



On-site sanitation and groundwater: The art of balancing unknown risks?

Guy Howard

Does the siting of pit latrines close to water sources pose a significant risk to health? Or does the real danger lie with the absence of, or inadequate, sanitation facilities?

In this issue of *Waterlines* we return to a subject much-debated in the water and sanitation sector — the impact of on-site sanitation¹ on groundwater. The potential for on-site sanitation to cause significant pollution of groundwater has been known for many years,² leading some to suggest minimum safe distances separating latrines and groundwater sources. Figures suggested may vary from 10 to 30 metres and sometimes even further, causing confusion for those involved in projects trying to improve water and sanitation access. In the most comprehensive review of the subject, Lewis *et al.*² highlighted that this impact on groundwater is likely to be site specific, so a universal minimum safe distance would not provide protection in some circumstances, while at the same time would be over-cautious for others.

In addition, although some contamination of groundwater may result, debate continues as to whether this should preclude the use of on-site sanitation. Many have pointed out that the potential health benefits of improved sanitation,

particularly in high-density, low-income communities, may outweigh the risks of groundwater pollution. Concerns that the risk to groundwater may restrict sanitation improvement is certainly one that requires proper investigation. Despite the significant progress made in improving access to water and sanitation facilities in low and middle-income countries since the start of the International Water Supply and Sanitation Decade (the 1980s), millions of people remain without access to safe and adequate drinking water supplies, or sanitation. Excreta disposal, in particular, has lagged behind water supply development and the WHO estimated that 2873 million people lacked access to basic sanitation facilities in 1994.³

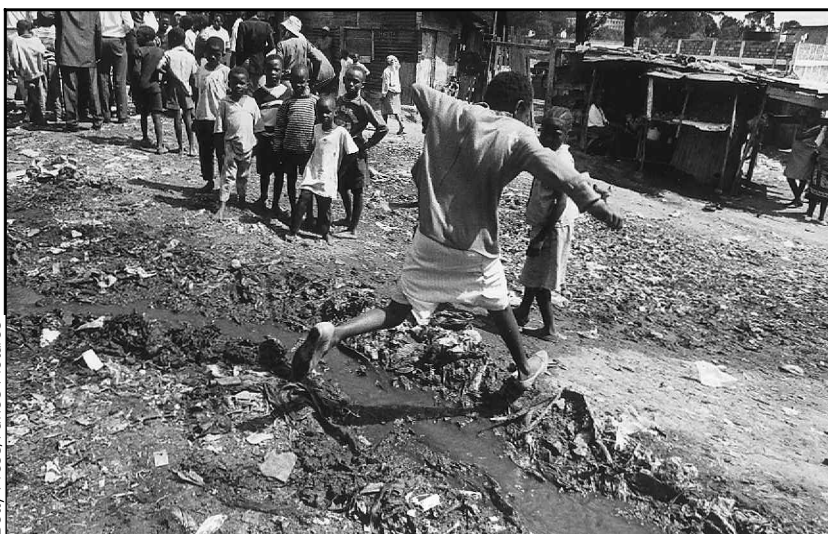
Risks to groundwater

In essence, the following major questions need to be considered:

- What is the extent and nature of contamination to groundwater caused by on-site sanitation?
- What level of priority should be given to protecting groundwater quality in relation to sanitation improvement?
- How can contamination from on-site sanitation be limited?
- What implications does groundwater pollution have for water supply technologies?

Here we draw on four main articles dealing with these questions. Two of these — by **David Macdonald, Kazi Matin Ahmed, Mohammad Sirajul Islam, Adrian Lawrence and Zaglul Zubaer Khandker** on page 6, and by **Mike Barrett, Mai Nalubega and Stephen Pedley** (page 10) — provide an overview of ongoing research into the impact of on-site sanitation on groundwater in Bangladesh and Uganda, respectively. These articles look at the

1. Technologies where waste is collected, stored and decomposes in-situ, rather than being transported to a treatment facility. Such technologies include pit latrines, septic tanks and aquaprivies.
 2. Lewis, W.J., *et al.* 1980 (see Resources Guide).
 3. WHO, *Water Supply and Sanitation Sector Monitoring Report*, WHO Document EOS/96.15, WHO, Geneva, Switzerland, 1996.



Open sewerage ditch in a Nairobi slum. The health benefits from improved sanitation may outweigh the risks of groundwater pollution.

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relative importance of latrines in contaminating boreholes and protected springs used for domestic water supply, and discuss the long and short-term effects of such pollution. An article by **Darren Saywell** on page 22 challenges the view that the risk of groundwater pollution from on-site sanitation is a major issue of concern. He suggests that the tendency to treat groundwater as sacrosanct may greatly impede the provision of sanitation services that provide a potentially greater impact on health. Finally, in their article on page 24, **Simon Lewin, Carolyn Stephens and Caroline Hunt** question whether the whole groundwater/on-site sanitation issue is in fact misleading, given that there are far more fundamental problems such as political disenfranchisement and underlying poverty that should take priority. They also stress the need for meaningful community involvement in setting environmental health improvement objectives.

Extent and nature of contamination

Whilst the types of pollutant that may result from the contamination of groundwater by on-site sanitation are well known, it has often proved difficult to quantify the degree of contamination that has occurred. In their article, MacDonald *et al.* conclude that whilst there is some microbiological contamination (as shown by the presence of faecal coliforms) of boreholes in their two study areas, this appears to be localized. They suggest that where faecal coliforms are found it tends to be more as a result of poor sanitary completion of the tube-wells (such as the concrete surround being inadequate), and thus direct contamination by surface water, rather than from latrines. Barrett and his co-authors suggest that a similar scenario is true for many of the protected springs in Kampala, although in both Kampala and Dhaka contamination by latrines at some sites is not ruled out. The situation in Kampala is particularly interesting. The author of this article is currently managing a three-year surveillance project that has carried out monthly sampling of around 60 springs over a 12-month period. The findings of this study tend to indicate that for most springs, the poor condition of the immediate protection works, particularly protection of backfill media,⁴ is the principal cause of microbiological contamination. However, it is clear that in

some cases contamination from latrines is important, particularly in high-density areas.

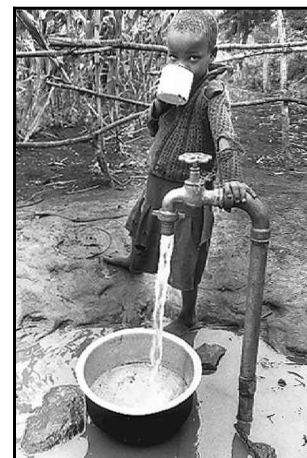
The conclusion that can be drawn from the work in Bangladesh and Uganda is that where microbiological contamination of small systems is found, more attention should be placed on improving the protection works and well-heads than on latrine proximity.

As noted in the MacDonald article, on-site sanitation is likely to be a major contributor to inorganic chemical (especially nitrate and chloride) contamination of groundwater in low-income countries. Some countries in Central and Eastern Europe have serious nitrate problems, and while chloride does not in itself have any direct impact on health, it may cause rejection of otherwise good-quality water supplies. Both nitrate and chloride contamination raise serious long-term resource issues that need to be considered when planning water and sanitation improvement.

A question of priority?

Much of the argument presented by various workers in the sector, and summarized by Saywell and Lewin *et al.*, relates to the relative risk to health posed by contaminated drinking water and sanitation. Many people suggest that improvements in sanitation provide a much greater health gain than improving water quality at source. However, as Lewin and his co-authors point out, it is often difficult to predict reliably the health gains from individual interventions, given the highly integrated nature of the impact of water and sanitation. It is also true that the reasons for improving water quality sources often have more to do with the prevention of epidemics, rather than promoting simple health gains.

Research suggests that contributions from latrines are less important than other sources of groundwater contamination, and therefore concerns over groundwater quality should not prohibit the development of on-site sanitation. However, there has to be a major qualification on this research because of uncertainties about the value of indicator bacteria in groundwater. While these indicators demonstrate that recent contamination has occurred, and therefore pathogens in infective doses are likely to be present, we also know that some pathogens will survive for far longer than



Jorgen Schytte/Still Pictures

The impacts of individual water and sanitation interventions are often very hard to predict.

Where microbiological contamination of small systems is found, more attention should be placed on improving the protection works and well-heads than on latrine proximity.

4. The aggregate (sand and gravel etc.) that is placed immediately behind the spring box in the catchment area.



Mark Edwards/Still Pictures

People living in informal settlements, often with limited security of tenure, may have different priorities from service planners and providers.

the indicator bacteria. Hence, as Barrett and others point out, sole reliance on current microbiological indicators may not always gauge whether faecal contamination has occurred.

We also have to bear in mind the long-term impacts of deteriorating groundwater quality, the effects of which may not be felt for several years or decades. In the short-term, however, we may need to accept that some contamination of groundwater is unavoidable if the health gain from improved sanitation is to be realized. This may also require a re-think on the technologies used.

Possible strategies

Clearly, if we are to limit groundwater pollution, or minimize the impacts on health, we need to consider ways in which this can be achieved. One option is to establish protection areas around boreholes in which on-site sanitation or other polluting activities are not allowed.

Whilst providing an adequate separation between water sources and latrines may be relatively easy to achieve in rural areas, in the high-density, informal settlements this is much more difficult. These settlements often utilize both point water sources and on-site sanitation using technologies transferred from rural areas, and the difficulties with such a direct, unmodified, transfer are clear.^{5,6}

Another possible solution would be to ensure that piped water is accessible to populations in high-density settlements, and it has been suggested that this would be cheaper than using alternatives to on-site sanitation (such as modified, low-cost sewerage). Whilst this may be true, there are major problems in making piped water supplies available to informal settlements. Municipal planners might reject such

approaches because they feel it would provide formal recognition of what they see as illegal settlements, and utilities may be reluctant to invest in communities with limited security of tenure. At the same time, communities themselves may not view piped water access as a priority if there are socially acceptable and lower-cost alternatives, and if they have limited security of tenure anyway. As emphasized in the Lewin article, ignoring the principal concerns of communities and imposing narrowly defined solutions are likely to raise serious concerns about long-term sustainability.

Technical improvements

Given the nature of most low-income, high-density areas, it is likely that the use of point water sources and on-site sanitation in informal settlements can be expected to continue, at least in the short to medium term.⁷ If access is to be increased, we need to consider possible changes in water and sanitation technologies. Saywell, for instance, has suggested there are simple ways in which pit latrines may be modified to reduce the risk of microbial contamination, while at the same time options for the treatment of groundwater sources at a community level should also be considered.

However, such approaches do not deal with health concerns as a result of increasing nitrate problems, nor with raised chloride. Here, integrated water and sanitation development and water resource management, is called for. One lesson from the North is that ignoring long-term resource issues leads to spiralling costs and the loss of resources — something which lower-income countries in the South can ill afford to ignore, particularly if they are dependent on groundwater for much of their water needs.

Community involvement

Without community involvement in service provision, it is unlikely that improvements can be sustained. Clearly communities need a far greater say, and service providers should not ignore community preferences if they do not happen to coincide with their own perception of priorities. However, at the same time, communities may not have expert knowledge, and may not fully understand the long- and short-term implications of different solutions to water and sanitation problems. Issues such as long-term impacts on the environment should be fully

5. Howard, G., *Urbanisation, sanitation and environmental health*, Commonwealth Secretariat, London, 1996.

6. McCommon, S., E.A. Perez, and F. Rosensweig, *Providing urban environmental services for the poor: Lessons learned from three pilot projects*, Applied Study No.7, Environmental Health Project, USAID, Washington DC, 1998.

7. Howard, G., J.K. Bartram and P.G. Luyima (in press), *Small water supplies in urban areas of developing countries*, paper presented at the 1st NSF/PAHO/WHO Symposium on the Economics, Technologies and Operations of Small Water Systems, 10-13 May 1998, Washington, USA.

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discussed, as should the potential positive and negative consequences of every option that may be available. In the long term, unless we facilitate a process where communities can speak from a position of strength, we will not have truly achieved community participation, or sustainability.

Conclusions

In a sense, as the purpose of this edition is to engender debate, conclusions are irrelevant. However, we can pull some common themes from the articles and suggest some key issues that require careful thought and planning in water and sanitation projects, and in national plans for service provision. In summary these are:

- The need for integrated planning and real participation by communities in resolving priorities and strategies for reducing risks to health, in both the short and long term.
- When groundwater contamination is detected, careful evaluation of likely pollutant pathways is essential. Unless this is done, conclusions may be drawn which are incorrect and reduce access to other services.
- The sustainability of point source development and on-site sanitation in some environments needs careful review. Technological modifications may be required in both sanitation and water supply technologies.
- There is clearly a need for ongoing routine surveillance of groundwater sources, including both water quality analysis and sanitary inspection, so as to ensure that any changes in water quality caused by on-site sanitation can be quickly identified and remedial action taken. ■

about the author

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Coming up in the July 1999 issue

Long-term sustainability, based on sound financial arrangements and community management, is central to the planning and implementation of rural water and sanitation projects. In an edition co-ordinated by Bob Boydell from the UNDP/World Bank, and Gayle Gibbons, July's issue of *Waterlines* will focus on rural water supply and sanitation projects and how to make them financially sustainable. Case studies, featuring a variety of different financing mechanisms, include World Bank-sponsored projects, bilateral donor and NGO projects. Examples are taken from locations around the world; we look, for instance, at measuring sustainability in Indonesia, at local informal private sector involvement in Tanzania, and at financing community management, with a particular emphasis on India. Some possible future trends in water project financing are also covered.

contributions

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webwatch

■ UNDP World Bank Water and Sanitation Programme

This site provides a web interface into UNDP-World Bank activities in the sector, focusing on rural water supply and sanitation, urban environmental sanitation, and participation and gender. There are comprehensive listings of resources under each of these, including project examples, publications and discussion papers. Full contact to the Programme's five regional offices is also provided.

<http://www.wsp.org/English/index.html>

■ Water and Environmental Health at London and Loughborough (WELL)

Managed by the London School of Hygiene & Tropical Medicine (LSHTM) and WEDC, Loughborough University, WELL is a resource centre promoting environmental health and well-being in developing and transitional countries. In addition to describing the types of activities that WELL offers, the site includes full text versions of technical briefs, consultancy reports, and access to the WELL online catalogue of water and environment-related publications.

<http://info.lut.ac.uk/well/>

■ Environmental Systems Information Center

ENSIC (formerly the Environmental Sanitation Information Center) is based at the Asian Institute of Technology and aims to provide developing countries with information on water supply, environment and sanitation. It operates an outreach network (called Ensicnet) for 7 countries including China, Colombia, Indonesia, Nepal, Pakistan and Vietnam.

<http://www.ait.ac.th/clair/centers/ensic/>

■ Healthlink Worldwide

Healthlink Worldwide (formerly AHRTAG) works to improve the health of poor and vulnerable communities by strengthening the provision, use and impact of information. Activities include communications on health; promoting good policy and practice; and training in information management. The site contains listings of recent publications, on-going projects, and Healthlink newsletters such as *Aids Action* and *Child Health Dialogue*.

<http://www.healthlink.org.uk/index.html>

Compiled by Darren Saywell, WEDC

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