Arsenic Screening of Ground Water From Tube Wells Located Within Chittagong City

Abid Moin Uddin & Md. Toufiqul Islam

Abstract— Arsenicosis is a well-known chronic disease which occurs due to the reason of drinking arsenic concentrated tube well water. Tube well water of 60 districts in Bangladesh is suffering from danger level of arsenic concentration. Chittagong is one of them. But the city area was not thoroughly screened out as it was thinking that also arsenic is not present in Chittagong city ground water. But recent research revealed that there are 13 wards of the city are affected by arsenic. Out of these 7 wards are vulnerable to human health. The investigation which is done in 2010 includes the through screening of shallow tube well water in two wards in term of arsenic concentration, Some deep tube well water also checked randomly for the same. The screening has been done on the basis of field test through well established test kit. From the investigation it has been established that the arsenic affected pockets are present in the ward. Also the numbers of affected tube wells, the percentage of area contamination are specified and a discussion has been made regarding the possible reasons for the arsenic contamination.

Keywords— Arsenic concentration, Arsenic contamination, Wagtech, Shallow Tube well, Drinking Water, Chittagong, Bangladesh.

1 INTRODUCTION

ARSENIC poisoning is more often thought of as a topic for a mystery novel but it is a grim part of our life.The groundwater pollution caused by arsenic in a number of Asian countries has led to a major environmental crisis. Some recent estimates indicate that more than 35 million people in West Bengal (India), Nepal and Bangladesh are potentially at risk from drinking arsenic-contaminated water [1]. The crisis has its roots in another worthy effort to fight water-borne diseases that had impacted this tropical region for a long time. Acute health problems, such as gastrointestinal diseases and infant mortality, were attributed to drinking microbiologically-contaminated surface water. It was widely believed that using groundwater would easily circumvent the problem because groundwater at certain depths is not exposed to microbiological contamination. It is now known that the alluvial aquifer that underlies the Ganges-Brahamputra river basin contains arsenic in mineral form. During the past two decades about four million wells have been installed to utilize the groundwater from shallow aquifer layers, typically less than 200m deep [2]. Exploitation of groundwater from these wells for drinking water and irrigation purposes has resulted in mobilizing the arsenic [3].

Awareness about the pollution of drinking water with arsenic and the significance of the crisis has risen significantly during the 1990's. Naturally-occurring and human-induced arsenic pollution in drinking water has since been discovered in many parts of the world. It is now recognized that dealing with arsenic contamination in groundwater may be a problem of global dimensions.

2 STUDY AREA

Detail arsenic screening has been conducted in two wards among 41 wards of Chittagong City. Name of the two selected wards are ward no 6 (East Sholoshahar), ward no 26 (North Halishahar) [4]. Study area has been shown in Fig1. Chittagong City Corporation (CCC) is the second largest city of Bangladesh, has a major seaport and is considered the heart of all commercial and business activities. The national government declared Chittagong as the commercial capital of the country which situated in the south-eastern part of Bangladesh and stands on the bank of river Karnaphuli. At present, the city's land area occupies around 155 km2 inhabited by about 4 million people (2001 CCC census). Chittagong Water Supply and Sewerage Authority (CWASA) which is the authority for water supply and sewerage only supply water to one-third of city dwellers. Rest of people depends on the shallow tube well and deep tube well.

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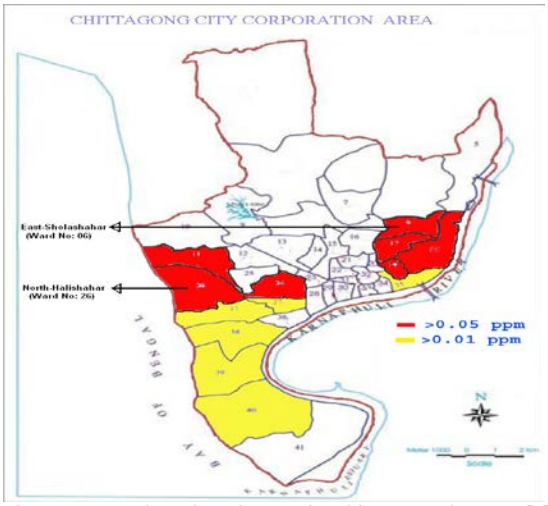

Figure 1: Location of study area in Chittagong city area [4]

3 ALLOWABLE ARSENIC CONCENTRATION IN DRINKING WATER

The World Health Organization has fixed a provisional guideline for maximum concentration of arsenic in water which is tolerable foe human body. Under the guideline, the WHO recommended that the concentration 0.01mg/L arsenic in water is safe & tolerable. This is a provisional guideline and it is not compulsory to follow. In Bangladesh, the maximum permissible level of arsenic in water has been fixed at 0.05mg/L. The standard is not the same in different countries in Europe, America and other part of the world. Maximum Admissible Concentrations for Arsenic in Drinking Water has been given in the Table 1 [5].

Table 1: Maximum Admissible Concentrations for Arsenic in Drinking Water [5]

Country/ Agency	MAC (mg/l)	Country/ Agency	MAC (mg/l)
USA	0.01	Bureau of Indian Standard	0.05
Great Britain	0.05	Russia	0.05
Canada	0.025	Bangladesh	0.05
Japan	0.01	Srilanka	0.05
Australia (1996)	0.007	Zimbabwe	0.05
WHO (1980)	0.05	China	0.05
WHO (1993)	0.01	Indonesia	0.05
EU	0.01		

4 METHODOLOGY

All shallow tubewell water will be screened for arsenic concentration in the field itself using a well established field test kit named 'Wagtech Arsenic Kit' as it was superior to other test kits (Arsenic concentration in ground water within Chittagong city, CUET). It was selected by earliar research (Arsenic concentration in ground water within Chittagong city, CUET) on the basis of criteria mainly accuracy point of view. The Wagtech kit box with color chart has been shown in Fig 2. Simultaneously, some deep tubewell water were also checked for arsenic concentration as random basis so that it can be assured the earliar research theme that no deep tube well water is contaminated by arsenic.Moreover the distance between the tubewell & the latrine has been measured to check out either the distance is safe for faecal contamination or not.

For creating awareness among the people of the ward, discussion had done to describe the ill-efects of arsenicosis & how they can be free from this desease.

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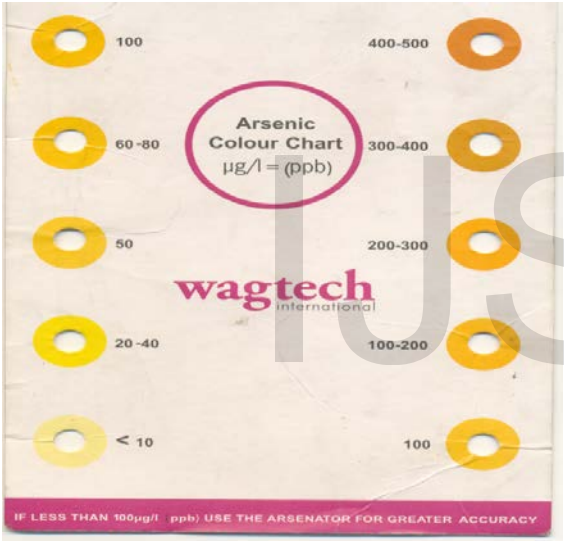

Figure 2: (a) Wagtech Arsenic kit box (b) color chart

5 FIELD INVESTIGATION

At first a general survey on the total area is done.Then all the shllow tubewell & some deep tubewell samples of the ward area have tested by Wagtech Arsenic kit in field. But during field investigation it has also been observed that in some areas, there are very few shallow tube wells where people relay on CWASA and deep tube wells for drinking water and in some other places there are too many shallow tube wells. Some photographs of the field work has been shown in Fig 3.

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Figure 3: (a) Field test in spot (b) Principle investigator Prof Dr. S.K.Palit along with other Investigator Engr. M. Ali Ashraf visiting the affected area

6 RESULTS (WITH GRAPHICAL REPRESENTATION, MAPS & TABLES)

6.1 Testing of water samples from deep tubewells

A total of 11 water samples from deep tubewells in North halishahar & 30 in East Sholosahar above 220ft were collected. None of these samples were found to contain traceable Arsenic. So it can be said that water from deep tubewells are still free from Arsenic.

Table 2: Categories of Arsenic in various tube wells

Ward	No of tube wells tested	No of tube wells As<0.01 mg/l	No of tube wells As>0.01 mg/l	No of tube wells As=0.01-0.05 mg/l	No of tube wells As >0.05 mg/l
East Sholashahar (ward-6)	223	110	113	17	96
North Halishahar (ward-26)	426	264	162	80	82

6.2 Testing of water samples from shallow tubewells

A total of 193 water samples from shallow tubewells in East Sholosahar & 415 from North Halishahar were collected. Arsenic concentration (Percentage) of East Sholoshahar & North Halishahar has been shown in Fig 4 & Fig 5, So as The distribution of collected samples from East Sholoshahar & North halishahar has been shown in Fig 6 & Fig 7, a map showing the arsenic contaminated areas of East Sholoshahar & North halishahar has been shown in Fig 8 & Fig 9, graphical representation of arsenic concentration of East Sholoshahar & North halishahar has been shown in Fig 10, 11 & 12, the summery of the investigation has been shown in Table 2, percentage of area contaminated has been shown in Table 3, and the detailed results of field investigation in appendix have shown in the end.

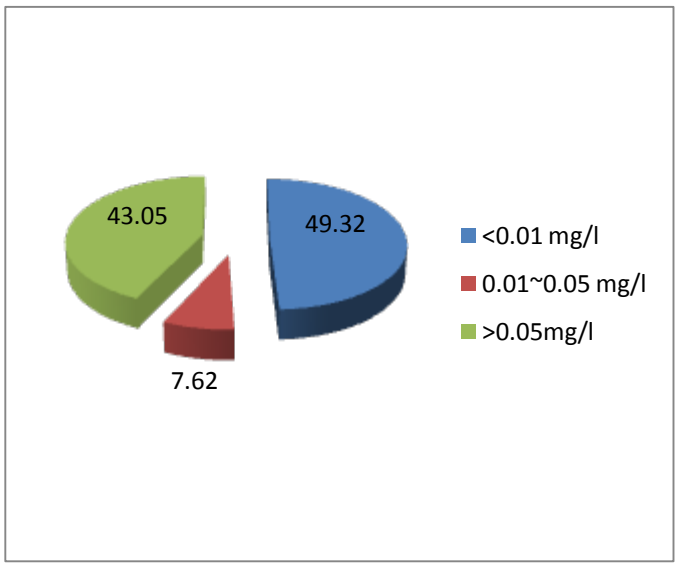

Figure 4: Arsenic concentration in East-Sholashahar (Percentage)

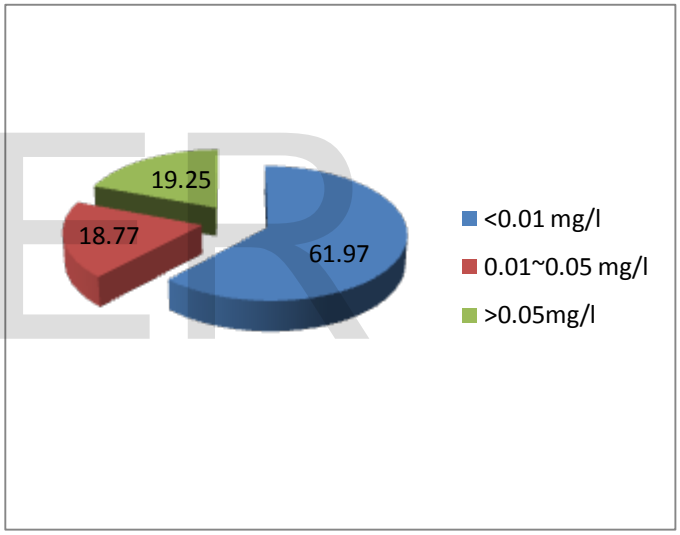

Figure 5: Arsenic concentration in North Halishahar (Percentage)

Table 3: Percentage of Area Contaminated

Ward	Area	No of tube wells tested	No of tubewells		No of tubewells		No of tubewells		No of tubewells	
			As<0.01 mg/l	percentage (%)	As>0.01 mg/l	percentage (%)	As=0.01-0.05 mg/l	percentage (%)	As >0.05 mg/l	percentage (%)
East Sholashahar (ward-6)	Ghashia para	32	25	78.2	7	21.8	0	0	7	21.8
	Madya Bakalia Bakalia	30	5	16.7	25	83.3	0	0	25	83.3
	Barai para	36	0	0	36	100	0	0	36	100
	Chairmanghatan	17	6	35.3	11	64.7	3	17.6	8	47
	Nathun bridge approach area	28	13	46.5	15	53.5	0	0	15	53.3
	Arkan road n r	26	21	80.8	5	19.2	1	3.8	4	15.3
	Boro koboresthan	25	14	56	11	44	7	28	4	16
	Bepari para pa	21	21	100	0	0	0	0	0	0
	Mazar gate	8	8	100	0	0	0	0	0	0
North Halishahar (ward-26)	B-block	73	39	53.42	34	46.57	26	35.61	8	10.95
	Golichipapara	151	75	49.66	76	50.33	44	29.12	32	21.19
	Fulchowdhury para	31	12	38.71	19	61.3	8	25.8	11	35.48
	Nathpara	81	59	72.83	22	27.16	2	2.47	20	24.69
	Sundorypara	16	5	31.25	11	69.75	0	0	11	69.75
	Abbaspara	7	7	100	0	0	0	0	0	0
	Mohimapara	20	20	100	0	0	0	0	0	0
	Acharjopara	47	47	100	0	0	0	0	0	0

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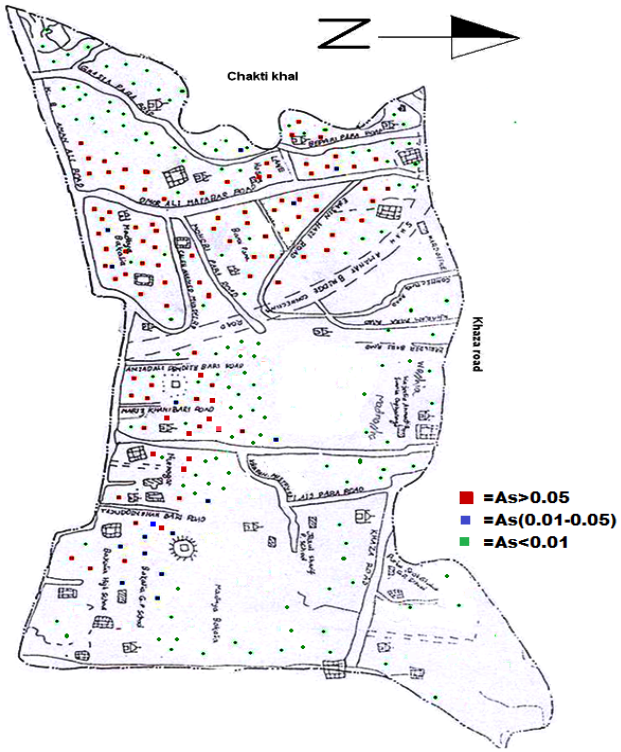

Figure 6: Distribution of collected samples from Shallow tube wells of East Sholashahar

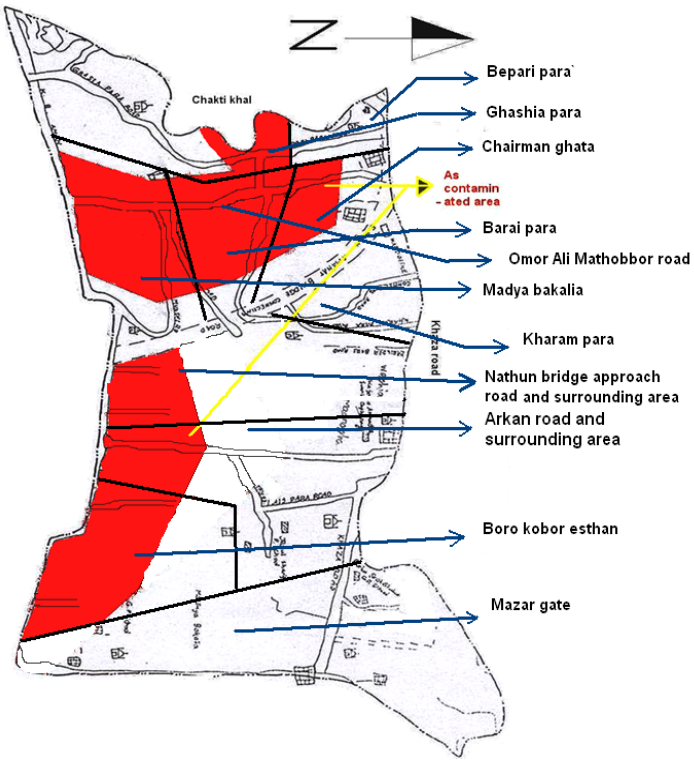

Figure 8: Map showing the arsenic contaminated area of East sholoshahar

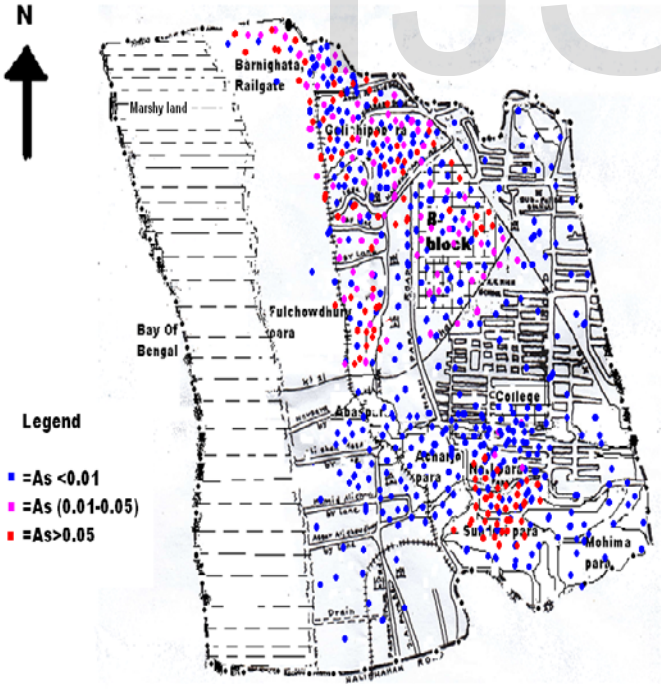

Figure 7: Distribution of collected samples from Shallow tube wells of North Halishahar

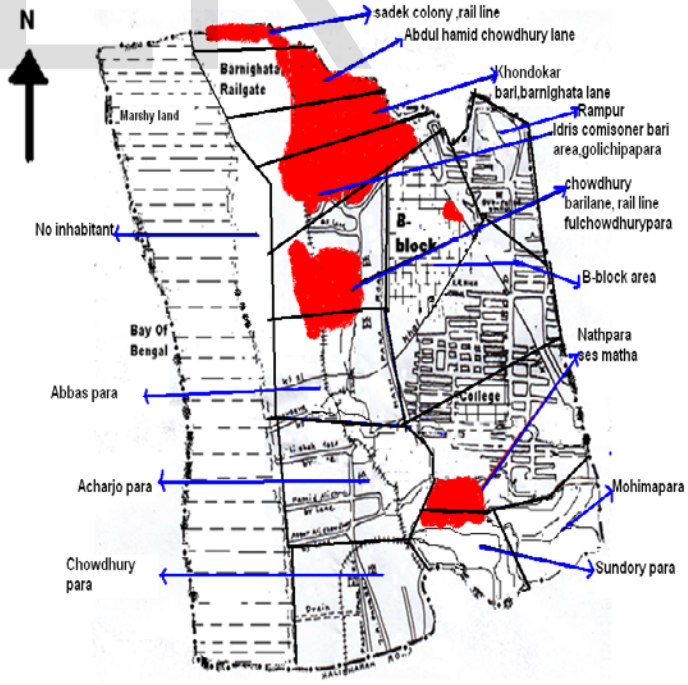

Figure 9: Map showing the arsenic contaminated area of North Halishahar

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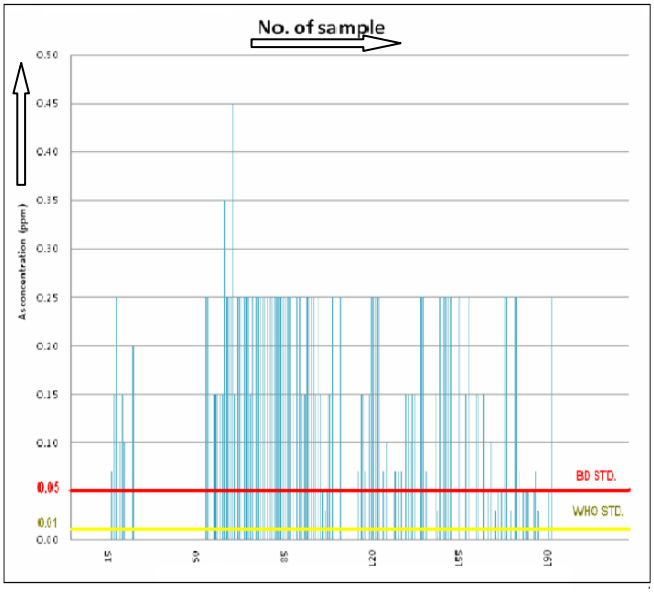

Figure 10: Arsenic consentration in shallow tube wells of East-Sholashahar

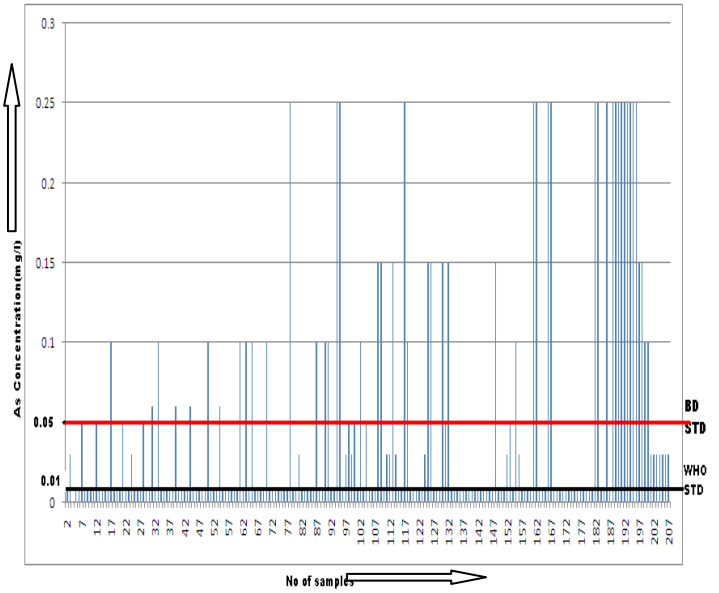

Figure 11(a): Arsenic consentration in shallow tube wells of North Halishahar (prat 1)

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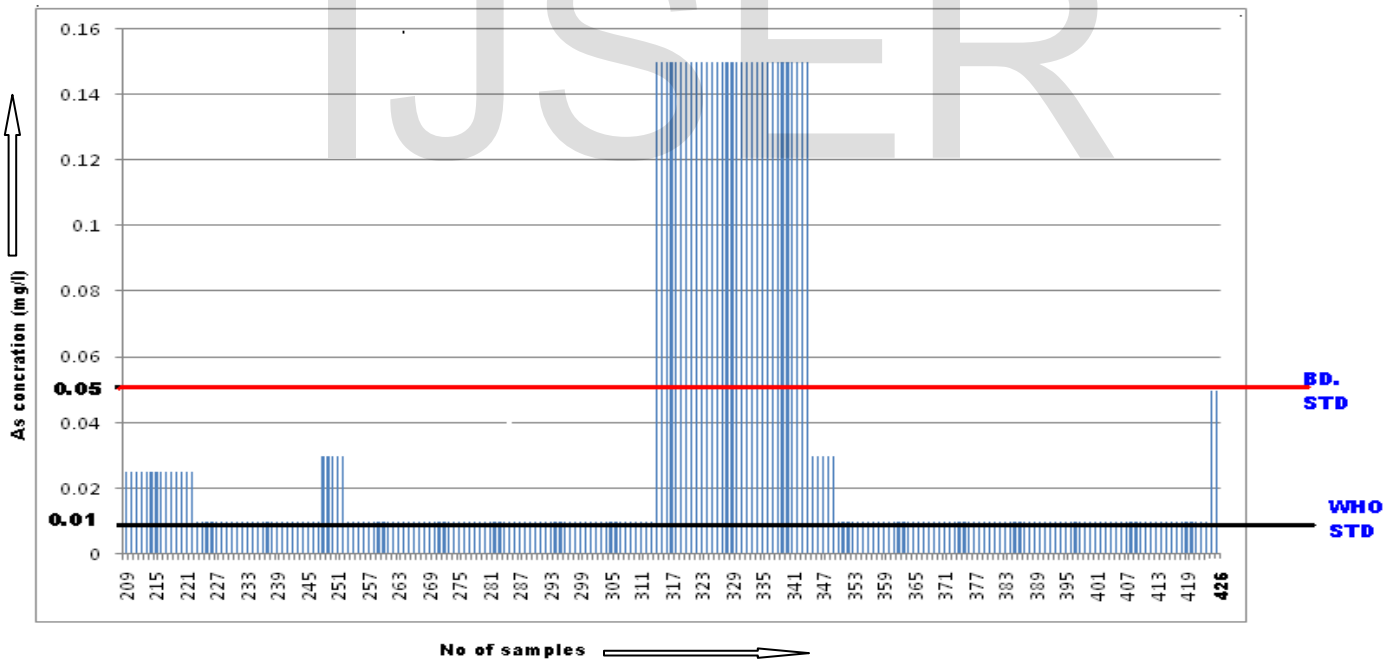

Figure 11 (b): Arsenic consentration in shallow tube wells of North Halishahar (prat 2)

7 CONCLUSION (WITH DISCUSSION & REASONING)

Most the arsenic affected areas are low laying area and the affected tube-wells are having depth within 60'-100'. In some case where two shallow tube wells are situated side by side. The tube well having lesser depth is contaminated with arsenic. Some of the deep tube wells tested during field investigation. All the deep tube wells tested are free from arsenic contamination. Canal may play a role in arsenic contamination.

7.1 The possible reasons and sources of arsenic contamination in East-Sholashahar and North-Halishahar

- The most arsenic contaminated area Omor Ali Mathobbor road within the East-Sholashahar are found mostly near Chakti Khal (canal). Arsenic in the water borne sediments comes mostly from pyrites like arseno-pyrite, copper pyrite, iron sulfate, and iron oxide etc. may be one of the reasons for the presence of arsenic in the ground water. The average concentration of arsenic in alluvial sand and mud/clay has been reported to be 2.9 mg/kg and 6.5 mg/kg respectively in Bangladesh [6]. The arsenic released under conditions conductive to dissolution of arsenic from solid phase on soil grains to liquid phase in water.
- Arsenic rich hard rocks in Lushai Hills in Eastern India might be the source of Arsenic in Chittagong. Karnaphuli River originating in the Lushai hills carried arsenic debris created out of denudation and erosion of the hills and deposited it in the West Bakalia which is one of the low lying areas within the city.
- The arsenic affected areas are Barai para road, Omor Ali Mathobbor road, Arkan road, Boro kobor esthan etc of East-sholashahar and Golichipapara, fulchowdhury para, Nathpara, b- block etc. of North-Halishahar are low laying area are often flooded during monsoon period. During flood the water remain stagnant for two to three days in those areas which may contains arsenic sediments. In Bangladesh it has been observed that the deeply flooded areas are mainly the arsenic affected areas. There is a direct relationship between the degree of reduction in groundwater and arsenic concentration. The reducing environment in the flood plain is produced by anaerobic condition in fine grained sediments rich in organic matters. The reducing environment in recently deposited sediments in flood plains appears to be the main cause of arsenic contamination [7]. The deposition of recent sediments occurs each year in the flooded area like East-Sholashahar. The reducing soil environment in the deeply flooded areas appears to be conductive to the release of arsenic in groundwater. That may be one of the possible reasons of arsenic contamination in East-Sholashahar.
- Chakti khal (canal) located beside the East-Sholashahar, may have an additional reason of arsenic contamination because of various industrial wastes containing arsenic compounds carried by it and deposited.

8 ACKNOWLEDGEMENTS

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