Estimation of impact of arsenic contamination: The severity and contextuality

Riti Chatterjee[1*], Sankar Kumar Acharya[2], Subhodip Mitra[3]

[1]Senior Research Fellow (PhD scholar), [2]Professor, [3]PG Student (Agricultural Extension), [1-3]Dept. of Agricultural Extension, [1-3]Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal, India

***Corresponding Author: Riti Chatterjee**
Email: ritichatterjee2015@gmail.com

Abstract

The eastern part of river Hooghly in west Bengal due to some geogenic factor has been a classical example for arsenic (As) contamination. The multi-directional effect of Arsenic Has been harshly reflected through the contaminating effect of rice, vegetables, meat, eggs and even breast milk used to feed new born babies. The depletion of ground water in irrigation based agro system has worst the situation further. A study on this topic was carried out at Nonaghata-uttarpara village of the Haringhata block of Nadia district in West Bengal taking seventy respondents randomly. Variables like age, cropping intensity, source of irrigation, communication variables are taken for collection of reliable data. The present study well identified some of the important factors (age, education, cropping intensity, communication exposures, homestead land) are mainly responsible for this type of deceptive level arsenicosis.

Keywords: Age, Arsenicosis, Education, Ground water.

Introduction

The eastern part of river Hooghly in west Bengal due to some geogenic factor has been a classical example for arsenic (As) contamination. The multi-directional effect of Arsenic Has been harshly reflected through the contaminating effect of rice, vegetables, meat, eggs and even breast milk used to feed new born babies. The depletion of ground water in irrigation based agro system has worst the situation further. This material finds a happy go round in the operating food chain and subsequently bio-logical magnification results. The present study has confined its inquiry into the perceptual and behaviour responses of the victims to the menace already inflicted into the health and nutrition of the people. It has seen in Bangladesh and West Bengal, alluvial Ganges aquifers used for public water supply are polluted with naturally occurring arsenic, which adversely affects the health of millions of people. Here we show that the arsenic derives from the reductive dissolution of arsenic-rich iron oxyhydroxides, which in turn are derived from weathering of base-metal sulphides. This finding means it should now be possible, by sedimentological study of the Ganges alluvial sediments, to guide the placement of new water wells so they will be free of arsenic.[8] But Groundwater arsenic (As) contamination in West Bengal (WB, India) was first reported in December 1983, when 63 people from three villages of two districts were identified by health officials as suffering from As toxicity. As of October 2001, the authors from the School of Environmental Studies (SOES) have analysed >105,000 water samples, >25,000 urine/hair/nail/skin-scale samples, screened approximately 86,000 people in WB.[4]

So, the dynamics of agro-ecology is characterized by support from existing ecologist functions on the other hand the entry of heavy and toxic materials in food chain completely jeopardised the system function.

The effect of arsenic contamination has not been designable in the quality of agricultural produce but also has been harshly reflected into the general health status of poor, social stigma, cultural isolation, withdrawal symptoms to ill-fated victims good enough to consider the gravity of situation and its protractile effect on future generation with this back ground to generate classified information on arsenic contamination in water,to estimate the level of impact on the health of the rural people in terms of socio-ecological factor and it will generate micro level policy implication based on the empirical study.

Materials and Methods

Research locale and sampling

Nonaghata-uttarpara village of the Haringhata block of Nadia district in West Bengal was randomly selected for the study (Table 1). The area has been selected for the study because of – a) There is sample scope for collecting relevant data for the present study, b) Acquaintance with the local people as well as local language, c) The concern area was very easily accessible to the researcher in terms of place of residence, d) The area was very easily accessible to the researcher in terms of transportation and e) The closer familiarities of the student researchers with the area, people, officials and local dialects. Before taking up actual field work a pilot study was conducted to understand the area, its people, institution, communication and extension system and the knowledge, perception and attitude of the people towards arsenic contamination concept.

Table 1: Sampling techniques and sampling design

Step	Items	Level	Approach
1	State	West Bengal	Purposive
2	District	Nadia	Purposive
3	Subdivision	Kalyani	Purposive
4	Block	Haringhata	Purposive
5	Gram Panchayat	Mollabilia	Purposive
6	Village	Nonaghata-Uttarpara	Purposive
7	Respondents	70	Random

Empirical measurement of the independent variables

After reviewing various literatures related to the field of study and consultation with respected Chairman of the Advisory Committee and other experts, a list of variables was prepared. The dependent and independent variables are give in Table 2.

Table 2: Empirical measurement of the independent variables

Types of variables	S. No	Variables	Notation
Independent Variables	1	Age	**x1**
	2	Education	**x2**
	3	Family size	**x3**
	4	Occupation	**x4**
	5	Size of land Holding	**x5**
	6	Homestead land	**x6**
	7	Land under Irrigation	**x7**
	8	Source of Irrigation	**x8**
	9	Communication Variables	**x9**
	10	Cropping Intensity	**x10**
Dependent Variables	1	Disease Severity (1-10 scale)	**y1**

Results

Table 3: Co-efficient of correlation between y1 (Disease severity due to arsenic contamination) vs. 10 independent variables (x1–x10)

Variables	Disease severity (y1)
x1 (Age)	0.804**
x2 (Education)	-0.368**
x3 (Family size)	0.365**
x4 (Occupation)	-0.392**
x5 (Size of land holding)	0.124
x6 (Homestead land)	-0.438**
x7 (Land under irrigation)	0.180
x8 (Source of irrigation)	-0.064
x9 (Communication exposure)	-0.495**
x10 (Cropping intensity)	0.333**
Significance level at **P<0.01	

Table 4: Regression analysis: y1 (Disease Severity due to arsenic contamination) vs. 10 causal variables (x1-x10)

Variables	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	Beta	Std. Error	Beta		
x1 (Age)	0.325	0.047	0.678	6.847	0.000
x2 (Education)	-0.092	0.131	-0.055	-0.707	0.482
x3 (Family size)	-0.014	0.126	-0.010	-0.111	0.912
x4 (Occupation)	-0.077	0.368	-0.018	-0.211	0.834
x5 (Size of land holding)	-0.125	0.128	-0.220	-0.977	0.332
x6 (Homestead land)	-0.247	0.251	-0.088	-0.982	0.330

x7 (Land under irrigation)	0.210	0.140	0.331	1.502	0.138
x8 (Source of irrigation)	0.566	0.524	0.080	1.080	0.285
x9 (Communication exposure)	-0.992	0.416	-0.190	-2.383	0.020
x10 (Cropping intensity)	-0.240	0.447	-0.045	-0.537	0.593
Multiple R-sq=71.40%; S.E=1.52					

Table 5: Regression Analysis: y1 (Disease severity due to arsenic contamination) vs 2 causal variables(x1, x9)

Variables	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	Beta	Std. Error	Beta		
x1 (Age)	0.346	0.036	0.723	9.685	0.000
x9(Communication exposure)	-1.039	0.389	-0.199	-2.672	0.009
Multiple R-sq=68.00 % (95.23 per cent of total R2 value has been contributed by these two variables); S.E=1.51					

The Table 3 presents the coefficient of correlation between y1: Disease Severity vs. 10 independent variables (x1-x10). It has been found that following variables viz. Age (x1), family size (x3) and Cropping Intensity (x10) are positively associated with disease severity while Education (x2), Occupation (x4), Homestead land (x6), Communication Variables (x9) have recorded significantly negatively correlation with the dependent variable. The present study reveals that the age, family size and cropping intensity are contributing positively to the disease severity due to Arsenic Contamination. So, for the higher age group the case of arsenicosis goes up, the respondent with higher family size have shown higher propensity to arsenic contamination. It also has been found pre-dominant for farmers having high cropping intensity. In agro-irrigation based cropping system higher cropping intensity means more frequent exposure of ground water to raise crops. Again respondents with poorer education, lower occupational status, smaller size of home stead land and poorer communication variables are more vulnerable to arsenicosis with different degree.

The step wise regression analysis (Table 4 and Table 5) shows that reaching at the 9th step two critical variables (x1=age, x9=communication exposure) have contributed to the variance with disease severity. These two variables have contributed 95.23 per cent of total variance, explained in the full model summary. The health problems due to Arsenic contamination varries according to age. So, while dealing with the problem of arsenicosis suffer by the ill-fated responses, proper intervention should be made at proper age. And communication awareness campaign should be conducted because in getting time to time information about the hazards, communication matters a lot.

Drinking of arsenic (As) infected well water has done a lot of danger to the health of millions of people in Bangladesh but, the implications of contamination of agricultural soils from long-term irrigation with arsenic infected groundwater for phyto-accumulation in food crops, and in turn nutritional exposure to arsenic, and different metals, has not been assessed previously in Bangladesh. A number of vegetables were sampled in Samta village in the Jessore district of Bangladesh, and screened for As, Cd, Pb, Cu and Zn by means of inductively coupled.[1] It has found that men had a higher risk of having skin lesions than women. Starting of As exposure (cumulative exposure) before 1 yr of age is comparatively lower in obtaining skin lesions as compared to begin of As toxicity later life stages.[9] At date, most careful attention has been paid to the risks of the usage of contaminated groundwater for irrigation. Irrigation water with high levels of Arsenic may also bring about land degradation in various stages of crop production (lower yield) and food safety (food chain contamination).[3,5] Longer use of As-infected irrigation water may cause As accumulation within the soil. If absorbed by the plants, this could cause significant uptake to the dietary As consumption, for that reason posing additional human health problems. Zhu and Meharg (2006) analysed six hundred rice samples from China, specifically Hunan province, for overall As, and randomly analysed 17 of these for inorganic As. The common percentage of inorganic As was ninety one percent, which become three times better than that said through Williams (2006). Assuming a similar percent of inorganic As in all six hundred samples, approximately 50 percentage of all samples exceeded the chinese food safety standards for inorganic As in rice, 0.15 mg/kg. And this affects human health. Williams et al. (2006) concluded that rice is the principal source of inorganic As from food items. This is based on a daily intake of 500 g rice, 130 g vegetables, 12 g pulses and 5 g spices (all weights based totally on unprepared products) and data on inorganic As and total As in a range of food objects from Bangladesh. It has seen that maximum of the Boro rice samples accrued contributed at least 50 percent to the provisional maximum tolerable daily intake (PMTDI) for inorganic As (0.126 mg/day for a 60 kg person). That leaves 0.66 mg/day or less to different different of exposure along with drinking-water. Assuming a realistic level of inorganic As of 0.2 mg/kg in rice, a drinking-water concentration of 0.050 mg/l (Bangladesh consuming-water widespread) and a water consumption of 3 l/day, the total every day intake of inorganic As would be 0.25 mg/day, exceeding the PMTDI by means of a factor of two. Rice might make a contribution forty percent of overall daily intake of As. Whilst evaluating dangers to human health associated with As in foods, different sources of exposure inclusive of consuming-water have to be taken under consideration as well. The WHO guideline value is 0.010 mg/l and the Bangladesh drinking-water standard is 0.050 mg/l (5,12). A water intake of three l/day with 0.050 mg/l might already exceed the PMTDI, regardless the levels of Arsenic in foods. This shows that the PMTDI and the Bangladesh drinking-water standard need to be evaluated in order that a proper evaluation of As in food may be made. Arsenic is not only a physical but also a social phenomenon [7] besides arsenic toxicity and arsenicosis illnesses, arsenic poisoning creates considerable social implications for its victims and their families in affected regions. some of socio-economic troubles like social uncertainty, social injustice, social isolation and difficult family issues are mentioned due to arsenicosis (2,6). In case of communication issues, from data from the 2004 Bangladesh Demographic and health Survey it has found that overall, eighty four per cent of households had heard about Arsenic issues. The richest group (quintile) of people is signifi-cantly more knowledgable to Arsenic understanding (97%) than the poorest quintile (69%) but, in terms of divisional coverage, Khulna department (95%) human beings have greater information than another divisions and the human beings in Rajshahi department have the bottom stage (78%), universal, it may be concluded herewith that, the poverty inclined humans are more inclined in terms of Arsenic know-how as compared to others, due to the fact it's proven that, the variety of deference among inter-wealth index class of humans is greater higher that the range of inter-divisional coverage.

Conclusion

The present study well identified some of the important factors (age, education, cropping intensity, communication exposures, homestead land) are mainly responsible for this type of deceptive level arsenicosis. The ground water should not be a free gift of water or safest source of water.If ground water is extracted in-discriminately, the dragon in sleep (As) will awake and destroy humanity, livestock’s and the eco-system as a whole.

Conflicts of Interest: None.

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