



Monsoonal variation and correlation in concentration of trace elements in ground water of Bareilly region U.P., India

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Abstract - Ground water samples were collected from different tehsil (Aonla Tehsil, Baheri Tehsil, Bareilly Tehsil, Faridpur Tehsil, Mirganj Tehsil) of the Bareilly region and analyzed quantitatively for the concentration of trace elements like As, Mn, Al, Cr, Fe and Pb by using Atomic Absorption Spectrophotometer. The concentration was found fluctuating due to the temperature variance in different season and observed mostly below the permissible limit and some time at various sites slightly high or equal to permissible limit of WHO and BIS. As and Mn observed about the maximum permissible level at Aonla Tehsil in both the season respectively (0.01 mgL^{-1} and 0.50 mgL^{-1}) and (0.013 mgL^{-1} and 0.54 mgL^{-1}). Concentration of Mn was also observed highest at Faridpur in pre monsoon season (0.50 mgL^{-1}) whereas at Meerganj Al and Cr concentration observed nearby maximum permissible limit in both the season. Ground water of the study area in different tehsil's of Bareilly can be used for drinking purpose after suitable treatment, constant monitoring of the trace elements concentrations in the surface water as well as comprehensive conservation efforts recommended should be taken by relevant organization.

Keywords— Trace elements, Ground water, Pre monsoon, Post monsoon, Bareilly region.

I. INTRODUCCION

In today's world, environmental scenario amount of trace elements in ground water is the major issue of concern, due to the exploration of population, urbanization and industrialization, over exploitation of natural resources i.e. land use (deforestation, agricultural, residential etc.). The impact of urbanization on trace elements concentration in water (surface and ground both) that more than 50% of world population adversely effected by it [1] water resources for

industrial, agriculture and house hold/ drinking purpose. Contaminated water is major vector for extension of diseases in humans [2, 3]. In third world countries it is reported that about 1.8 million people and mostly children were die each year due to the water associated disease [4]. In India because of unplanned urbanization and industrialization water resources have reach to point of crisis [5]. There are about twenty trace elements which are lethal and causes major risk to human environment, the regular trace elements have been found in ground water are arsenic, copper, lead chromium and zinc. Estimation of groundwater quality provided the information about the ion concentration and its authenticity for purpose like drinking, agriculture and industries purpose [6]. Ground water is a major source of drinking water in both urban and rural areas. By given above facts trace elements suspend in environment at a rate higher than its natural purification. It has been proven by several researches that the agricultural waste like pesticides, insecticides, fertilizers causes ground water pollution through leaching of trace elements present in it. Disposal of sewage water and effluent from various industries into fresh water aquifers is the main cause of ground water pollution various elements are useful to organisms for the maintenance of health but its deficit in diet inhibits growth and vitality of humans, animals and plants to a certain degree [7]. Trace metals can be toxic and even lethal to humans even in relatively low concentrations because of their accumulation tendency in body [8]. The collective toxic effects of some trace elements are very serious like hematological, brain damage, anemia and kidney malfunction [9]. Some metals with their toxic effects on human are shown in Table 1. The major purpose of the given study is to investigate the trace elements concentration present in groundwater in the different tehsil of Bareilly region and their comparison with [4] and [10] standards for drinking purposes

II. MATERIAL AND METHOD

A Study Area

The present study is carried out at different Tehsil area of Bareilly district, Uttar Pradesh which is geographically bounded by latitudes 28°1' to 28°54' North and longitude 78°58' to 78°58' East, and lies in northern India. Different Tehsil's of Bareilly district are selected for study viz. Baheri, Aonla, Faridpur, Meerganj and Bareilly (Table 2). In pre rainy season maximum temperature is recorded up 40°C and minimum temperature was observed 8°C in post monsoon season. Ground water samples uniformly collected over the entire study area in pre rainy and post rainy season during 2014 in 1 Liter plastic bottles for trace element analyses. The collected water samples were grouped under categories, A₁, A₂, B₁, B₂, C₁, C₂, D₁, D₂, E₁ and E₂. Prior to the collection of the samples, the hand pumps were duly pumped so that the stagnant water, if any, is completely removed from storage in the well assembly.

Atomic Absorption Spectrophotometer (AAS) was used for the determination of all the trace metals

Table 1 Some heavy metals and their toxicity to humans

Metal	Toxicity
Arsenic	Carcinogenic, Skin diseases, Irritation
Aluminium	Central nervous system, dementia, loss of memory, listlessness, severe trembling
Chromium	Low-level exposure can irritate the skin. Long-term exposure can cause kidney and liver damage, and damage to circulatory and nerve tissue
Iron	Hepato-cellular cancer, Neurodegenerative disorders, Parkinson's and Alzheimer's
Lead	Long term exposure can cause acute or chronic damage to the nervous system on humans.
Manganese	Parkinson, lung embolism, bronchitis, Chronic Mn poisoning may Damage to the brain and the central nervous system.

2	Baheri Tehsil	Sekhupur, Bhikampur	Various Hand pumps, depth 100-110 fit (approx.)	Daily, urban and agri waste	B ₁ , B ₂
3	Bareilly Tehsil	Bakarganj, Chahabai	Hand pumps, depth 100-110 fit (approx.)	Daily and urban waste	C ₁ , C ₂



4	Faridpur Tehsil	Jairgram, Vilaspur	Various Hand pumps, depth 75 - 85 fit (approx.)	Daily, urban and agri waste	D ₁ , D ₂
5	Mirganj Tehsil	Paiganagri, Goola	Various Hand pumps, depth 100 - 110 fit (approx.)	Daily, urban and agri waste	E ₁ , E ₂

S.No.	Sites	Sample location	Sample Sources	Sources of pollutant	Code
1	Aonla Tehsil	Alampur, Sardarnagar	Various Hand pumps, depth 120-130 fit (approx.)	Daily and urban waste	A ₁ , A ₂

Fig.1 Map of Selected Tehsil of Bareilly region (India, U.P.) for the Sampling of ground water

III RESULT AND DISCUSSION

The standards of Trace Element for drinking purpose prescribed by [4] and [5] are given in Table 3.

1 Arsenic (As)

As leads lung cancer and mental disturbance, gastro intestinal disorders (As) was widely distributed throughout the earth's crust and it was toxic in nature. The source of As in ground water are industrial effluents, atmospheric deposition,

S.N	Sites	Trace Elements					
		As	Al	Fe	Cr	Mn	Pb
1	Anola Tehsil	0.010 ± 0.001	0.120 ± 0.042	1.04 ± 0.26*	0.046 ± 0.004	0.50 ± 0.12	0.08 ± 0.04*
2	Behari Tehsil	0.004 ± 0.001*	0.180 ± 0.024	0.86 ± 0.14	0.044 ± 0.006	0.41 ± 0.09	0.09 ± 0.04
3	Bareilly Tehsil	0.004 ± 0.001	0.102 ± 0.064	1.10 ± 0.07	0.053 ± 0.006	0.26 ± 0.12	0.01 ± 0.01
4	Faridpur Tehsil	0.003 ± 0.001	0.160 ± 0.040	1.03 ± 0.06	0.051 ± 0.009	0.52 ± 0.08*	0.01 ± 0.00
5	Mirgunj Tehsil	0.003 ± 0.001	0.215 ± 0.049*	0.98 ± 0.08	0.074 ± 0.008*	0.33 ± 0.09	0.07 ± 0.08

pesticides, insecticides and herbicides. The permissible level of arsenic is 0.01 mg L⁻¹ according to [4]. The concentration of As in the study area ranged from 0.003 to 0.010 mg L⁻¹ in pre rainy season site A₁ (Table 4). In post rainy season its concentration was found increased in ground water than in pre rainy season at all the samplings sites and it was ranged from 0.003 – 0.013 mg L⁻¹ (Table 5) and once again its concentration was found high at the site A₁.

2 Aluminium (Al)

The maximum permissible limit of Aluminium (Al) is 0.2 mg L⁻¹. Long lasting uptakes of significant concentrations of Al can lead to serious health effects, such as damage to the central nervous system, dementia, loss of memory, listlessness, severe trembling [5]. In the study area the minimum value (0.102 mg L⁻¹) of Al is observed at the sites A₁, A₂ whereas the maximum value (0.215 mg L⁻¹) at D₁, D₂ sites has been observed. During the post rainy season the highest value was again observed at the sites D₁, D₂ (0.226 mg L⁻¹) (Table 4 and 5), all the other study sample show the lower

Trace elements	WHO 2004		BIS 1991	
	Highest desirable level	Max. Permissible level	Highest desirable level	Max. Permissible level
As	-	0.01	-	-
Fe	0.1	1	0.3	1
Mn	0.5	0.5	0.1	.5
Al	-	-	0.03	0.2
Pb	-	0.1	-	0.1
Cr	-	0.05	0.05	0.05

S.N	Sites	Trace Elements					
		As	Al	Fe	Cr	Mn	Pb
1	Anola Tehsil	0.013 ± 0.001*	0.120 ± 0.007	1.30 ± 0.37	0.048 ± 0.002	0.54 ± 0.13*	0.08 ± 0.01
2	Behari Tehsil	0.007 ± 0.001	0.153 ± 0.09	1.14 ± 0.31	0.056 ± 0.006	0.45 ± 0.01	0.10 ± 0.04*
3	Bareilly Tehsil	0.006 ± 0.003	0.148 ± 0.09	1.40 ± 0.12*	0.055 ± 0.01	0.32 ± 0.13	0.03 ± 0.01
4	Faridpur Tehsil	0.006 ± 0.001	0.186 ± 0.03	1.30 ± 0.09	0.055 ± 0.003	0.50 ± 0.04	0.13 ± 0.006
5	Mirgunj Tehsil	0.003 ± 0.001	0.226 ± 0.048*	1.24 ± 0.11	0.078 ± 0.005*	0.40 ± 0.05	0.09 ± 0.02

concentration in both the study periods.

3 Iron (Fe)

Iron is a micro-nutrient and essential for humans, plants and animals but in high concentration it becomes toxic and cause diseases like hemochromatosis, transfusion siderosis [11]. The limit of concentration of iron in drinking water ranges between 0.3 (desirable limit) to 1.0 mg L⁻¹ (permissible limit). In the study area, a minimum value (0.86 mg L⁻¹) of Fe is observed in B₁ whereas the maximum value (1.04 mg L⁻¹) has been observed in A₁. The entire study samples show the higher concentration in pre rainy season were as in post rainy season the concentration of Fe was range from 1.24 – 1.44 mg L⁻¹ (Table 5). The lowest concentration was reported at the E₁ and E₂ site were as highest was reported at the B₁ and B₂ sites. At Hindon-Yamuna interfluvies region of Bagpat District of U.P also show the higher concentration of Fe and higher Fe levels are also reported in other part of western U.P [12] and [13]

Table 3 Standards of Trace Element for drinking purpose given by [4] and [10].

Table 4 Trace element concentrations during pre-rainy season year 2016 in ground water sample (mg L⁻¹)

Table 5 Trace element concentrations during post rainy season year 2016 in ground water sample (mg L⁻¹).

Values are mean of 6 replicates ± standard deviation, significance at p ≤ 0.05. * Monsoonal significant values

Table 6. Correlation of trace elements for pre and post rainy season during 2016 in Bareilly region.

	As	Al	Cr	Fe	Mn	Pb
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As	0.9644 61				
Al		0.787 214			
Cr			0.933 149		
Fe				0.9863 66	
Mn					0.9958 02
Pb					0.999 802

Chromium (Cr) concentration in selected study sites was found between 0.046 to 0.074 mg L⁻¹, and thus, three sites C₁, C₂, D₁, D₂, and E₁, E₂ out of six studied sites had concentration level approaching the maximum permissible limit. In post rainy season its concentration was ranged from 0.048 – 0.078 mg L⁻¹ now this time at site B₁, B₂ the concentration of Cr is reached to maximum permissible limit (Table 4 and 5). High concentration of Cr in groundwater may cause ulceration of nasal septum and dermatitis. High concentration of Cr values may be related to the industrial influence. Chromium (Cr) may cause skin disorder and cancer in respiratory track [14].

5 Manganese (Mn)

It is one of the most abundant metals in the earth's crust and usually occurs together with iron. On exposure to oxygen Mn and form insoluble oxide that may result in undesirable deposits. Permissible limit of manganese concentration in drinking water is 0.5 mg L⁻¹ (4, 2004). In ground water samples of Bareilly region Mn concentration was found in the range of 0.26 – 0.52 mg L⁻¹, at D₁ and D₂ sites (Table 4) it range was observed slightly high then permissible limit and in post rainy season it range was observed from 0.32 – 0.54 mg L⁻¹ (Table 5) and at this period of study its higher concentration was noted at the site A₁ and A₂ (0.54 mg L⁻¹) followed by the site D₁ and D₂ (0.50 mg L⁻¹) which is slightly higher than the permissible limit of [4] (2004),

and at other station it was found below the permissible limit in both the seasons.

6 Lead (Pb)

Pb concentration in natural water increases mainly through anthropogenic activities. Lead occurs geologically in association with sulphide minerals and may be present in generally elevated concentration in areas with ores and coal [15]. Lead can cause several unwanted effects, such as disruption of the biosynthesis of hemoglobin and anemia, a rise in blood pressure, kidney damage, miscarriages and subtle abortions, disruption of nervous systems, brain damage and behavioral disruptions of children, such as aggression,

impulsive behavior and hyperactivity. The prescribe limit of Lead concentration in drinking water is 0.1 mg L⁻¹ (4, 2004). In the present study, lead concentration ranged from 0.01 - 0.09 mg L⁻¹ in pre rainy season and highest concentration was found at B₁ and B₂ site and in post rainy season it was ranged from 0.09 – 0.13 mg L⁻¹ (Table 4 and 5), there is remarkable concentration of Pb was found i.e. 0.13 mg L⁻¹ at D₁ and D₂ sampling site it is about 13 fold more than pre rainy season.

Trace elements concentration during pre-rainy season has been correlated with post rainy season which shows the positive relation amongst all trace elements except Aluminium which has slightly lower correlation as compared to other trace elements (Table 6). The positive correlation shows the percolation of trace elements was increased during rainy season which increases the amount of trace elements in underground water.

IV CONCLUSION

Organized study of the chemical data obtained as results of ground water samples from different tehsils and following conclusion are made:

1. There should be need of regular monitoring of ground water.
2. Water should be carefully treated before using.
3. Most of the time concentration of studied trace elements concentration was found below the prescribed level [4] and [10] sometime some of trace elements concentration was found equal to or slightly high than permissible limit.
4. In pre rainy season concentration of trace elements found lower than in comparison to post rainy season.
5. Lower concentration of trace element found in pre rainy season due to the excessive evaporation level of ground water goes low and the trace element settle down low.
6. It is found higher in post rainy season due to the excessive run off and percolation of impurities, lower temperature in season mention the ground water level high.

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