Sustainable Agriculture Research; Vol. 1, No. 2; 2012
ISSN 1927-050X E-ISSN 1927-0518
Published by Canadian Center of Science and Education

Socio-economic Impacts on Human Life in Arsenic Affected Area of Basti Rasul Pur, Rahim Yar Khan, Pakistan

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Received: January 9, 2012 Accepted: February 20, 2012 Online Published: July 15, 2012

doi:10.5539/sar.v1n2p100 URL: http://dx.doi.org/10.5539/sar.v1n2p100

Abstract

The availability and scarcity of both surface and ground water alongwith adverse impacts of contaminated water have become major problems in Pakistan. Groundwater arsenic contamination in the southern part of the country has exponentially endangered the human life and complicated the efforts to provide safe drinking water in the arsenic contaminated areas. To gauge the adverse impacts amongst the affected population, household survey in Basti Rasul Pur district Rahim Yar Khan was conducted on core socio-economic indicators such as household conditions, sex ratio, earning sources, literacy, health morbidity, water borne diseases, drinking water contamination, education, employment and unemployment, expenditure on hospitalization for drawing best possible conclusions. Resultantly, sex ratio observed was about 1.01% for adults and 9.8 % for children. A total of 77 % water samples were found with arsenic contamination, due to which 50 % people were found with arsencosis symptoms and 60% of their earnings were being spent on hospitalization. Due to poverty and illiteracy, the entire population was un-aware of the adverse impacts of drinking water arsenic contamination. There is a dire need of installation of sustainable community based arsenic mitigation technologies for provisioning of safe drinking water to affected community.

Keywords: arsenic contamination, quality standards, socio-economic survey, arsenicosis patients, nation action plan, water quality practices

1. Introduction

Compatible socio-economic conditions of a particular area guarantees quality of life in such environments. Access to safe drinking water is one of the most important determinants of health and socio economic development (Nahar et al., 2008). The importance of safe water supplies has led to an emphasis on the provision of appropriate facilities in developing countries (WHO, 2001). The consumption of arsenic contaminated water causes adverse impacts on human health which in-return detoriates socio-economic status of the population. Inadequate drinking water not only results in more sickness and death, but also causes higher health care cost, low work productivity, lower school enrollment, and increased poverty. Therefore, safe drinking water is an essential component of primary health care and is imperative for poverty alleviation (Ahmad et al., 2005). Water intended for human consumption should be safe and wholesome. This has been defined as “water that is free from pathogenic agents, free from harmful chemical substances, pleasant to taste, i.e. free from color, odor, and usable for domestic purposes” (Park, 1997). The health benefits from reducing water-related disease can in some circumstances be transmuted into a greater work capacity, which may contribute to increased production and hence to overall economic development.

Arsencosis is the effect of arsenic poisoning, usually over a longer period such as from 5 to 20 years. Drinking arsenic-rich water for longer period results in ill-impacts on human health which include skin problems (such as color changes on the skin, and hard patches on the palms and soles of the feet). Thickening lesions once developed are irreversible even with the restoration of safe drinking water for a long time. Long term exposure also leads to skin cancer, bladder cancers, kidney and lung, and diseases of blood vessels of the legs and feet, and possibly diabetes, high blood pressure and reproductive disorders.

In some rural villages, arsenicosis is given the name "Curse of God." This only hints at the social trauma effect of arsencosis, which in many instances far outweighs the physical pain and suffering. Entire villages are isolated and treated as leprous colonies. Women are abandoned by their husbands, young women and men cannot get married, men lose their jobs, children are kept home from school to hide the disease.

The emerging health problem of arsenic contamination in drinking water has mostly been observed in southern Punjab. District Rahim Yar Khan has been categorized as one of the high risk arsenic impacted area which is situated on the bank of river Indus. The most affected union councils are located very near on the Indus river i.e. Basti Rasul Pur, Rajan pur Kalan, and Bahoodi Pur qureshian. Rahim Yar khan is a prominent agriculture production land and main crops are Cotton, wheat and sugarcane which require extensive use of pesticides and fertilizers, the probable causes of ground water arsenic contamination.

The primary purpose of this study is to propose a methodology to analyze the health status, how people can cope with the socioeconomic consequences of the arsenicosis disease and to predict the beneficial effects of various alternative mitigation technologies. The research study was carried out in union council Rasulpur tehsil Sadiqabad district Rahim Yar Khan. People living in this area are generally poor, having small pieces of land and most work on daily wages. Literacy rate is very low though school facilities exist but due to poor economic conditions, most of the people along with their children work in the field. Deep tube wells are the only source of water for domestic and agriculture use and are usually not treated. Health care facilities are not compatible with the prevailing diseases and most of the people are suffering with skin diseases. Death rate is generally high mainly due to stomach problems and cancer. The research area is located near River Indus in district Rahim Yar Khan, location map of research area is shown in Figure 1.

Figure 1. Location map of research area, Basti Rasul Pur, Tehsil Sadikabad, Ditrict Rahim Yar Khan

2. Literature Review

Survey on the ill impacts on human health due to arsenic contamination was conducted in Bangladesh which revealed that men in rural households are generally found to be more susceptible to arsenocosis than women. The survey also indicated that villagers with lower annual income are more likely to experience arsenocosis. About 60 percent of the respondents indicated a willingness to pay up to a dollar of their monthly income for safe water. More than 70 percent of women were found to be willing to walk for five minutes to collect safe

water. Awareness campaigns conducted over the last decade seem to have been effective for villagers. Overall, findings from the survey paint a picture of a gradually evolving social and health scenario in rural Bangladesh that health officials must heed to safeguard the public health of the rural public. (Nurun Nahar et al., 2008)

Julius Tieroyaare Dongdem, et al. (2009) and Simon Kapaj, (2006) have also discussed ill impacts of arsenic contamination on socio-economic conditions of the affected population, which verify that sustained consumption of arsenic contaminated water adversely impacts the human health. Both the papers do not cover broader range of socio-economic core indicators which impacts socio-economic conditions where as this paper discusses the wide range of socio-economic indicators which helps in the visualization of enormity of the problem and mitigation measures

3. Objectives

Since human health is directly related to the socio-economic levels and their effects, the following objectives have been identified:

To analyze core socio-economic indicators and their impacts on health status of the people with the view to create awareness about the health risks associated with arsenic contaminated ground water sources.

To study the health impacts of consumption of arsenic contaminated water and to compare the susceptibility of men and women to the arsenicosis disease.

To identify cost-effective and sustainable arsenic mitigation system, compatible to the local socio-economic environments.

4. Methodology

The following methodology was adopted for achieving the research objectives;

Acquisition of primary data from the respondents through a well-designed questionnaire and personal interviews, covering core socio-economic indicators like, household income, family size and structure, education, health, income sources, average expenditure on hospitalization, water quality ensuring methods /technologies (being practicing by the community) and sample testing for bacterial and chemical contamination.

Sample size was taken as that house where arsenic concentration was ≥ 100 ppb of Basti Rasul Pur (research area).

Interpolation of secondary data related to previous surveys, relevant information from concerned departments (basic health unit), from books, journals, newspapers and web sites.

All the data and information collected was sifted, collated, organized and then analyzed for drawing conclusions.

5. Arsenic Testing - Rahim Yar Khan

The secondary data obtained from Pakistan Council of Research in Water Resources (PCRWR) has shown high arsenic concentration in ground water, particularly in Tehsil Sadikabad in which the research area lies. The statistics of high level of arsenic are given in Table 1.

6. Results and Discussions

To asses the adverse impacts on socio-economic conditions on human life by consuming arsenic contaminated water, a detailed survey on social impacts in the research area was carried out. A comprehensive questionnaire was designed, discussed and vetted by Dr. G. M. Arif, Joint director, Pakistan Institute of Development Economics (PIDE) of Quaid–e-Azam University Islamabad, Pakistan. The outcomes of survey were analyzed with a view to draw some conclusions on the basic ignored realities and reject the generally accepted false assumptions regarding socio-economical level and its complicated relationship on health impacts. It provides the estimates of the data on selected core socio-economic indicators and other features of household conditions like sex ratio, earning sources, literacy, health morbidity, water borne diseases, drinking water contamination, education, employment and unemployment, patterns of arsenic contaminated water consumption and consumption expenditure and many other aspects suitable for the best conclusions pertaining to research area. The major emphasis was on adverse impacts of drinking arsenic contaminated water due to which majority of the population was observed suffering with arsenicosis disease. The summary of socio-economic profiling of the target population is given in Table 2.

Table1. Ground water arsenic contamination in District Rahim Yar Khan (2004-2007)

Location		2004		2005		2006-2007	
Tehsil	Conc.ppb	% Sample	% persons	% Sample	% persons	% Sample	% persons
Liaqat Pur	≤10	60.2	60.2	67.8	65.5	73	73
	11_50	30.2	25	25	28	22	22
	51-100	7.5	14.2	5	6	4	4
	>100	2.1	0.6	2.2	0.5	1	1
Raim Yar Khan	≤10	40.2	55	42.9	60	53	66
	11_50	38.6	40.2	30.6	26.2	36	27
	51-100	18.9	4.1	15	9.5	8	5
	>100	2.3	0.7	11.5	4.3	3	2
Khanpur	≤10	46.2	52.3	43.5	55.3	45.9	60.2
	11_50	46.4	43.5	33.4	35.4	37.8	29.9
	51-100	5.5	4	17.6	6.5	15.6	7.2
	>100	1.9	0.2	5.5	2.8	0.7	2.7
Sadiqabad	≤10	52.8	80	44.9	75.3	50.8	81.3
	11_50	40.2	16	34.5	20.4	40	15.2
	51-100	5	3.5	12.9	3	7.5	3.1
	>100	2	0.5	7.7	1.3	1.7	0.4

Table 2. Summary of socio-economic statistics of research area

1	Activity Description	Cumulative Average						
		Adult	Male	Female	Children	Male	Female	Total
1.1	Average household size (No)	2	1	1	3	2	1	5
1.2	Literate people (No)				2			
1.3	Total earning hands (No per family)				2			
1.4	Type of job/source of income	Agriculture, Govt employs, Teacher, Shop keeper and Driver						
1.5	Total income (per year)	Rs 577625						
	Household health impact							
2	People in house effected by disease	4						
2.1	Type of diseases	Skin infections, gastro-intestinal, seasonal flu & fever and jaundice.						
2.2	Frequency of hospital visit/yr	25						
2.3	Average expenditure (Rs/family/annum)	73100						
2.4	Social Impacts	Sympathetic behavior and poverty						
3	Household Bacterial Water Quality/Practices							
3.1	How is water treated	Mostly in closed storage but in some houses it was stored in open pots.						
3.2	Quantity of water used per household per day (litres)	66						
3.2.1	Time taken by household to collect water per day (hrs)	2						
3.2.2	Storage capacity under utilization by household (litres)	185						
3.2.3	Cost borne by house for water per day (Rs)	0.075						
3.2.4	Bill for drinking water per month (Rs)	250						
3.3	Factors which effect water quality during handling	High levels of arsenic, iron and bacterial contamination. Poor personal, domestic & environmental hygiene.						
4.1	Source Bacterial Water Quality/Management							
4.1.1	Drinking water source	Protected motor pump, tube wells and hand pump.						
4.1.2	Depth of water source (ft)	72.75 (arsenic is generally found upto depth of 30-140 ft						
4.1.3	Location of drinking water source	In most of the cases within house but sometime located outside house.						
4.2	Bacterial water quality	20 % water sources are safe						
4.3	Who manages the O&M of water supply	In case of private tube wells; self maintained while community motor pumps are maintained by CBOs.						
4.4	Other sources of drinking water	Tube wells						
5	Source chemical Water quality (As & Fe)	77% water sources un-safe 23% are unsafe.						

Hence after, detailed data analyses, following major socio-economic indicators have been discussed in the subsequent paragraphs, which are outcomes of the adverse impacts of drinking arsenic contaminant water as below;

Ground water arsenic contamination comparison of three Tehsil of district Rahim Yar Khan is shown in Table 1.

Highest ground water arsenic contamination was observed in Tehsil Sahibabad.

Results / outcomes on all the major socio-economic indicators have graphically been illustrated in Figures 2-11, which indicates the enormity of the problems, of consuming arsenic contaminated water.

During the course of survey some people were identified who had the symptoms of arsenicosis, as shown Figure12.

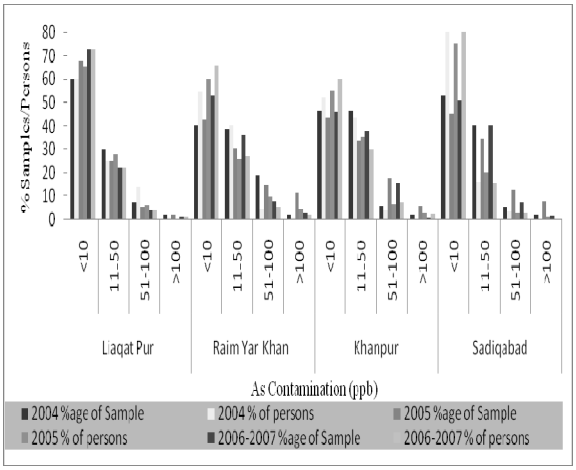

Figure 2. Comparison of Arsenic (As) contamination in district Rahim Yar Khan

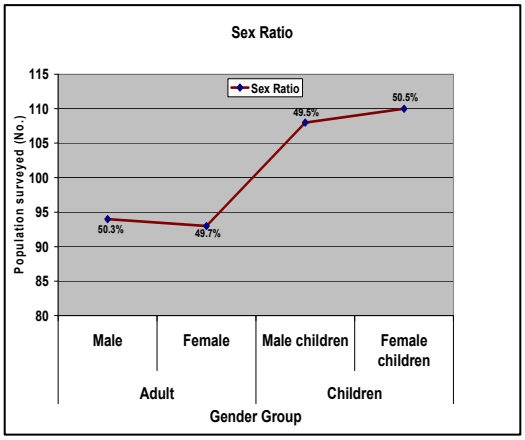

Figure 3. Sex Ratio graph showing gender groupings

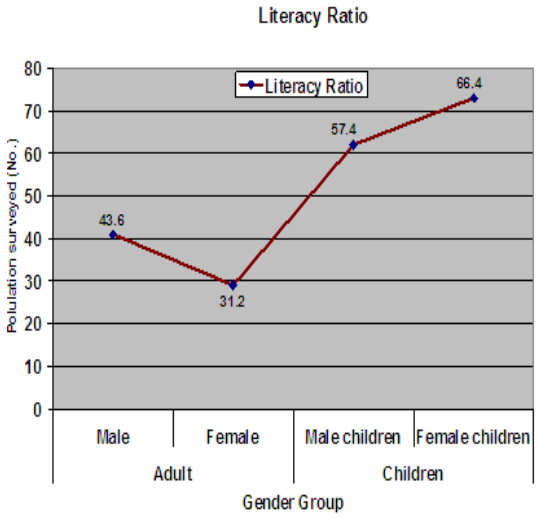

Figure 4. Graph showing the literacy rate in different gender group

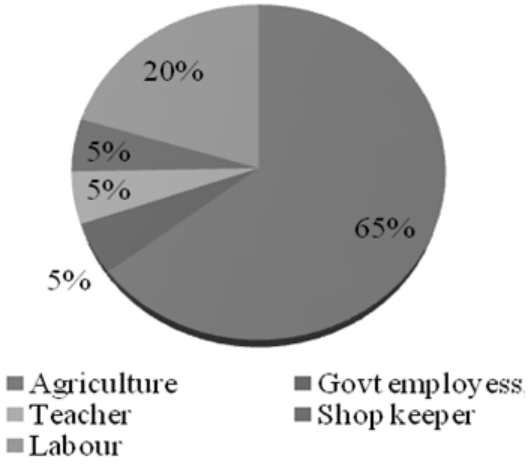

Figure 5. Source of income of the people of the research area

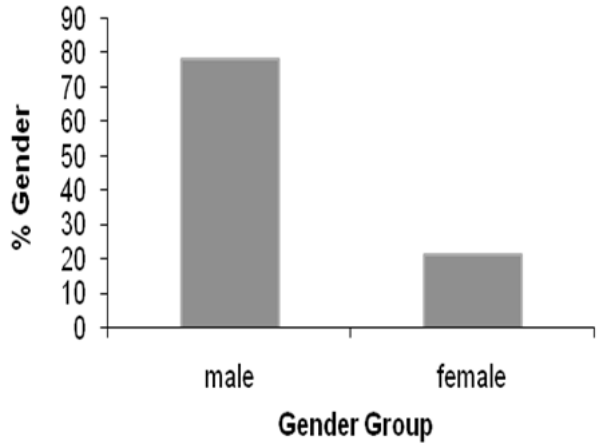

Figure 6. Contribution of the different gender to the household income

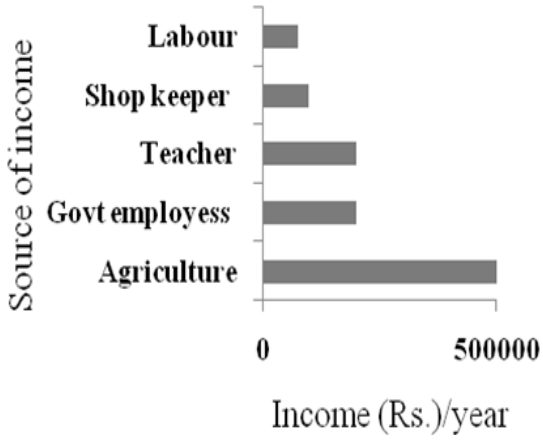

Figure 7. Total income/year against the source of income

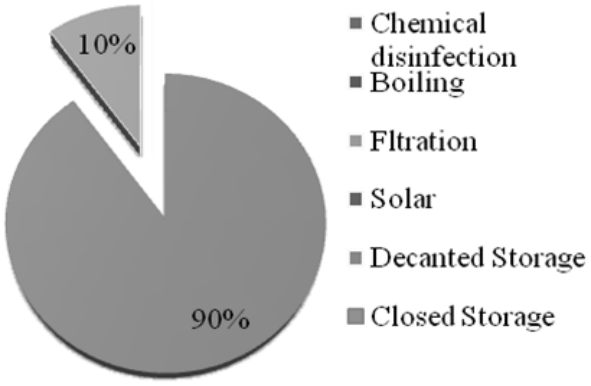

Figure 8. Water quality practices used at household level in the research area

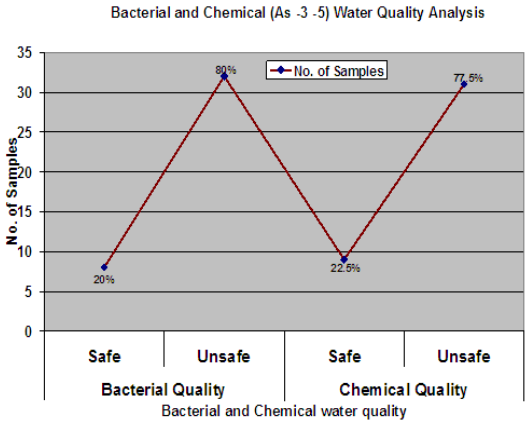

Figure 9. Bacterial and Chemical (As $^{-3\ -5}$) water quality analyses

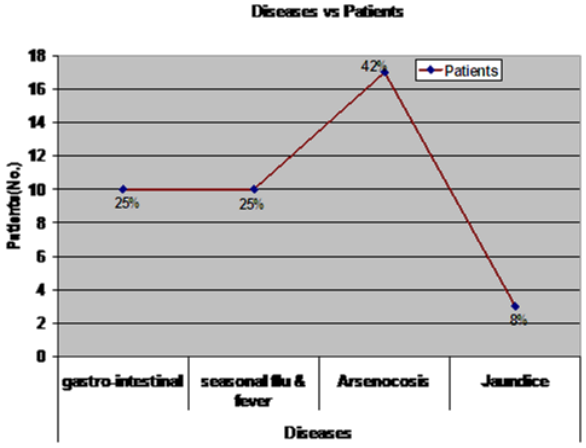

Figure 10. Percentage of the patients against the different diseases

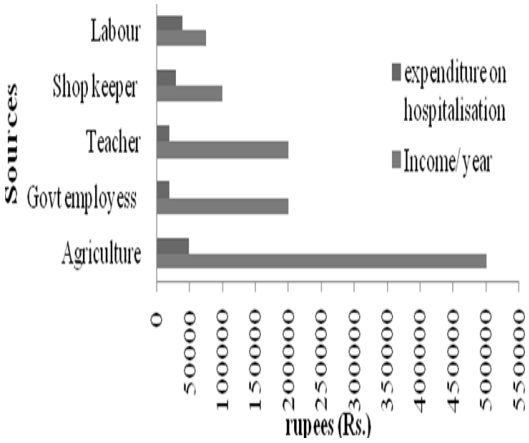

Figure 11. Income vs Expenditures on hospitalization

Figure 12. Suspected arsenicosis patients who are having skin pigmentation and other symptoms of diseases which are generally caused by consuming arsenic contaminated water

Major portion of the population were suffering from skin diseases which were due to drinking arsenic contamination water. Following photographs of the affected people provide enough evidence adverse impacts of arsenic contamination on human health;

7. Major Conclusions

After assessing and analyzing the adverse impacts of arsenic contamination on human health, following major conclusions have been drawn;

Average Household size is 5 with 2 adults and 3 children with sex ratios, 101:100 in adults and 98:100 in children. The families with low income have greater household size as compared to higher income groups. In future, the area is likely to be female dominated due to increased female child population which may change socio-economic prospects. (Shown in Figure 3)

Literacy rate is 40 percent in adults and 60 percent in children. Female are less educated or illiterate. Literacy rate is now improving due to better educational facilities and improved economic conditions. (Shown in Figure 4)

The community was totally devoid of adverse impacts of arsenic and microbial contamination of drinking water. Approximately, 80% samples were found bacterially and 77% chemically ($As^{-3\ -5}$) contaminated. Water samples taken from the low income families were found totally arsenic contaminated due to shallow pumps.

Ground water is the main source in the area and average depth of water source recorded was 72.75 feet. Water consumption per household per day is 66 litres which shows that most of the residents of the research area get lesser quantity of water than as per the laid down standards and the time taken by household to collect water per day is almost 2 hours.

On the average 4 person per household were found to be affected by diseases (mainly arsencosis) and the frequency of hospital visits were recorded 25/year/household. There is a joint family system and illiterate adults and children, younger than 10 years, are more affected from arsenicosis than literates.

Arsenic contaminated water leads to serious skin disease and cancer and significant numbers population is exposed to ground water arsenic contamination. Approximately, 42% patients were found suffering with arsenicosis which is on the increase with decrease in the income resources and lack of awareness amongst the people. Roughly, 60% of the earnings of the poor class is being spent on hospitalization.

8. Recommendations

High levels of ground water arsenic prevalence in the area are adversely affecting the health of the people due to low socio-economic conditions, therefore, following is recommended;

Installation of community based sustainable arsenic mitigation system for provisioning of safe drinking water compatible with the socio-economic conditions.

Blanket ground water arsenic contamination survey in the adjacent areas to ascertain the scope and extent of arsenic contamination.

Community mobilization for creating awareness pertaining to adverse impacts of arsenic contamination and promoting house hold level water treatment technologies.

Exploring the possibilities of alternative drinking water supply options.

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