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WATER, SANITATION, ENVIRONMENT and DEVELOPMENT

Water quality in family wells

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Introduction

Standards of drinking water and public sanitation are low in many rural communities in developing countries. Contamination of drinking water with pathogenic micro-organisms maybe an important source of waterborne diseases such as bacillary dysentery, cholera and typhoid. It has been estimated that as many as 80% of all diseases in the world are associated with unsafe water.

In Zimbabwe, water quality is not a problem in urban areas, but then only 40% of the population lives in the town. A large number of family wells exist in the country, an estimated 100 000. Most of these are poorly protected and yield water of poor quality.

Since 1988, the Blair Research has been investigating ways of protecting family wells in order to enhance the quality of water they yield. Hence the inception of the Upgraded Family Well, which was a simple method of protecting family wells without the use of a handpump. In the upgraded family well emphasis has been placed on lining of the well from the bottom right up to the top, with a simple apron and run-off around the well-head which should be raised at least 300m above ground level. A simple concrete slab is then placed over the well and finally a simple improved windlass, bucket and chain arrangement is then fitted supported by two cement mortared brick pillars. The central access hole in the slab is covered with a metal tin lid. Previous work on water quality has shown that significant improvements in water quality can be made by this type of protection of the well (1,2). However, there is still insufficient scientific data available on the various components of the family well and their relative importance vis a vis water quality. The government of Zimbabwe at the moment offers a subsidy of 3 bags of cement, a windlass and a lid to each family as its contribution to this rural water supply programme. However, with the Economic Structural Adjustment Programme, this subsidy will not be there forever. What options could then be there? In many countries the windlass, which is the most expensive component of the technology, is quite unknown. Attempts have therefore to be made to investigate means of improving water quality in the absence of a windlass. Would improving the headworks only, be sufficient? If the pit was not lined, would this make a drastic difference to the water quality? This study attempts to answer some of these questions.

Materials and methods

Four communal areas were selected in Mashonaland East has a large number of family shallow wells and some of these wells already upgraded. Convenience sampling was done to select a number of family wells which were either upgraded, improved or open. Various features of the improved and open wells were noted and then these subdivided into various types according to the absence or presence of various technological components of the well.

Water samples were then collected from each well for analysis and each sample analysed for faecal contamination, pH and turbidity. The membrane filtration method using lauryl sulphate broth was employed for enumeration of *E. coli* (3).

Results

Level of contamination

This was indicated by the numbers of *E. coli* in the samples, for the different types of wells as shown on Table 1. The Upgraded Well produced water with the lowest level of *E. coli* (mean count 45/100ml) and the unimproved wells, the highest level of contamination (mean count 182 and 263/ml for Type 1 and Type 2 respectively) within the various categories of "improved" wells, the well with no cover slab, no lid, and no windlass provided the lowest quality water. Type 2, 3 and 4 wells were not significantly different.

PH and turbidity

For the turbidity and pH analysis, a total of 80 wells were examined, 16 upgraded, 32 lined, therefore improved wells and 32 unlined, therefore unimproved wells. Here it was not necessary to differentiate the improved wells into the presence or absence of certain technical components. Results obtained are as shown on Table 2.

The unupgraded, but lined wells had turbidity values significantly higher than those of the upgraded wells, but significantly lower than the unlined wells. All the lined wells had values below the maximum permissible level of 25 (Turbidity Units) for rural community water supplies. Ph values for the upgraded lined and unlined wells were not significantly different.

Table 1. Level of contamination of drinking water

WELL TYPE	NO. SAMPLED	NO. OF *E.COLI*/100ML RANGE	MEAN
Upgraded Well	16	0 - 80	45
Improved Well			
Type 1: Wells with lining, concrete slab and windlass	8	0 - 160	75
Type 2: Wells with lining, and concrete slab (no windlass)	22	0 - 220	81
Type 3: Wells with lining, cover slab and lid	18	0 - 180	78
Type 4: Wells with lining only (no cover slab and lid)	10	10 - 280	140

WELL TYPE	NO. SAMPLED	NO. OF *E.COLI*/100ML RANGE	MEAN
Unimproved Well			
Type 1: No lining, no cover slab, with windlasses	9	10 - 400	182
Type 2: No lining, no cover slab, no windlass	6	10 - 720	263

Table 2. Range of pH and turbidity for the well waters

Well type	No of wells	Turbidity (TU) Range	Mean	pH Range	Mean
Upgraded	16	5 - 15,6	8,5	5,5 - 7,6	6,52
Lined wells (Improved)	32	5 - 26,0	21,8	5,2 - 7,9	6,58
Unlined wells (Unimproved)	32	8 - 288,0	156,0	5,0 - 7,3	6,12

Discussion and conclusions

The present study is one of the few studies carried out which has wide implications and application in Zimbabwe and the subcontinent in terms of rural water supply programmes. What is obvious here of course is that any shallow well whether upgraded or not cannot supply good quality water as is achieved with the deep wells with handpumps (4,5). However, rising costs, maintenance problems, etc, warrant that this simple and cheap technology be promoted to the rural populations.

Results obviously demonstrate that the upgraded well, with the improved head works, a good water raising system provided by the windlass complete with bucket and chain and the pit itself lined from the bottom right up to the top, delivers the best quality water - in terms of bacterial or faecal indicator load as well as the turbidity. The standard permissible level for turbidity, for community water supplies is 25 Tu and the upgraded well waters had values far below this limit. An improved headworks obviously prevents wastewater released at the surface from draining back into the well. The cover slab with lid prevents access of foreign objects, dust, dirt into the well; whilst a well lined pit prevents collapse and soil erosion, hence the low turbidity values. The latter was also apparent in this study, where the lined, improved wells had turbidity values also within the maximum permissible level as compared to the unimproved, unlined wells which had values as high as 288 TU. Turbid waters also harbour many more micro-organisms in the soil particles, hence encouraging contamination.

On individual components of the shallow well, the windlass whose reason for existance is that it is there to maintain the water-raising system in a hygienic environment, i.e. keeps the chain clean and aids in raising the bucket and keeping it on a safe clean place, was shown here not to have any significant effect on the quality of water. Presence or absence of a windlass did not alter the numbers of *E. coli* in the improved wells in any way. What was apparent however, was the lining of the pit. Results demonstrate this to be most important aspect to affect water quality in shallow wells, together with the coverslab and lid, which obviously keeps all contamination out.

The findings of this study should have important application in countries like Malawi, Tanzania and various countries where the windlass is relatively unknown. For Zimbabwe, where government still provides a windlass as a subsidy, emphasis when improving a shallow well and hence water quality should be on the proper lining of the pit and the covering of the well contents.

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