Drinking water contamination in Calcutta

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THE FOLLOWING PAPER summarizes the results of a study on drinking water contamination in Calcutta undertaken since November 1999 which is still going on at the time of writing and which mainly deals with

- the bacteriological and chemical quality of Calcutta's drinking water and
- public awareness with regard to related issues.

Drinking water quality in Calcutta

In the course of the study, water samples from 20 locations spread all over Calcutta were taken during the 1999 post monsoon season and the premonsoon season of 2000. (Samples of the monsoon season are still to be taken).

Methodology

The bacteriological contamination was examined by multiple tube fermentation technique at the All India Institute of Hygiene and Public Health, and chemical parameters were determined by meter (pH, EC), AAS (Perkin Elmer AA Analyst 100, for Fe, Mg, Pb, Cr, Cu), and titration against $K_2Cr_2O_7$, $AgNO_3$ and H_2SO_4 for COD, chlorides and carbonates/bicarbonates respectively in the laboratories of Presidency College and the Geological Survey of India. Due to technical problems with the equipment, some tests (e.g. for As) could not be carried out up to the time of writing.

Bacteriological Contamination

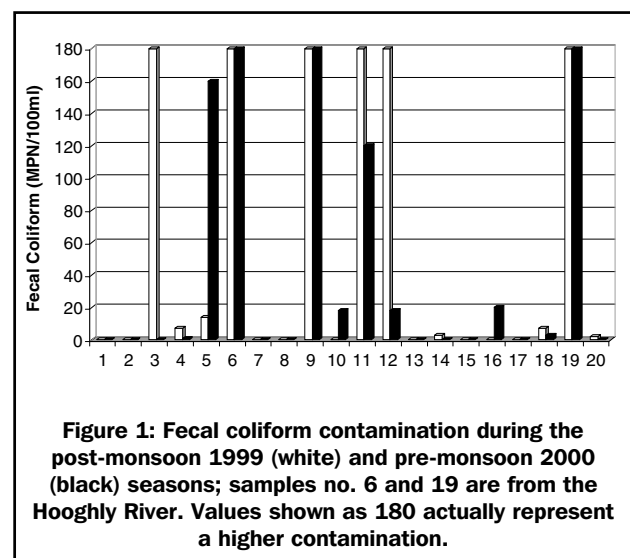In the following, water samples were classified according to their bacterial counts (MPN/100 ml) as follows:

Table 1: Classification of drinking water with respect to bacteriological quality

	Total coliform	Fecal coliform
Excellent	0	0
Satisfactory	1-3	0
Suspicious	4-10	0
Unsatisfactory	>10 and/or	> 0

During both the postmonsoon season in 1999 and the premonsoon season in 2000, a considerable part of the samples was found to be completely unsatisfactory (2 samples not intended for drinking purpose are excluded):

Table 2: Results of the bacteriological study

	Postmonsoon 1999	Premonsoon 2000
Excellent	39%	44%
Satisfactory	11%	6%
Suspicious	None	None
Unsatisfactory	50%	50

Even though the number of samples classified as unsatisfactory remained at a constantly high level, it must be stated that the average bacterial count has decreased.

Samples taken from handpumps on average showed a lower contamination than those from taps, with the tap water in Belgachia and Shyambazar being an exception. This may be an indication that the water coming from the Tallah-Palta waterworks in the North of Calcutta gets recontaminated further South in the distribution system.

Figure 1: Fecal coliform contamination during the post-monsoon 1999 (white) and pre-monsoon 2000 (black) seasons; samples no. 6 and 19 are from the Hooghly River. Values shown as 180 actually represent a higher contamination.

Chemical Contamination

In general, chemical contamination appears to play a relatively minor role as compared to bacteriological contamination.

- Lead was the only heavy metal found to exceed the maximum permissible limits in 39% of the drinking water samples with a maximum value of up to 93 mg/l (as compared to a MPL of 15 µg/l).

- 56% of the samples show a COD which is slightly higher than the desired 5 ppm.
- 39% of the samples exceed the maximum desireable limit for chlorides (200 mg/l), but not the MPL (600 mg/l)

Studies conducted by other institutions

A comprehensive study of the water quality of 100 handpumps conducted by the School of Environmental Studies (SOES), Jadavpur University, yielded the following results in terms of bacteriological contamination:

Table 3: Results of bacteriological studies of handpump water undertaken by SOES (M: monsoon, Pre: pre-Monsoon, Post: post-monsoon)				
	M 94	**Post 95**	**M 97**	**Pre98**
Excellent	66%	81%	10%	27%
Satisfactory	11%	1%	3%	7%
Suspicious	7%	3%	6%	19%
Unsatisfactory	16%	15%	81%	47%

The data appear to indicate a deterioration of the water quality besides seasonal variation, but unfortunately, this study was not carried out very systematically and the selection of the handpumps was modified twice during the study (i.e. after the postmonsoon season of 1995 and the monsoon season of 1997).

In the recent past, arsenic contamination has become a growing source of concern. Water samples taken from shallow tubewells in P.N. Mitra Lane, Behala, have shown arsenic concentrations of up to 58 mg/l (proposed MPL: 5 µg/l); in this case, the contamination was discovered in 1991 after several people were found to suffer from arsenic poisoning. The factory found to be the cause of this contamination was shut down and the people of P.N. Mitra Lane have been supplied with tap water after the discovery of the problem in 1991. Totally unrelated to this are the findings of arsenic in parts of southern Calcutta which appears to be of geogenic origin and part of a much bigger calamity also affecting parts of Howrah, Hooghly, North & South 24 Parganas, Barddhaman, Nadia, Malda and Murshidabad districts of West Bengal. In this case, the contamination in Calcutta is attributed to the inflow of arsenious groundwater from affected areas in North and South 24 Parganas.

A number of studies on both bacteriological and chemical contamination have been undertaken by various other institutions in the recent past, but generally seem to be characterized by the following drawbacks:

- No large-scale, systematic long-term studies have been undertaken to assess the quality of different drinking water sources and its seasonal variation.

- The existing studies have been undertaken by many different institutions including the All India Institute of Hygiene and Public Health, the Geological Survey of India, the School of Tropical Medicine, the School of Environmental Studies (Jadavpur University), Central Groundwater Board and many others, but there appears to be only very little coordination, and the data is not stored centrally.
- The choice of test parameters is often influenced by the current (un)availability of laboratory equipment.

Public Awareness

181 randomly selected people from different residential areas of Calcutta were asked for their personal experiences with and awareness of problems related to drinking water contamination with the help of standardized questionnaires. Some of the results are presented below:

Characteristics of the study group

Most of the people interviewed have completed at least a higher school education; their average age was 27.0 years, 29% were females and the average household size 4.3 people.

Used Water Sources

Tap Water	95%
Water from hand pumps	43%
Mineral water	46%
Water supplied by vendors	15%

Availability of Water

Tap water, avg. hours per day	13.9 h
Public sources near to household	71%
Public sources actually used	55%

Water Purification in the household

Water filter	81%
Boiling	43%
Chlorination	31%

Experiences with waterborne diseases

Personal	83%
Family	84%
Neighbours	95%
Personally afraid	85%

Knowledge about the causes of waterborne diseases and water contamination

Diarrheal diseases	28%
Chemical/metallic contaminants	35%

The average per capita consumption of water (for all purposes) was estimated to be 36.2 LPD (min. 1.2 LPD, max. 600 LPD) by the study group. About 90% grossly underestimated their consumption.

Only 11% had a realistic idea about the annual death toll of waterborne diseases in India (> 1 million fatalities per year); the remaining 89% underestimated it or had no idea at all.

Conclusions

Even though the majority (83%) of those asked have already suffered from water-borne diseases, only few people have knowledge about their causes, and some even replied that they did not do anything to purify the water they drink. The extent and true nature of the problem is often falsely understood. When asked in more detail, many people expressed their fear of iron (and sometimes arsenic) in the water, but hardly anybody mentioned bacteriological contamination. This is in sharp contrast with the findings of the analyses – around one third of the samples tested we unfit for consumption from the bacteriological point of view, whereas the maximum permissible limits for chemical contaminants were rarely exceeded.

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