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Distributive Family Expenditure of Farmers due to Arsenic Contamination: The Interpretation and Inferences

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Abstract

Arsenic contamination in groundwater of west Bengal takes a serious shape and at least 120 blocks in West Bengal are under the clutch of moderate to high level of Arsenic contamination. The ill effects of human exposure to arsenic (As) have recently been re-evaluated by government agencies around the world. This has lead to a lowering of as guidelines in drinking water. A study on this topic was carried out at Nonaghata-uttarpara village of the Haringhata block of Nadia district in West Bengal taking 70 respondents by random sampling method with the objective to generate classified information on distributive family expenditure of the arsenic contaminated farmers, estimate the level of impact of the expenditure pattern on the health of the rural people in terms of socio-ecological factor. Variables like age, cropping intensity, source of irrigation, communication are taken for collection of reliable data with help of interview schedule under the guidance of chairman and advisory committee members. The present study well identified some of the important factors (age, education, cropping intensity, communication exposures) are mainly responsible for arsenic related social issues and also for distribution pattern of farm family expenditure towards remediation of arsenic contamination.

Keywords: *Arsenic, cropping intensity, expenditure, ground water.*

Introduction

Water, especially ground water is becoming highly scarce resource, both in terms of quality and availability, where groundwater is significantly main source of drinking water in many parts of the world. But this ground water may get contaminated by some natural causes or anthropogenic activities. So, the water either will be treated or replaced by surface water sources or rainwater harvesting. Because, the treatment cost is so high (Koundouri, n.d.) In a study by Chowdhury *et al.* (2015), it has seen that in calculation of cost of arsenic contamination, an individual needs to contribute for suffering from an arsenicosis symptom an amount as high as his annual household income. Because, in a developing country, attribution towards medical expenditure due to arsenicosis impose burden to a great extent (Thakur, *et. al.*, 2013) .The present study envisages the threat of arsenic contamination in terms of its socio-ecological functioning, livelihood and health dynamics and ecology. The expenditure pattern and distribution of the families under the stress of arsenic contamination are has undergone both undulations and chaos leading to a pernicious ecological dysfunctioning and unpredictability. And present study will generate classified information on distributive family expenditure of the arsenic contaminated farmers and to estimate the level of impact of the expenditure pattern on the health of the rural people in terms of socio-ecological factor.

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Methodology

Location: Nonaghata-uttarpara village of the Haringhata block of Nadia district in West Bengal was randomly selected for the study. 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.

Population and Sample: Among 1100 villagers 70 villagers were taken as respondents with the help of random sampling method interviewed by interview schedule.

Instrument and Methods of Data Collection: On the basis of the findings of pilot study a preliminary interview schedule was formed with the help of literature and by the assistance of Chairman of Advisory Committee, which has used to collect data regarding the present study.

Measurement of the Variables

After reviewing various literatures related to the field of study and consultation with respected chairman Advisory Committee and other experts, a list of variables was prepared.

Table 1 List of Independent Variables:

Independent Variables: SL No	Variables	Notation
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

Empirical Measurement of the Variables

Independent variables

Age (x1): In all societies, age is one of the most important determinants of social status and social role of the individual. In the present study, age of the respondent was measured on the basis of their chronological age at the time of investigation.

Education (x2): Education is instrumental is building personality structure and helps in changing one's behaviour in social life. Education may be conceptualized as the amount of formal schooling literacy acquired by the responded.

Family Size (x3): Number of family members of an individual respondent.

Occupation (x4): Respondent's occupation.

Size of Land Holding (x5): The amount of land owned by a person is an important parameter to access the economic status of the person in the society.

Homestead Land (x6): Amount of land acquired by the home building and surrounding. This total amount is divided by the family size.

Land under irrigation (x7): Amount of irrigated land acquired by the home building and surrounding. This total amount is divided by the family size.

Source of irrigation (x8): Irrigation Sources from where water is used for cultivation purposes.

Communication variables (x9): Respondent's exposure to different communication variables viz. TV, radio, newspaper, phone etc was measured in the way.

Cropping Intensity (x10): It has been conceptualized as the proportion of total annual cropped area to the size of holding expressed in percentage. It's calculated as-

Cropping Intensity=Total annual cropped area/size of holding × 100

Dependent Variable

Expenditure on intervention due to arsenic contamination (y): Annual expenditure of the farm family on the remediation towards arsenic contamination, expressed in rupees.

Analysis of Data

The statistical methods for analysis and interpretation of raw data were...

a) Correlation of coefficient and

b) Stepwise multiple regression

Findings and Discussion

Relationships between 10 Independent Variables and Expenditure on Intervention due to Arsenic Contamination: The purpose of this section is to explore the relationships between 10 independent variables and expenditure on intervention due to arsenic contamination. The relationship is presented in Table 2.

Table 2 presents the coefficient of correlation between y: expenditure on intervention due to arsenic contamination vs. 10 independent variables(x1-x10). It has been found that following variables viz. Age -(x1), Occupation- (x4), Homestead land-(x6), Communication Variables-(x9) and Cropping Intensity-(x10) have recorded significant correlation with the dependent variable.

The Table 2 reveals that age and cropping intensity are contributing positively to the expenditure on intervention due to as contamination. So, for the higher age group the expenditure on intervention goes up.

Table 2 Coefficient of correlation (r) between expenditure on intervention due to arsenic contamination (y) and 10 independent variables (x1-x10)

Variables	r Value
Age(x1)	0.640**
Education(x2)	-0.182
Family size(x3)	0.149
Occupation(x4)	-0.345**
Size of land holding(x5)	0.163
Homestead land(x6)	-0.260*
Land under irrigation (x7)	0.222
Source of irrigation(x8)	-0.152
Communication exposure(x9)	-0.453 **
Cropping intensity(x10)	0.287*

When, r>=0.232 and r>=0.302 are significant at 5% and 1% level of significance respectively.
1%>0.302=** 5%>0.232=*

Guha Mazumder (2008) conducted a study on villagers from birth to 79 year aged persons; it had seen that the cumulative ischaemic heart disease increases with endemic arsenicosis. It also has been pre-dominant for farmers having high C.I. In agro-irrigation based cropping system higher C.I. means more frequent exposure of ground water to raise crops. Rawal and Swaminathan (1998) have stated that the anthropogenic source of arsenic water contamination is the over-exploitation of ground water. And this is associated with increased cropping intensity, increased land use and more water requiring agricultural practices. Again respondents with lower occupational status, smaller size of home stead land and poorer communication variables are more vulnerable to expenditure on intervention with different degree.

Functional Relationship between 10 Independent Variables and Expenditure on Intervention due to Arsenic Contamination: The purpose of this section is to explore the functional or causal relationships between 10 causal variables and expenditure on intervention due to arsenic contamination. The functional relationship between 10 causal variables and expenditure on intervention due to arsenic contamination is presented in Table 3.

Stepwise regression is a variation of multiple regressions which provides a means of choosing independent variables that expenditure on intervention due to arsenic contamination the best prediction possible with the fewest independent variables i.e. the screening of the variables having highest efficacy in Table 3.

Table 3 Regression Analysis (Step wise): Screening of variables having significant efficacy for character expenditure on intervention due to arsenic contribution(y)
Multiple R-sq. =52.40% in multiple regression

Unstandardized Coefficients Model			Standardized Coefficients	t	Sig.
	Beta	Std. Error	Beta		
x1 (Age)	30.852	5.509	.536	5.600	0.000
x7 (Land under irrigation)	13.027	6.681	.171	1.950	0.055
x9 (Communication exposure)	-140.589	59.822	-.225	-2.350	0.220

Multiple R-sq. =48.30% (48.30 per cent variance within 52.40 per cent variance in contributed by these three variables, i.e. x1, x7 and x9) S.E=232.63

The Table 3 presents the multiple regression analysis between exogenous variable y: expenditure on intervention due to arsenic contamination and 10 causal variables(x1-x10): It has been found that the variables x1(Age), x7(Land Under irrigation) and x9(Communication Variables) have contributed to the substantive variance embedded with the consequent variable y; Expenditure.

The R^2 value being 0.524, it is to infer that 52.40 percent of variation in the consequent variable has been explained by the combination of these 10 causal variables.

The Next Table presents the step wise regression and it has been depicted that the 3 causal variables, x1=Age, x7= Land under Irrigation and x9=Communication Variables have been retained at the last step. Roy *et al.* (2008) have seen that because of highly water-intensive rice cultivation massive ground water lifting leading to damaging environmental consequences, one of them is arsenic contamination through both drinking and agricultural practice is of most serious concern in West Bengal. Then cost remediation of polluted aquifers also goes high. It has also seen that though male are greater affected because of more exposure but female face more social wrath and exclusion. But, receiving the messages resulted in 6 to 7 per cent point decrease in switching. Intervention randomly varied on how the strategies were orally communicated to households in a one-time discussion with survey staff (Hassan *et al.*, 2005; WHO, 2005 and Bennear *et al.*, 2012).

The variables (x1, x7 and x9) have been retained at the last step which is explaining 48.30 per cent out of 52.40 per cent. So, these variables have been explained 92.17(48.3/52.4*100) per cent of total R^2 in respect of y.

The step wise regression analysis reveals that reaching at the 8th step three critical variables(x1=age, x7=land under irrigation, x9=communication exposure) have contributed to the variance with expenditure on intervention. These three variables have contributed 92.17 per cent of total variance, explained in the full model summary. So, while dealing with the problem of arsenicosis suffer by the ill-fated responses, proper intervention should be made at proper age, use Arsenic free water for irrigation purposes and communication awareness campaign should be there.

Conclusion

The present study well identified some of the important factors (age, cropping intensity, land under irrigation, communication exposures etc.) involves much of the total costs in case of mitigating the problems due to arsenic contamination. It has seen that due to water-intensive rice cultivation, high amount of ground water is being lifted, leading to damage to the environment, one of them is arsenic contamination through both drinking and agricultural practices, which is of most serious concern in the study area .Indiscriminate exploitation of ground water for irrigation purpose is going to an alarming condition, but, if the dragon in sleep (As) will awake, it will destroy humanity, livestock's and the eco-system as a whole.

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