Household water quality in rural Zambia

by Sally Sutton and Dominic Mubiana

New water sources in rural areas of Zambia have provided safe water to 150,000 people. Yet it is often assumed that the way in which the water is drawn, the method of transport to the home and the storage vessel used once there are all potential sources of contamination. The authors look at household practices in Zambia and find that this is not the case.

IN THE WESTERN Province of Zambia, recently constructed boreholes and dug shallow wells now provide water to some 150,000 of the rural population. The bacteriological quality of these sources is a vast improvement on that of the traditional scoop-holes which previously provided most drinking-water. However, the first stage of back-slapping and self-congratulation as the improvements became apparent and were maintained by communities, slowly became tinged with an element of doubt, common in such situations.

The questions that spring up revolve around the tendency of people carrying water to their houses, and storing it in small easily accessible vessels, to contaminate initially coliform-free water, and turn it into a health hazard. The corollary, less easy to investigate, is whether 'self-contamination' by those within the family is less potentially hazardous than contamination by those with less familiar strains of bacteria who caused problems at the source.

As a start, the project in Western Province attempted to quantify the levels of contamination which were brought about by transport and storage of water for household use. This was combined with a study of water collection and storage practices to try and identify what aspects introduced greatest risk. The results were a surprise to all. They indicated that the local perception of clean water, and efforts to retain its cleanliness from well to mouth, were logical and effective.

Correspondence to the authors should be sent to Dr Sally Sutton, SWL Consultants, 10 Thorney Hedge Road, Chiswick, London W4 5SD, UK. The co-author, Dominic Mubiana, is Health Co-ordinator, Department of Water Affairs, PO Box 910029, Mongu, Western Province, Zambia.

The Western Province of Zambia lies either side of the wide Zambezi flood plain. It mostly consists of sandy uplands, with bush and tree cover, where water is only easily accessible from *dambos* and the few small streams, and the flood plain itself. Villages are mostly concentrated along the edge of this plain and around *dambos*. Most are small, with populations of less than 400. The population of the whole area totals some 450,000 spread over about 140,000 square kilometres — a very low density even for rural areas.

From within this environment, 10 communities were selected and samples taken from about 25 houses in each (constituting approximately 50 per cent of the households). The houses were chosen at random.

The villages represent several stages of the project, half still using traditional scoop-holes before the installation of a borehole, and half having improved sources. The latter have had courses in health education, the former have not. All are rural villages except Mandanga, which is a peri-urban settlement. This like Ilundu Bus Stop and Lwatembo, consists mainly of 'squatters' who are coming in from the surrounding bush. In no case was the water badly contaminated at source, improved sources having no coliforms, and traditional sources having less than 10 faecal coliform/100ml. Villages with more badly contaminated sources were not chosen for this study, in order that contamination subsequent to collection could be easy to identify.

Household water quality

Of the 250 or so samples collected, 85 per cent had no faecal coliform and only 4 per cent contained more than 10 faecal coliform/100ml (see Figure and Table below). Less than one in 100 samples exhibited what might be called gross faecal contamination.

Total coliform counts were higher, partly because six out of 10 sources contained coliforms, and wind-blown contamination was frequent, but also because it is common practice to float leaves in wide collecting vessels to stop water slopping out in transit and being wasted. Leaves are a particularly good source of non-faecal coliforms, and it is noticeable that water sources under mango trees show much higher coliform counts during the season when mango fruit and leaves are dropping.

The samples were taken from the drinking-water storage vessel, via

Table 1. Household water quality sample results

Village	*Number of samples*	*Faecal coliform count per 100ml* *Zero*	*1-10*	*11-50*	*50-100*	*100-500*
With handpumps						
Lwatembo	41	39	1	1	0	0
Mandanga	40	24	7	7	2	0
Shallow well or handpump						
Katongo	36	36	0	0	0	0
Shallow well						
Kahonono	18	18	0	0	0	0
Lower Kasima	15	14	1	0	0	0
Traditional sources						
Mwandi	23	19	4	0	0	0
Sikuyu	25	20	4	1	0	0
Nalongo	21	10	11	0	0	0
Chinoya	18	17	1	0	0	0
Ilundu Bus	17	17	0	0	0	0

the decanting vessel or the drinking cup used by the household. Advance notice was not given to the household, but the purpose of sampling was explained at the time. Questions were then asked about the length of time water had been stored, how it was collected and transported, who had access to the storage jar, what washing was done of storage and collection vessels, as well as observations being made at the source. Since the results of the bacteriological analyses indicate such low faecal counts, the information on behaviour can only really show that what is being done is good, it cannot show what practices increase risks and what minimizes them.

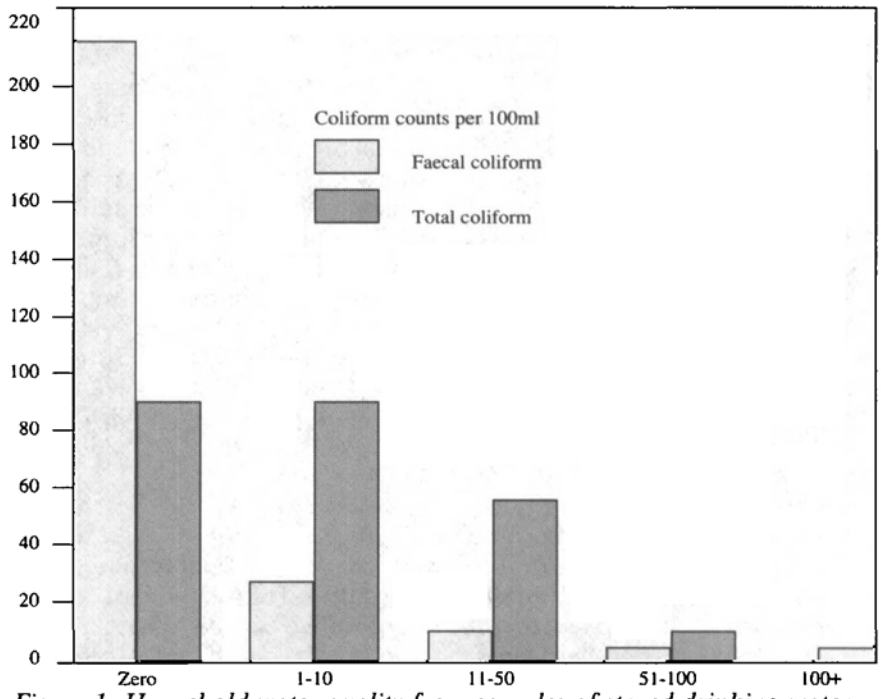

Figure 1. Household water quality from samples of stored drinking-water.

Water collection and transport

An average Western Province household collects water about twice a day. Children sometimes help, but most do not do so every day as a regular routine. Families are poor, and most (about 80 per cent) also use the collecting vessel for storage, but may decant some of the water into a special storage vessel for a particular purpose, usually drinking. The pots are made from a variety of materials, just over half being galvanized iron buckets and bowls, 15 per cent being plastic bottles (2.5- or 5-litre cooking-oil bottles) and the same proportion being enamel bowls and buckets. The rest are mainly clay pots, with a small proportion of gourd calabash pots. Water carried out to the house only averages some 10 litres per head per day, being mainly for drinking, pot washing and cooking. Distance to water sources averages about 200 to 300 metres, and washing tends to be done as a separate activity.

At a protected source water is abstracted using a communal vessel kept only for this purpose. The establishment of village water committees and the consequent communal responsibility for the source has ensured that the vessel is not stolen and sold. Where no committee exists, few communities have been able to maintain a communal bucket or scoop. People therefore have to bring their own, so increasing the risk of contamination.

Almost everyone rinses or washes out their pots when collecting water, and it is usual to see it scoured by hand if not with sand or ash. On average, one litre is used per trip for washing of vessels, and even children do this as a matter of course. Only about one in four people covers pots in transit to the house, but a higher proportion cover drinking-water in storage. Vessels which are for drinking-water are usually kept separate.

When taking water from the storage jar, 80 per cent scoop rather than pour the water, but this is almost always done with a vessel kept in a clean place and used only for this purpose. Fewer than 15 per cent of households use the last bit of water left in the storage jar for drinking. It tends either to be thrown out or used for washing clothes or utensils before the vessel is refilled. Drinking-water storage vessels are usually covered.

Health education

In the period immediately prior to construction of an improved source, and in the four months following, there are several meetings with the community, which include health education. This is done with posters, dramas, open-ended stories, and focuses particularly on water use and sanitation. The need to keep the source clean is emphasized, but not a great deal of time is spent on 'How to look after the water in your home'. This omission seems to be justified by the low level of contamination found in domestic water.

Although the number of samples is not sufficient for high statistical significance, it does appear that those without health education do not fare markedly worse than those who have received it, in terms of the degree to which they keep their drinking-water clean. Of those with health education 87 per cent had no faecal coliform in the drinking water, while of the other group 80 per cent had faecal coliform-free water.

The communities where 'domestic contamination' of water was worst were those where population densities were highest, in the vicinity of Mongu, the town which is the provincial capital. Gross contamination (over 100 faecal coliform/100ml) was only found in two houses. Comparison of practices in these and households with no, or low levels of contamination did not show any particular factor which might have led to health risks.

Safety at source

It is often assumed that the carrying of water to houses, and its storage before consumption, will cause deterioration in quality. As far as the villages in Western Province, Zambia, are concerned, it seems that this is not so. This may partly be because of overall low population densities, and so perhaps low mobility of faecal coliforms, but the inherent good practices of the women and children who collect and look after the water must also be given credit. The result is that any attempts to improve water quality at source, have a very good chance of being carried through as benefits to the consumers themselves.