SANDEE
South Asian Network for Development and Environmental Economics

POLICY Brief

Number 20-07, May 2007

Counting the Cost of Water Pollution – an Investigation into Arsenic Poisoning in West Bengal

Arsenic contamination affects drinking water in almost half of the districts of West Bengal in India. This in turn has a significant impact on the health of many people in the area. In an attempt to find a solution to this health crisis, a SANDEE study examined the costs of contamination and its implications. It finds that households would benefit to the extent of Rs. 297($7) per month if arsenic concentrations met safety standards. The current cost of supplying safe piped water by the Kolkata Municipal Corporation is Rs 127 ($3) per month per household. Thus, investing in safe drinking water is economically feasible. The study also finds that poor households, who are most affected by the pollutant, will be major beneficiaries of any such solution.

The study is the work of Joyashree Roy, Professor of Economics at Jadavpur University in Kolkata. She assesses the economic impact of arsenic contamination on households in West Bengal and quantifies the benefits of an arsenic-free water supply. This is done by looking at how much it costs households to find alternative clean sources of water, how much income they loose due to illness and how much they have to spend on medical costs linked to arsenic poisoning. Prof. Roy's findings are particularly significant because various plans are being drawn up to address the problem of arsenic contamination. Up until now only the costs of these plans have been known. Now, thanks to her work, the benefits are clear. This means that the necessary investment can be more easily justified.

A HISTORY OF ARSENIC POISONING

The study was undertaken in response to increasing concerns about drinking water contamination in West Bengal. Evidence of arsenic contamination was first identified in the 1980s, and it is now clear that this problem constitutes a major public health crisis. A large number of studies have shown that arsenic in drinking water can cause many types of illness, including cancers and problems relating to the nervous system. It may also cause birth defects and other reproductive problems. In West Bengal, these arsenic-related health problems impose a significant extra burden on an already overstretched medical system.

Arsenic dissolves in water and cannot be detected without chemical testing. In West Bengal, the basic source of arsenic is geological. The chemical is released naturally from sulphide rocks into groundwater. It is in drinking water partly as a result of the rapid rise in agricultural water use. This development contributed to lowering the water table and lead to the mixing of arsenic in the sulphide rock with oxygen, which subsequently dissolved in water. The impact of this pollution has been compounded by the fact that shallow tube-well water has been heavily promoted as a safe alternative to untreated surface water.

THE STUDY AREA

The information for Roy's study comes from a survey of over 470 households that was carried out

This policy brief is based on SANDEE working paper No. 21-07 'Estimating the Economic Benefits of Arsenic Removal in India: A Case Study of from West Bengal', by Joyashree Roy, Jadavpur University, Kolkata. The full report is available at www.sandeeonline.org

REDUCING POVERTY BY IMPROVING HEALTH

One of the interesting findings of Prof. Roy's report is the link between poverty and arsenic contamination. The proportion of households who enjoy arsenic-free water is almost the same for lower and middle-income households (80%), while a higher proportion, some 90%, of upper-income households enjoys safe water. In contrast, 21% of lower-income households suffer from an arsenic-related disease, while only 5-7% of rich and middle-income households do so. Thus, if we consider the total number of households with people who are sick from arsenic poisoning, then 63% are poor, while only 33% and 4% are from the middle- and higher-income groups respectively.

Overall, lower-income households suffer most from both arsenic and non-arsenic diseases, and are able to spend less on safeguarding their health – this is reflected by their relatively low medical expenditures (compared to the other groups). The poor have a higher number of sick days on average and spend a greater amount of time getting medical help for arsenic diseases relative to non-arsenic diseases. They also put greater effort into getting medical help as revealed by the distance they travel to seek medical care for arsenic related diseases.

Because higher-income groups are less adversely affected by arsenic, their members will gain relatively less from arsenic removal. In contrast, poor households will be the major beneficiaries of any such investment.

during 2002-2003. The study was undertaken in the district of North 24 Parganas. This district has the largest number of arsenic-affected areas of all the districts in West Bengal. It also exhibits the greatest variation in the level of arsenic pollution present in ground water. In the areas selected for the study, there are 278 villages with arsenic concentration above the safe limit (50 ì g/l).

Even though pollution levels in the area are high, the problem of arsenic contamination has only been taken seriously at the governmental level since the year 2000. Since then work has been going on in two main areas: setting up of arsenic removal plants and arsenic treatment clinics.. Non-governmental organizations (NGOs) have conducted a large number of education programmes to make local people aware of the health effects of drinking arsenic-contaminated water. NGOs have also highlighted possible preventative measures that householders can take.

GETTING THE NECESSARY INFORMATION

The study used a questionnaire to interview a random sample of 473 households, which included 2,432 individuals of all age groups. The information that was gathered included socio-economic details, household medical histories, household medical expenditures and information about arsenic awareness. Households were also asked questions regarding the approximate distance they travel and the time they spend collecting arsenic-free water. On average households spend about seven working days per month collecting clean water. The economic value of this time was calculated using the wage rate for female participants in the survey.

THE HEALTH IMPACTS OF ARSENIC POISONING

Field data shows that 36% of households suffered from some kind of disease over the past year. There are seven main categories of arsenic-related diseases that occur. 115 people among the individuals interviewed suffered from an arsenic-related disease. Extrapolating from this information, the chance of an individual who lives in an arsenic-contaminated area being affected by an arsenic-related disease is 0.05. If we consider only the individuals who have some kind of sickness, then the data shows that 13% of these individuals have an arsenic related disease. For those affected by arsenic, there are many negative implications. For example, an average sick person suffering from arsenic-related disease works 2.73 hours compared to a healthy person who works over 8 hours per day.

TABLE: HOUSEHOLD CHARACTERISTICS AND HEALTH RELATED EXPENDITURES BY INCOME CLASS

Characteristics/ Income Range	Low Income (0-2000)	Middle Income (2000-6000)	High Income (6000 & above)
% using arsenic- free water	80	80	90
% of households suffering from Arsenic Diseases	21%	7%	5%
Average distance travelled to collect water in km.	0.18	0.11	0.13
% of households who consider arsenic contamination as major cause of health effects	46	52	47
Average Number of sick (including all kinds of sickness) days in a month	9.5	7.8	7.7
Average per capita Medicine Exp for Non- Arsenic Diseases (Rs/month)	0.95	1.5	13.38
Average per capita Expenditure on medicine for Arsenic Diseases (Rs/month)	1.58	12.96	29.17
Average Time spent (in minutes/month) by an household to visit hospital for Non- Arsenic Disease	27.84	37.01	71.68
Average Time Spent (in minutes/month) by an household to visit hospital for Arsenic- Related Disease	33.07	47.41	2.50
Average distance travelled to medical facility for Non-Arsenic Disease (km/month)	2.32	6.00	15.94
Average Distance Travelled to visit medical facility for Arsenic Disease (km/month)	6.95	11.88	18.75

THE IMPACT OF ARSENIC AND THE BENEFITS OF CLEAN WATER

The study calculates the economic impact of arsenic-related diseases by adding up three types of costs that affected households bear: a) medical expenses, b) wages lost due to sick days, and c) economic costs of seeking out clean water supplies. Through some careful statistical analyses, Roy controls for other factors that may affect these costs and then estimates the decrease in costs that would occur if arsenic contamination is reduced. She estimates that the welfare gain from a 1ì g reduction in arsenic per litre of water would be Rs 0.49 per household per month. If arsenic concentration was reduced to the safe limit of 50 ì g/l, the monthly benefits to each household would be Rs 297, while the annual gain would be Rs 3,573 per household. These benefits would be Rs 161 per month and Rs 1,934 per year if arsenic concentrations were reduced to half of what they are presently.

These findings can be used to estimate of the overall benefit to society of clean water supply. Consider the fact that the chance of an individual getting an arsenic-related disease in an arsenic-contaminated zone is 0.05 and that the total population size of the study district is 7.2 million. Then the total number of people that are likely to have arsenic-related sicknesses is 338,400. Thus, the total annual welfare gain to households in the district from

bringing down arsenic concentration to a safe limit of 50ì g/l would be in the region of Rs 229 million.

CONCLUSIONS AND POLICY IMPLICATIONS

It is important for policy makers to know that reducing the concentration of arsenic in drinking water to a safe limit can generate significant health and economic benefits. Most tellingly, if the benefits generated from arsenic removal are compared with the cost of supplying filtered piped water, then it is clear that investment in an arsenic-free water supply system is economically justified.

Currently, the cost of supplying filtered piped water (by the Kolkata Municipal Corporation) to households is approximately Rs 9.44/m^3. Households use an average of 450 litres of water per day. Supplying this amount of clean water would impose a cost burden to the municipality of Rs 127/month per household. In contrast the benefits that a household would get from consuming arsenic-free water are Rs 297 per month. Thus the cost of providing clean water is significantly less than the benefits associated with it (noting that there will be other benefits in addition to those related to a reduction in arsenic sickness). Furthermore, if a comparison is made between the benefits and costs of installing deep tube wells to supply clean water in arsenic-affected areas, it is found that the initial costs of installing these wells can be paid back in a maximum of three years.

Overall this means that investing in safe drinking water is economically feasible and beneficial. Households are willing to pay for such investments; particularly if they are made aware of the impact such action would have on their health and economic welfare. Clearly, there is scope for education and awareness campaigns. The introduction of clean water supplies should become a political priority.

SANDEE

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This policy brief is an output of a research project funded by SANDEE. The view's expressed here are not necessarily those of SANDEE's sponsors.

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