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WATER, SANITATION AND HYGIENE: CHALLENGES OF THE MILLENNIUM

Rehabilitation of protected springs in Kampala, Uganda

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A LARGE PROPORTION of the urban population of Uganda still lacks access to piped water supplies delivered to the home. In most towns, current rates of access to piped water supplies remain low (Howard and Luyima, 1999a; Howard, in press). The availability of point sources in many urban areas in Uganda is high and in Kampala represented at least one-third of available sources for the population lacking their own household connection.

The use of protected springs is widespread. Water usage studies in low-income areas where there was a choice of water source type indicate that whilst tap water is the preferred first choice source for much of the population, many households use multiple sources of water. Overall around 60% of the low-income population utilise protected springs for at least part of their domestic water needs (Howard, in press). It should be noted that in these communities, there is little differentiation in use of water collected from different sources and there is no differential use of water by source that that is found in some countries (Ahmed et al, 1998).

The water quality of the springs in Kampala has been described previously (Howard and Luyima, 1999a; Howard et al, 1999; Barrett et al, 1999) and in general the microbiological quality is poor. There is pronounced seasonality with significant increases in contamination noted in wet periods and more recent studies have shown very rapid response to rainfall events, with changes noted within hours (Barrett et al, 2000). The causes of failure appear to be primarily related to the poor maintenance of sanitary completion measures around the springs (Howard and Luyima, 1999b) and the use of backfill media that offers little in the way of filtration and attenuative capacity (Howard et al, 1999). The importance of hazards such as pit latrines appear to have less effect, although are important at certain sites.

Protected springs in Kampala

There has been a long record of spring protection in Kampala. Since the colonial period numerous springs were protected by Mengo Municipal Council and later by Kampala City Council and other organisations. The protected springs are found in both high-density, city centre areas and the lower density, peripheral areas of the city. After independence a greater emphasis was placed on the provision of drinking water through a piped distribution system. As a result of the upheavals experienced by the country in the 1970s and 1980s, much of the water infrastructure was lost as the service deteriorated in the face of an almost total lack of investment. When the current Government came to power in 1986, a project aimed at providing water supply for low-income areas (PAPSCA) was carried out, partly in response to the austere structural adjustment policies demanded by the IMF at the time. This project provided both public taps (most of which are now disconnected) and re-protected significant numbers of the springs.

The design used for this protection was the same as in rural areas, where the backfill media is used primarily to canalise the water from the eye of the spring to the outlet. Such designs, whilst adequate in rural and some low-density peri-urban areas, fail to provide the level of protection needed in higher density areas and this, combined with failure in operation and maintenance, has led to the significant deterioration in water quality.

Demand for rehabilitation of protected springs

There is demand from many communities for improvement in the protected springs. This relates partly to problems with sustaining public taps (Mutabazi, 2000) and because much of the urban population is relatively new and composed of migrants. In many cases, migrants to urban areas may prefer using technologies with which they are familiar from their home areas and are in any case often reluctant to pay for more expensive levels of water supply as it is preferred to invest resources within their home area.

During needs assessment exercises in Kawempe Division by Save the Children Fund, UK (SCF-UK), a number of communities expressed a desire for rehabilitation of their springs as opposed to the erection of public taps. There had not been any provision initially for the rehabilitation of springs, but faced with the demand from the low-income communities within the target area and evidence that it was possible to improve the spring design, it was agreed that a small pilot project would be undertaken to rehabilitate 5 springs in two Parishes (both low-income and high density) in Kampala. Only springs with a reasonable yield were selected as lower yielding springs were felt to be capable of serving too few people to be economic and more susceptible to contamination.

SCF obtained funding from DFID to implement the work and advice on design and construction was provided from the Ministry of Health and the Public Health & Environmental Engineering Laboratory at Makerere University.

It was agreed that construction would be undertaken by contractors identified through restricted tender. Communities were asked to provide a proportion of the capital cost and to provide labour as required by the contractor. An initial two springs were identified for rehabilitation, with one contractor per spring appointed to induce some degree of competitiveness. The remaining springs were rehabilitated once the first two were completed.

Improving designs

Given the available information on the current performance of the springs in relation to water quality and the evidence of the causes of failure, it was apparent that if the rehabilitation of protected springs was to be implemented, it could not be based on the existing design that had proved ineffective. It was also clear that any rehabilitation would have to address underlying problems with operation and maintenance of the springs to ensure sustainability.

The first issue was whether the design of the springs could be improved to reduce the level of contamination, particularly during the wet seasons. In particular, the reduction in short-term extreme contamination events was important given that these may represent periods of greater risk to health than much lower, but longer-term elevations (Havelaar, 1996). The importance of the short-term, but greatly increased contamination is illustrated by the association noted between the numbers of cholera cases and areas where use of water from protected springs was common during the 1997/8 cholera epidemic (Howard, in press). At lower levels of contamination it is likely that other transmission routes predominate in the transmission of faecal-oral route diseases (Moe et al, 1991).

In terms of water quality that could be achieved, it was recognised that these were unlikely to result in water of similar quality to piped water. However, reductions in contamination to meet the relaxation suggested by WHO as being appropriate in small, community-managed supplies of 10FC/100ml (WHO, 1993) were believed to be achievable.

The groundwater was primarily found in preferential flow paths rather than diffuse seepage lines. Whilst this would suggest that the springs are contact springs (which makes estimation of recharge area and thus protection requirement more difficult) it is unclear whether such flow paths represent simply the final stages of groundwater flow or whether they predominate as the main mechanism of flow. At present it appears likely that the flow to the majority of the higher yielding springs has two recharge mechanisms – regional baseflows that sustain high yields throughout dry seasons and seasonally important interflow whose influence appears be primarily on water quality rather than yield.

The key components for improvement in water quality were identified as being the rehabilitation of the basic sanitary protection measures such as grass cover over the backfill media, rehabilitation of the diversion ditches and

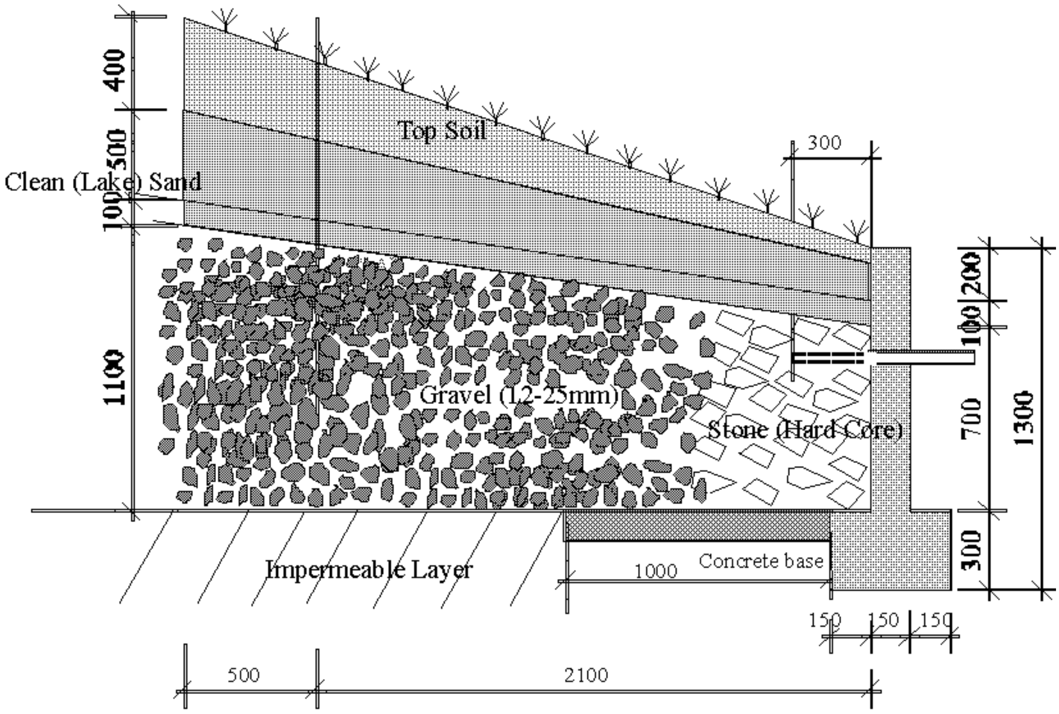

Figure 1: Cross-section through the spring structure

fences surrounding the springs and the use of more effective backfill media that would optimise the filtration capacity.

The latter was achieved by developing a multi-layered filter as shown in Figure 1. This design provides for a finer matrix built up from below the spring eye to above the maximum expected water rise in the wet season. The advantage of a finer, well-mixed basal matrix is that it promotes the development of more complex flow paths through the media, thus increasing attenuation potential through mechanical filtration and adsorption.

This basal matrix is overlain by a fine sand matrix and clay layer that provides additional protection against direct contamination from protozoa. The final layer of murram and grass provides further protection against any contamination from direct surface run-off onto the spring area. The backfill media is enclosed within wing walls, to ensure that the directional effect of the backfill was not lost and to ensure that the costs of improvement were kept within realistic boundaries.

In addition to the improvement in design aimed at reducing contamination, a further modification of the design provided more outlets at each spring (either through use of spring box or multiple outlet on a single wall) to overcome problems with congestion. This had been identified by a number of communities as being a significant problem at many springs. The use of a spring box also facilitates chlorination of the spring water should this be required.

Training of water committees and operators

In order to sustain the improvement of the springs and to prevent rapid deterioration, training was provided to committees and operators on basic management of the springs. This included the basic tasks required for maintaining the spring, simple systems of monitoring of the springs and establishing a small user fee in order to sustain maintenance work. Although water from springs has traditionally been provided free of charge, the need for routine maintenance was undermined within urban communities where no financial remuneration was available for the operators. Communities identified this as being a significant problem that would have to be addressed.

In each community, SCF staff worked closely with the water committee to develop a series of simple charges that could be levied on different users. This included households in the immediate area, vendors who collect water for sale in other communities and high-volume users such as schools. The sums suggested were low, as they were primarily designed to provide the operator with a small salary and to ensure basic items such as spades and pangas could be purchased. Recommended fees were in the region of USH 50-200 per household per month (equivalent to US$0.03 to $0.13 at an exchange rate of US$1:1,500 USH). This was obviously far cheaper than water purchased from public taps where costs are charged on a per container basis and were typically in the range of USH 25 to USH 50 per 20-litre Jerrycan.

Discussion

In terms of the improvement in water quality, there was strong evidence that not only were the short-term peak elevations of microbiological contamination significantly reduced, but the longer-term minor elevations were also reduced. Data for the first two springs show a significant reduction in levels of faecal pollution. At these levels of contamination, it is unlikely that water source quality will be a prime contributor to infectious disease transmission.

The improvements in quality were found despite the proximity of latrines uphill of the spring, indicating that the risk associated with contamination from pit latrines is less significant than from direct pollution. This is supported from evidence elsewhere in the country that faecal contamination in many cases derives from poor protection rather than land-use issues. This would be consistent with the major impact of interflow being felt in terms of quality rather than quantity. This implies that protected springs can be significantly improved even in high-density areas, where the yields indicate that baseflow is the primary means of recharge.

The use of contractors allowed useful lesson-learning and was deemed to be the most effective method of working. Initial problems were encountered in the interpretation of the designs, particularly where contractors had previously been involved in spring protection, which led to overspends on the budget on the first springs. However, these problems were resolved prior to the second set of springs to be protected and much closer liaison was maintained with the SCF supervisor and the design team.

During the rehabilitation of the first two springs, it became apparent that where communities had agreed to provide contributions in kind, delays in finishing the springs were found. The actual construction process itself was very rapid as the contractors sought to maximise their returns through rapid turn-around. However, finishing touches such as grass laying by communities was delayed significantly. On the subsequent springs, community contributions were financial with all work contracted out which provided much more rapid completion times.

Community involvement within the process and establishment of committees shows that community-based activities in low-income communities in large cities like Kampala are feasible. SCF have had similar experiences with the establishment of public taps. Whilst the actual method of participation may be somewhat different than in rural areas and where financial contributions are more significant than in-kind contributions, this does not undermine the principle of ownership and responsibility. Most of the committees formed have proved to function reasonably well and have developed codes of practice at the spring designed to support its sustainable use . Interestingly, this has included hygiene education messages that had not been previously suggested by the project team. Only in one community has the committee proved less effective and this appears to be largely related to the influence of a wealthy local politician who has in the past always resolved problems in the community from personal finances.

Conclusions

The rehabilitation of the springs in Kampala was shown to be successful. Water quality was significantly improved and operation, maintenance and management issues addressed. The rehabilitation allowed an expressed demand from the populations to be met and therefore provides a good example of flexible approaches to service provision. Whilst it would not be appropriate to rehabilitate all available protected springs in Kampala, the current pilot project indicates that where this is the preferred solution by the community and where the springs are sufficiently high-yielding, rehabilitation can be successful. Given high levels of use of springs and limited coverage with piped water supply, such rehabilitation provides a useful interim solution for many poor communities.

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