoon seasons there is an increase in the concentration which is associated with the decrease in dilution effect.

3.2 Arsenic distribution in Ballia district

Groundwater stream design is influenced by water level surface and subsurface redox potential because of seasonal rainfall. During monsoon seasons groundwater level in Ballia is increased due to its low-land shallow basin and flooding condition also help in rising its groundwater level. For an extensive stretch of the year, the land remains water-logged and this prompts low groundwater flushing rates. In this manner, the watched varieties in mean As concentrations during storm season contrasted with pre rainstorm season (Table 1.1).

Table 1.1 Distribution of Arsenic during Post monsoon& Pre monsoon in Blocks of Ballia district

Blocks in Ballia district	As in ppb	
	Post monsoon	Pre monsoon
Belhari	542	731
Bansdeeh	545	690
Sikandarpur	129	180

It was observed during the study period that there is interaction between sediment rocks and water due to slow flow of water current make long time contact and reducing condition all leads to high As concentration in groundwater. During monsoon time arsenic goes into groundwater by disintegration of Fe(III)- oxy hydroxides and in pre monsoon time arsenic reversibly adsorb on Fe(III)- oxyhydroxides. So these two processes control arsenic concentration during pre monsoon and post monsoon time. The sampling sites selected in Ballia district are Belhari, Bansdeeh, Sikandarpur .

3.3 Arsenic distribution in Ghazipur district

Arsenic concentration was relatively lower in Ghazipur district groundwater in comparison with Ballia district groundwater. The spatial distribution of ORP in the groundwater clearly shows most of the groundwater wells have lower ORP value. The

variations of elemental concentration are mainly clay controlled in both the margin and central parts. There is progressive increase in the finer particles and trace elements towards the central part of the sediments from the northern part which is attributed to decrease in grain size and the concentration of metals in sediments tend to increase in fine grained sediments. For an extensive stretch of the year, the land remains water-logged and this prompts low groundwater flushing rates. In this manner, the watched varieties in mean As concentrations during storm season contrasted with pre rainstorm season (Table 1.2). The sampling sites selected in Ghazipur district are Bhavarkole, Reotipur & Karanda blocks.

Table 1.2 Distribution of Arsenic during Post monsoon& Pre monsoon in Blocks of Ghazipur district

Blocks in Ghazipur district	As in ppb	
	Post monsoon	Pre monsoon
Bhavarkole	15	22
Reotipur	17	27
Karanda	45	52

4. Conclusion

Arsenic is a highly toxic element contaminate water & soil by mobilization and sedimentation Via river flood plains. Arsenic contaminated groundwater create many problems like health issues, social disorder and economic problems before human beings. A proper research is required for arsenic speciation of water & soil samples in this Gangetic plain area as people are not much aware of its future hazards. The objective of study is to investigate arsenic speciation by characterizing its organic and inorganic forms with arsenic limit in samples of different areas. Mineralogy study of arsenic has a great role to understand its mobilization by weathering of rocks into water resources and sedimentation of arsenic in affected areas. Different color codes have been suggested to investigate arsenic level, has to be more précised.

Each sample shows variation in As concentrations due to seasonal variation. There is decrease in As concentration from pre monsoon to post monsoon season. The cause of variation is change in groundwater level during rainy season and also consumption of groundwater in irrigation process. Arsenic concentration fluctuation during pre and post monsoon seasons is correlated in terms of its concentration. A direct relationship exists between As concentration and average amount of rainfall in rainy season. As concentration decreases with increase in amount of rainfall as it increases rate of dilution of as in water.

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