# Systematic Study of Arsenic Contamination in Irrigation Well and its Surrounding Drinking Water Well in Chakdaha Block of West Bengal, India using Different Parameters

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**Abstract:** All over the world ground water is used for drinking, domestic (cooking, bathing) and agricultural purposes. In the last few decades in several countries, it has been found that ground water is contaminated with geogenic arsenic (As). Arsenic contamination is mostly reported in south-east Asian countries namely India (mainly West Bengal) and Bangladesh. It has been found that arsenic contamination is mostly occurred in rural part of Bengal Delta Plan (BDP) where summer irrigation has been regularly used for Boro-cultivation. Arsenic mobilisation from ground to surface water happens due to the pumping of ground water. The present study highlights the role of pumping on Arsenic mobilization. Three different villages [Site 1 (Sashipur), Site 2 (Mathurgachi) and site 3 (Banamalipara)] have been selected where pumping is going on by irrigation well and a few drinking wells are surrounded with pumping well. The study indicates that two different situations have been observed in between three different study areas, the situation 1: site 2 and site 3 where As concentration in ground water in large remain unchanged during pumping period (starting and ending). However, in ground water quality parameters such as bicarbonate, conductivity, pH, hardness and iron has been changed along with increase in as concentration. These further suggest that there will be intense sediment water interaction in the site1 that ultimately reflected in change of the ground water quality. Apart from this it has been found that a pond is also located very near about ~5-10m to the irrigation well site1. There is good possibility that the pond can supply fresh organic matter to the aquifer due to pumping and thereby increasing sediment water interaction which ultimately increases As concentration in ground water.

**Keywords:** Pumping effect, Sampling, Measurement and Arsenics mobilization, Study of different parameter, and Comparative study in selected area.

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## 1. Introduction:

Drinking water is one of the most important pathways of exposure to arsenic in human population and ground water as a drinking source is thought to be responsible for the majority of the world's chronic health problem [1].Arsenic contamination in ground water has emerged as a major quality problem and health hazard kin parts of the country. In first reported case of arsenic contaminated ground water was detected in the year 1978 in West Bengal [2]. There were diagnosed 1983 by the School of Tropical Medicine (STM) and All Institute of Hygiene and Public Health (AIIH &PH) [3]. It was observed that the people suffering from arsenical dermatitis were consuming ground water and when the samples of ground water of respective area were chemically analyzed; those were found to contain arsenic beyond the permissible limit of 0.05mg/l [4].

As per the BIS (Bureau of India Standard) standard of drinking water (BIS 1991 and subsequent modification), the maximum permissible limit of the arsenic concentration in ground water is 0.05mg/l. Arsenic concentration in ground water >0.05mg/l, as permissible limit has been taken up based on recommendation of the task force set up in West Bengal. 0.05mg/l has been accepted as regulatory limit for the country. This was also recommended as permissible by earlier-by-earlier BIS standard. Ground water is the major source of human intake of as even is food chain like rice some time contributing substantially. High As ground water where millions of people are now suffering from serious health hazards included cancer [5].

The scale of the problem is grave and unprecedented both in terms of human exposure (~60-80 million) and geographical area coverage (173x103km$^2$) [6]. The presence of As in ground water, higher than the stipulated Indian Standard (50µg.L$^{-1}$drinking water quality standard for most countries) and WHO guideline value

(10µg.L$^{-1}$) for human consumption was first reported from West Bengal, India during early 1980's with first diagnosed case of arsenicosis [7]. As was widespread in the West Bengal Part of BDP and with frequent case of arseicosis was reported from 79 Block spread over nine districts covering ~3700km$^2$ in West Bengal, Starting from Malda to 24-Pgs(s) [8]. In West Bengal high as ground water areas (barring Purbasthali, Bardhaman district and Balaghar, Hoogly district) are confined to the west of the Bhagirathi River. However, in the eastward extension of BDP(Bangladesh), the natural Arsenic "hot spots" have much wider spatial distribution in those "hot spots) more than 90% of the shallow well are shown to have elevated levels of arsenic compared to Bangladesh National Standard (50µgL$^{-1}$), Through the resultant health problem was first diagnosed only in 1993 [9].

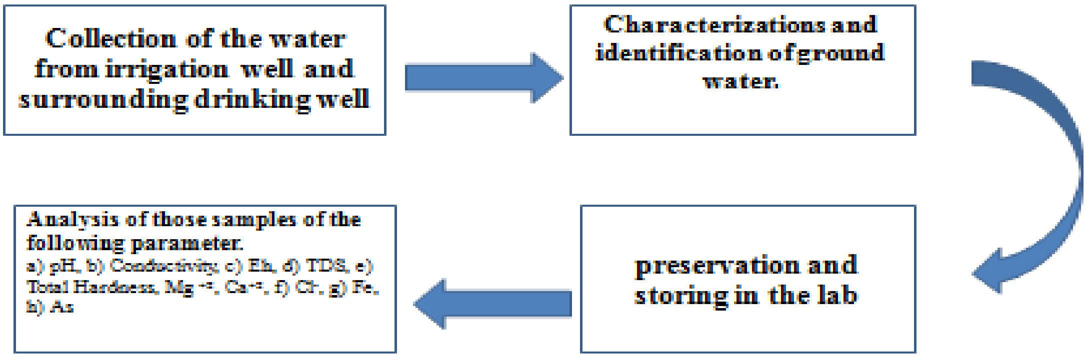
In nature Arsenic (0,-3, +3,+5 oxidation state) exist in both inorganic as well as organic form [10]. Dissolved forms of arsenic (+5), arsenic (+3), mono metrhyl arsenic and (MMA), However, the degree of toxicity solely depends on the form (inorganic/organic) and more toxic than organic forms (MMA/DMA) among the inorganic, the trivalent ($AsO_3^{3-}$) are likely to be more toxic than pentavalent ones ($AsO_4^{3-}$) [11]. Therefore, the prices (both aqueous and solid phases) are important because more toxic and labile As (III) is now globally identified as major public health issue [12].

The understanding of the behaviour and distribution of redox species in natural waters are essential to explain recently found large-scale ground water contamination reported from various part of the world [13]. Therefore, the present paper focus on the hydro-chemistry of high As ground water as well as interaction between water and arsenic traps to understand the release of redox sensitive species into ground water under local reducing condition. Moreover, understanding the distribution of redox species in natural water is also essential to explain the large-scale ground water contamination in the BDP. The different forms of As mobilization as well level of toxicity during human exposure. Attempts have also been made to visualize the geochemistry of the deltaic environment in relation with speciation of As [14].

Arsenic in ground water is found mainly in aquifers up to 100 meter depth [15]. The deeper aquifers free from arsenic contamination are found in some exceptional cases. At present about 162.6 lakhs people (35.8% of the total population of the state) live in the risk zone of potential threat terms of Arsenic related disease. Our site is worst affected by arsenic particularly in deltaic region of West Bengal, mostly in many parts of Nadia District. Ground is the potential resource of portable water, whether in recent time due to serious problem like, arsenic fluoride contamination have received serious problem suffering by human being [17].

Recent studies have revealed that human exposure of As resulted from several pathway such as drinking water food, beverage, soil, inhalation of dust and atmospheric particulates [17].Arsenic once ingested (mostly as oxy-anions), can be metabolized in human system through various process and pathway to form large number of metabolites of As [As (III)] has shown to be cytotoxic, more potent inhibitor and stronger promoter of oxidative DNA damage [18]. Skin lesions including pigmentation change and keratosis are commonly thought to be the hallmark features of as exposure including internal and external cancers, peripheral vascular diseases, hypertension and diabetes [19-20]. It was observed that the variability in the capacity of As methylation among individual might extra significantly control on human As toxicity [21]. Nutritional status is also an important factor in the methylation capacity of individuals and especially float has an important role in the methylation and excretion of Arsenic (As) [22].Therefore, the present study was under taken with the following objective: a) To study the arsenic contamination in shallow irrigation wells. b) To study Arsenic contamination relationship between surrounding drinking water wells and irrigation wells.

**Step wise working plan:**



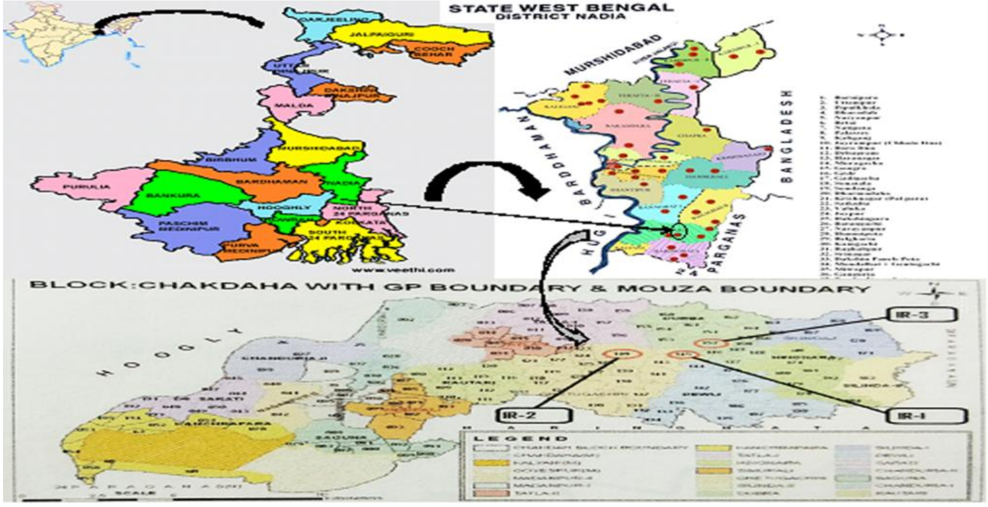
## 2. Study area:

**Location and demography:**

Nadia is one of the badly arsenic affected districts of West Bengal, is the current study area in this worked area is a part of Chakdaha Block. In the given map indicate my study area. Red boader circle are my sampling Zone 140(IR2), 145(IR1) and 152(IR3) respectively. Samples are collected from the location given below.

| **IR1- Sahispur<br>(23$^o$04’10.2’’N,088$^o$36’29.3’’E)** | **IR2-Banamalipara<br>(23$^o$04’36.1’’N,088$^o$36’37.9’’E)** | **IR3-Mathurgachi<br>(23$^o$03’58.2’’N,088$^o$35’48.2’’E)** |
|---|---|---|
| S-I: Sahispur<br>(23$^o$04’10.2’’N,088$^o$36’31.3’’E) | S-6 Banamalipara<br>(23$^o$04’36.3’’N,088$^o$36’32.8’’E) | S-11 Mathurgachi<br>(23$^o$03’59.4’’N,088$^o$35’50.2’’E) |
| S-2 Sahispur<br>(23$^o$04’14.8’’N,088$^o$36’28.9’’E) | S-7 Banamalipara<br>(23$^o$04’36.3’’N,088$^o$36’32.8’’E) | S-12Mathurgachi<br>(23$^o$03’58.3’’N,088$^o$35’38.5’’E) |
| S-3 Sahispur<br>(23$^o$04’14.8’’N,088$^o$36’28.9’’E) | S-8 Banamalipara<br>(23$^o$04’34.6’’N,088$^o$36’32.8’’E) | S-13Mathurgachi<br>(23$^o$03’56.6’’N,088$^o$35’47.6’’E) |
| S-4 Sahispur<br>(23$^o$04’15.3’’N,088$^o$36’30.3’’E) | S-9Banamalipara<br>(23$^o$04’33.6’’N,088$^o$36’32.5’’E) | S-14Mathurgachi<br>(23$^o$04’0.9’’N,088$^o$35’53.8’’E) |
| S-5 Sahispur<br>(23$^o$04’16.4’’N,088$^o$36’33.3’’E) | S-10 Banamalipara<br>(23$^o$04’31.7’’N,088$^o$36’33.5’’E) | S-15Mathurgachi<br>(23$^o$04’0.92’’N,088$^o$35’55.1’’E) |

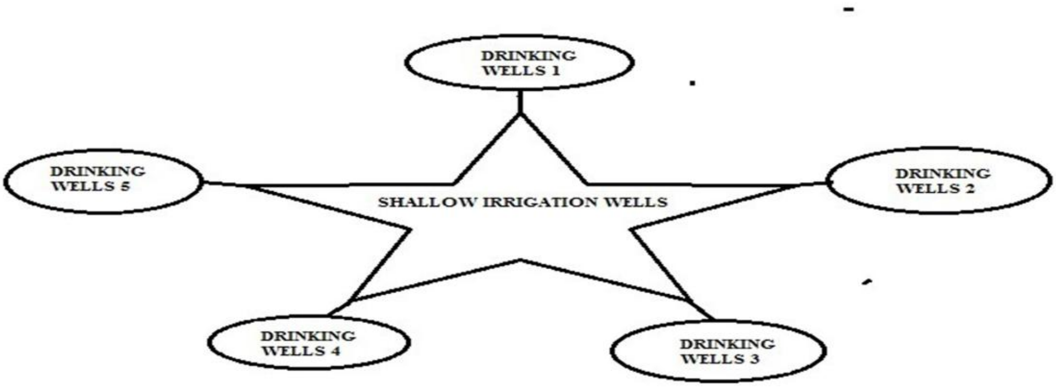
Fig.1: Schematic representation of study area.



## 3. Sampling and Sampling Frame

Water Samples were collected from the irrigation and drinking water wells of three villages [Site I (Sahispur), Site II (Banamalipara) and Site III (Mathurgachi)]. In total 18 samples were collected, three samples from irrigation (shallow) and fifteen from drinking tube wells. Here three irrigation wells and five drinking tube wells (corresponding to each irrigation wells) were selected from three different villages for sampling of the irrigation wells with a time interval of 10-15 minutes.

**Sampling Pattern:**



## 4. Methodology and Procedure:

**pH:** First the container was washed with distilled water (which contains the sample solution). The electrode was washed with distilled water and dried with tissue paper. Now the pH of the samples was measured by immersing the electrodes into the sample using Multimeter.

**Conductivity:** Conductivity of the samples measured using Multimeter.

**Total Hardness:**

To measure hardness (as mg/L $CaCO_3$) 50ml was taken in a conical flask (when sample have higher concentration in calcium then smaller volume of sample was taken). 1 mL buffer solution was added to it 2-3 drops of EBT (Eriochrome Black-T) indicator was added to it until the solution turns to wine red. Then the content was titrated against 0.1M EDTA solution until the colour changes pink colour.

**Calcium:**

50ml sample was taken in a conical flask (if the sample having higher alkinity then smaller volumes was taken and dilute to 50ml). 2mL 1N NaOH was added to it. 100-200 mg of murexide indicator added to it to develop a pink colour. The content was the titrated with 0.01M EDTA solution until the colour changes pink to purple.

**Magnesium:**

The amount of magnesium was obtained by subtracting the amount of calcium from the total amount calcium and magnesium.

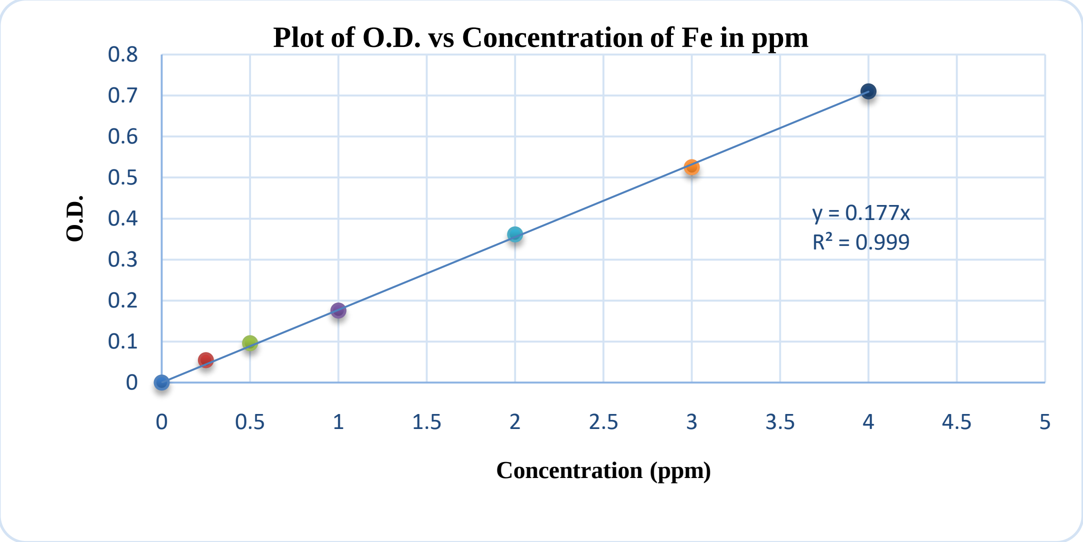
**Iron:**

Iron is determined spectrophotometrically (UV, UV-1) by developing the orange red colour with 1,10 phenanthroline at pH 3.2-3.3. The colour intensity of this red colour intensity of this complex is proportional to the concentration of Iron (II).

Total iron (+II, +III) is converted to Fe (II) state by reduction with conc. HCl and hydroxylamine Hydrochloride. Absorbance of this coloured complex was red out at 525nm on spectrophotometer.

| Concentration (ppm) | O.D. value |
|---|---|
| 0.00 | 0.00 |
| 0.25 | 0.055 |
| 0.50 | 0.096 |
| 1.00 | 0.176 |
| 2.00 | 0.361 |
| 3.00 | 0.525 |
| 4.00 | 0.710 |

Fig-1 Calibration Curve:



This is the calibration curve for estimation of Fe by colorimetric method. Absorbance value is plotted along Y-axis and the concentration (in ppm) of the standard solution is plotted along X-axis. From the slope of the graph the concentration of unknown samples are determined.

**Chloride:**

Silver nitrate reacts with chloride to form slightly soluble white precipitate of AgCl. At the end point when all chloride gets precipitated, free silver ions react with chromate to form silver chromate of reddish brown colour. 5ml of sample taken in a conical flask and 2 ml of $K_2Cr_2O_4$solution was added to it. The content was titrated against 0.1N $AgNO_3$solution.

**Arsenic:**

The total arsenic concentration of ground water was analysed by atomic absorption spectrophotometer, where the standard solution was passed first time and got the standard curve. The arsenic concentration of colourless water sample solution was measured with respect to the standard curve.

**Table for sampling location and some survey report:**

**Table 1(for irrigation Wells):**

| Sample No | Location | Depth of Irrigation(ft) | Discharge rate (L/h) | Installation Yr. | Duration of Discharge (h/day) | Cultivated area (Bigha) | Activity |
|---|---|---|---|---|---|---|---|
| IR-1 | Sahispur (23°04’10.2’’N,088°36’29.3’’E) | 70 | 2700-3000 | 5 | 6 | 5 | Bororice (miniket) |
| IR-2 | Banamalipara (23°04’36.1’’N,088°36’37.9’’E) | 70 | 2700-3000 | 18 | 18 | 8 | Bororice (miniket) |
| IR-3 | Mathurgachi (23°03’58.2’’N,088°35’48.2’’E) | 70 | 2700-3000 | 9 | 10 | 6 | Bororice (miniket) |

**Table 2 (for drinking wells)**

| Sample No. | Location | Depth of the Tube wells (ft) | Installation yr. | Distance from the irrigation well (ft) | Activity |
|---|---|---|---|---|---|
| S-1 | Sahispur (23°04’10.2’’N,088°36’31.3’’E) | 50 | 4 | 400 | Drinking, washing |
| S-2 | Sahispur (23°04’14.8’’N,088°36’28.9’’E) | 150 | 23 | 450 | Drinking, bathing |
| S-3 | Sahispur (23°04’14.8’’N,088°36’28.9’’E) | 130 | 7 | 500 | Drinking, bathing |
| S-4 | Sahispur (23°04’15.3’’N,088°36’30.3’’E) | 50 | 6 | 500 | Drinking, bathing |
| S-5 | Sahispur (23°04’16.4’’N,088°36’33.3’’E) | 50 | 4 | 450 | Drinking, washing |
| S-6 | Banamalipara(23°04’36.3’’N,088°36’32.8’’E) | 70 | 3 | 550 | Drinking, washing |
| S-7 | Banamalipara(23°04’36.3’’N,088°36’32.8’’E) | 70 | 1 | 500 | Drinking, washing |
| S-8 | Banamalipara(23°04’34.6’’N,088°36’32.8’’E) | 70 | 12 | 450 | Drinking, washing |
| S-9 | Banamalipara(23°04’33.6’’N,088°36’32.5’’E) | 70 | 7 | 350 | Drinking, washing |
| S-10 | Banamalipara(23°04’31.7’’N,088°36’33.5’’E) | 50 | 2 | 550 | Drinking, washing |
| S-11 | Mathurgachi(23°03’59.4’’N,088°35’50.2’’E) | 110 | 5 | 500 | Drinking |
| S-12 | Mathurgachi(23°03’58.3’’N,088°35’38.5’’E) | 120 | 3 | 450 | Drinking |
| S-13 | Mathurgachi(23°03’56.6’’N,088°35’47.6’’E) | 70 | 1 | 350 | Drinking |
| S-14 | Mathurgachi(23°04’0.9’’N,088°35’53.8’’E) | 50 | 1 | 250 | Drinking |
| S-15 | Mathurgachi(23°04’0.92’’N,088°35’55.1’’E) | 70 | 7 | 300 | Drinking |

**Experimental Results:**

**Table1. For cycle- I experimental data’s (IR-I and Surrounding Drinking Wells)**

| Sample no. | pH | Conductivity (µs/cm) | Eh (mv) | TDS (mg/lit) | Alkinity | Total hardness (ppm) | Ca (ppm) | Mg (ppm) | $Cl^-$ (ppm) | Fe (ppm) | As (ppb) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| IR1 | 6.88 | 616 | 33.8 | 394 | 409.5 | 291 | 169 | 122 | 14.2 | 2.12 | 12.0 |
| S-1 | 6.86 | 580 | 16.5 | 371 | 409.5 | 272 | 161 | 111 | 12.78 | 1.89 | 20.0 |
| S-2 | 8.86 | 618 | 13.4 | 396 | 409.5 | 295 | 153 | 142 | 14.05 | 1.92 | 11.7 |
| S-3 | 6.90 | 566 | 9.7 | 362 | 400.5 | 257 | 154 | 103 | 12.78 | 1.85 | 39.5 |
| S-4 | 6.98 | 618 | 8.4 | 395 | 458 | 261 | 162 | 99 | 12.78 | 2.14 | 97.5 |
| S-5 | 6.82 | 850 | 10.2 | 544 | 454 | 312 | 181 | 131 | 30.92 | 1.94 | 75.5 |

**Table 2. For cycle- II experimental data’s (IR-I and Surrounding Drinking Wells)**

| Sample no. | pH | Conductivity (µs/cm) | Eh (mv) | TDS (mg/lit) | Alkinity | Total hardness (ppm) | Ca (ppm) | Mg (ppm) | $Cl^-$ (ppm) | Fe (ppm) | As (ppb) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| IR1 | 6.81 | 626 | 21.7 | 400 | 412 | 306 | 193 | 113 | 14.6 | 2.16 | 22.27 |
| S-1 | 6.80 | 591 | 13.7 | 378 | 411 | 294 | 181 | 113 | 15.6 | 1.91 | 31.10 |
| S-2 | 6.85 | 624 | 13.1 | 399 | 416 | 329 | 190 | 139 | 14.78 | 1.98 | 19.90 |
| S-3 | 6.90 | 576 | 9.2 | 368 | 409 | 252 | 159 | 93 | 14.2 | 1.90 | 51.10 |
| S-4 | 6.92 | 627 | 6.2 | 401 | 468 | 267 | 178 | 89 | 15.6 | 2.17 | 108.1 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S-5 | 6.78 | 858 | 9.8 | 594 | 464 | 320 | 197 | 123 | 34.08 | 1.99 | 89.50 |

**Table 3. For cycle- I experimental data's (IR-II and Surrounding Drinking Wells)**

| Sample no. | pH | Conductivity (µs/cm) | Eh (mv) | TDS (mg/lit) | Alkinity | Total hardness (ppm) | Ca (ppm) | Mg (ppm) | Cl$^-$ (ppm) | Fe (ppm) | As (ppb) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| IR2 | 6.81 | 566 | 19.1 | 362 | 409.5 | 306 | 201 | 105 | 18.46 | 1.86 | 16.6 |
| S-6 | 6.80 | 574 | 14.6 | 367 | 351.0 | 244 | 140 | 104 | 18.46 | 1.82 | 9.4 |
| S-7 | 6.78 | 521 | 17.2 | 333 | 351.0 | 236 | 143 | 143 | 22.15 | 1.98 | 7.4 |
| S-8 | 6.76 | 731 | 19.4 | 468 | 409.5 | 298 | 190 | 190 | 29.82 | 1.95 | 2.5 |
| S-9 | 6.82 | 919 | 19.2 | 588 | 468.0 | 380 | 198 | 198 | 5.82 | 1.53 | 9.6 |
| S-10 | 6.91 | 743 | 10.9 | 475 | 526.5 | 333 | 201 | 201 | 22.72 | 1.43 | 11.4 |

**Table 4. For cycle- II experimental data's (IR-II and Surrounding Drinking Wells)**

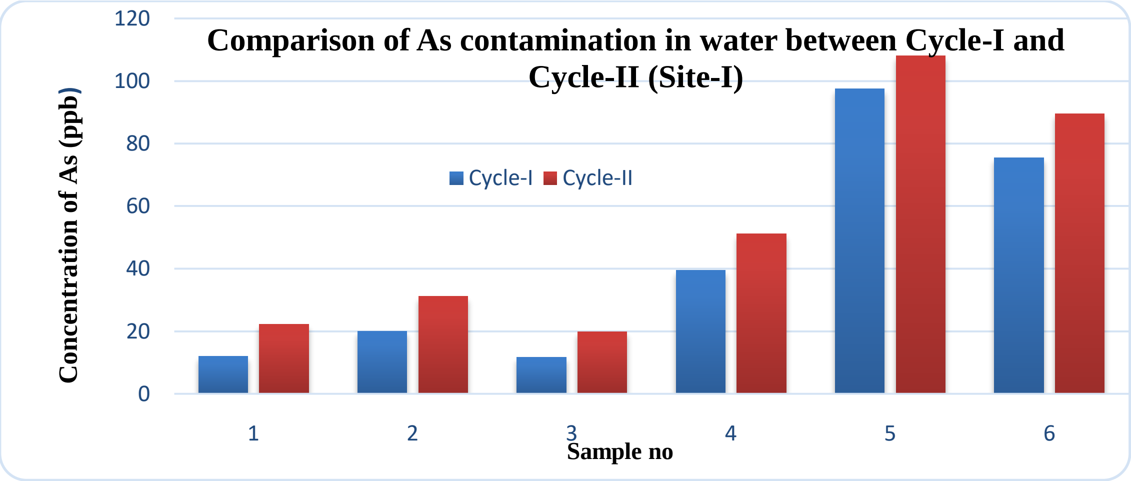
| Sample no. | pH | Conductivity (µs/cm) | Eh (mv) | TDS (mg/lit) | Alkinity | Total hardness (ppm) | Ca (ppm) | Mg (ppm) | Cl$^-$ (ppm) | Fe (ppm) | As (ppb) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| IR2 | 6.79 | 571 | 15.9 | 365 | 412.0 | 311 | 206 | 105 | 19.43 | 1.86 | 16.9 |
| S-6 | 6.78 | 576 | 17.9 | 369 | 355.0 | 242 | 138 | 104 | 18.42 | 1.82 | 9.5 |
| S-7 | 6.77 | 524 | 17.0 | 335 | 354.0 | 240 | 145 | 95 | 24.15 | 1.98 | 8.3 |
| S-8 | 6.72 | 730 | 18.9 | 467 | 410.0 | 296 | 187 | 109 | 29.74 | 1.95 | 2.4 |
| S-9 | 6.81 | 928 | 18.2 | 594 | 472.0 | 384 | 201 | 183 | 6.24 | 1.53 | 10.1 |
| S-10 | 6.89 | 746 | 10.1 | 477 | 529.5 | 338 | 204 | 134 | 24.08 | 1.43 | 12.0 |

**Table 5. For cycle- I experimental data's (IR-III and Surrounding Drinking Wells)**

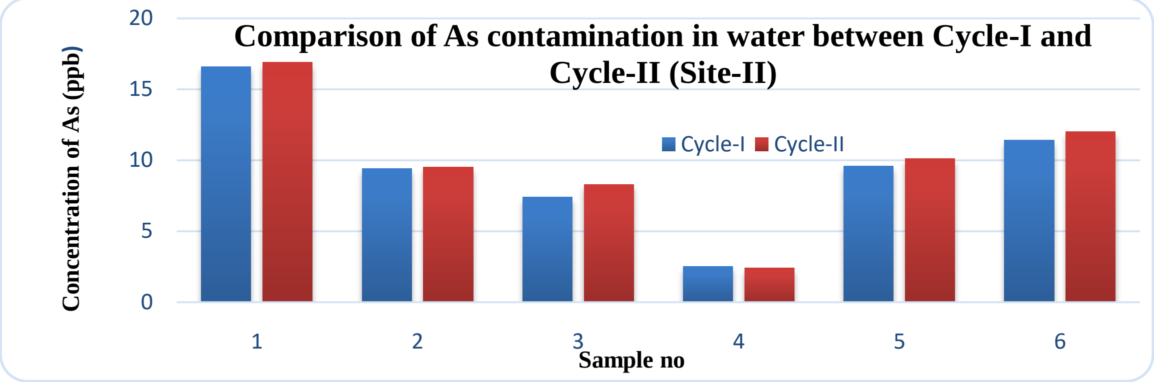
| Sample no. | pH | Conductivity (µs/cm) | Eh (mv) | TDS (mg/lit) | Alkinity | Total hardness (ppm) | Ca (ppm) | Mg (ppm) | Cl$^-$ (ppm) | Fe (ppm) | As (ppb) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| IR3 | 6.71 | 590 | 21.4 | 377 | 409.5 | 287.2 | 166.84 | 121 | 9.94 | 1.89 | 10.2 |
| S-11 | 6.58 | 613 | 28.7 | 392 | 351.0 | 298.7 | 159.60 | 139 | 9.94 | 1.99 | 12.8 |
| S-12 | 6.80 | 586 | 16.3 | 375 | 392.5 | 298.0 | 174.60 | 124 | 7.10 | 1.97 | 9.3 |
| S-13 | 6.91 | 646 | 9.9 | 413 | 409.5 | 318.1 | 186.24 | 132 | 11.36 | 1.95 | 14.3 |
| S-14 | 6.82 | 983 | 15.6 | 629 | 526.5 | 457.5 | 302.64 | 155 | 5.40 | 1.98 | 4.4 |
| S-15 | 7.02 | 710 | 4.0 | 454 | 526.3 | 345.5 | 190.12 | 155 | 21.3 | 2.82 | 3.7 |

**Table 6. For cycle- II experimental data's (IR-III and Surrounding Drinking Wells)**

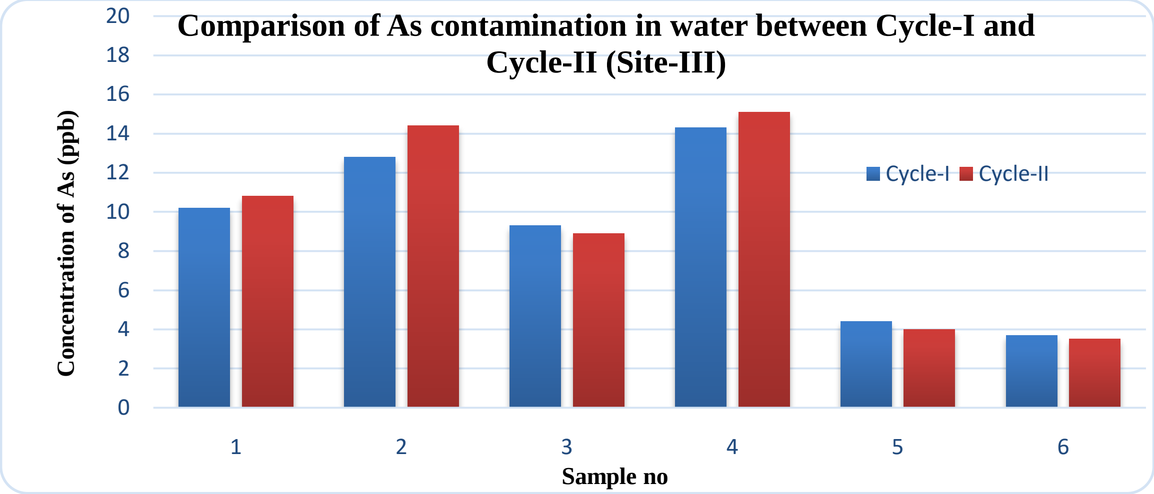
| Sample no. | pH | Conductivity (µs/cm) | Eh (mv) | TDS (mg/lit) | Alkinity | Total hardness (ppm) | Ca (ppm) | Mg (ppm) | Cl$^-$ (ppm) | Fe (ppm) | As (ppb) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S-R3 | 6.71 | 592 | 21.0 | 379 | 412 | 288.0 | 169.0 | 119 | 9.99 | 1.90 | 10.8 |
| S-11 | 6.58 | 616 | 27.9 | 394 | 353.0 | 299.5 | 161.0 | 138 | 9.98 | 2.01 | 14.4 |
| S-12 | 6.80 | 588 | 16.1 | 376 | 395.0 | 298.0 | 176.60 | 122 | 7.15 | 1.99 | 8.9 |
| S-13 | 6.91 | 649 | 9.8 | 415 | 410 | 317.8 | 188.24 | 130 | 11.46 | 1.97 | 15.1 |
| S-14 | 6.82 | 985 | 15.4 | 630 | 528 | 458.0 | 304.64 | 154 | 5.49 | 1.98 | 4.0 |
| S-15 | 7.02 | 714 | 3.9 | 457 | 527.5 | 348.0 | 195.12 | 153 | 21.39 | 2.84 | 3.5 |



**1. Comparison of As contamination in water between cycle-I and cycle-II (Site-I)**



**2. Comparison of As contamination in water between cycle-I and cycle-II (Site-II)**



**3. Comparison of As contamination in water between cycle-I and cycle-II (Site-III)**

## 5. Result and Discussion:

The ground water composition analysis of three different sites(site-I, site-II and site-III) have been presented in Table 1 to Table 6.The tendency of the data reflect that in site-I the chemical composition of the ground water has been found changed with respect to sampling time. It is interesting to note that in site-1, the As concentration has been changed significantly whereas in site-II and site-III As concentration has not changed, in fact practically remain identical. Similarly, it has been found that in the site-I the pH has become slightly changed and shifted towards acidic environment. Furthermore, it has been also found that the conductivity has been slightly increased in comparison to first cycle and second cycle which means that the system has become a little more anoxic than previous measurement of the ground water samples. It is interesting to note that the hardness of the later sampling period has been increased due to increase in mineral dissolution during intensive sediment interaction. As and Fe arc redox element and their concentration can be changed when environment. Our data clearly indicates that when the environment changes (oxic to anoxic) then redox element also increases. These redox reactions are generally occurred with the help of natural organic matter.

For example, the following reactions are considered:
$O_2 + C_{org} \rightarrow H_2O + CO_2$
$NO_3^- + C_{org} \rightarrow N_2 + HCO_3^- + CO_2$
$MnO_2(s) + C_{org} \rightarrow Mn^{2+} + HCO_3^-$
$FeOOH\ (s) + C_{org} \rightarrow Fe^{2+} + HCO_3^-$

In all the above reaction the end product is redox element such as Fe, Mn, along with $HCO_3^-$. As can be released when sobbed on iron surface and As will be released during Fe reduction.

Our data also support this above idea and it has been found that the alkalinity ($HCO_3^-$) has been increased during the 2nd time period of the sampling where As has also been increased.

The similarity and dissimilarity in Site-I and Site-II, Site-III are very remarkable. The field security of the sites (Site-I, II, III) reviled that site –I possess a big pond where As concentration has been increased. There is good possibility that the pond may supply trace organic matters into the aquifer due to pumping. It has also been observing the pond is rapidly drying the summer which means that the pond is acting like an infiltration basin due to sandy layer below the pond circus. This trace organic matter can act as a rapidly electron donor into the aquifer and thereby rapidly changing the chemical kinetics and thereby increasing As concentration in the aquifer.

The above fact is further corroborated by the increasing of alkalinity in the aquifer. The increase in alkalinity is to break down of organic matter (possibility microbial) and therefore producing final by product $CO_2$and $H_2O$ ($CO_2 + H_2O \rightarrow HCO_3$). This clearly indicates that increase in alkalinity is an indication of bio-indicator and thereby helping faster redox reaction and dissolution sedimentary iron minerals and thereby dissolving sobbed As on iron mineral phase.

## 6. Conclusion:

This has been notice during the difference in the site-I, site-II and site-III where site-II has do not associated with any pond whereas site-I has been associated with pond.

The concentration of arsenic in site-I of the district Nadia particularly at Chakdaha is found to be alarming. The average value of arsenic concentration in the observed area is 0.054mg/L with the minimum 0.012 mg/L and maximum 0.110mg/L.

Considering the above discussion and data it can be highly recommended and avoiding drinking water of arsenic contaminated water in the study area and using the alternate source and use of ground water from the fresh aquifer zones where such contamination has not yet been occurred. Particularly it is also recommended that to avoid water of such deep tube wells in irrigation purpose and findalternative source or such contamination has not yet been occurred ground water from the fresh aquifer zones where such contamination has not yet been occur.

Due to summer paddy cultivation farmers are pumping a significant amount of ground water. This Fe (II) is quickly oxidized to Fe (III) and there by arresting arsenic. This process has significantly increased the arsenic concentration in water.

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