9th WEDC Conference: Sanitation and water for development in Africa: HARARE: 1983

LOW COST IN RURAL GROUNDWATER PROJECTS IN MALAWI

. by A Smith-Carington

INTRODUCTION

The concept of Integrated Projects for rural groundwater supplies has been developed in Malawi since the introduction of low-cost boreholes in 1980.

The need for a low-cost efficient approach was clear because it is estimated that about 75% of the 1990 rural population of about 7 million people will need to be served from groundwater. The very successful gravity-fed piped water programmes can only serve the remaining proportion of the rural areas due to the limited number of protected perennial sources.

The integrated approach aims to provide complete coverage of an area with waterpoints such that the walking distance is less than 500m for the great majority of the population to be served. This is achieved by:

a) rehabilitation of existing boreholes where feasible
b) construction of new well-designed low-cost boreholes
c) protection of suitable existing dug wells
d) construction of new dug wells
e) establishment of a maintenance structure for all waterpoints

Full details of the programme are given in a comprehensive manual (Chilton, Grey and Smith-Carington, 1982).

There are two Integrated Projects currently being implemented, one in the Livulezi Valley in Ntcheu District and the other in Dowa District, and several more are planned. Both of those under construction will serve projected 1990 target populations of about 60 000, each borehole serving a design population of 250 and each dug well 125 people, with a design abstraction of 27 litres/head/day.

Hydrogeology

The waterpoints are being constructed in the weathered Basement aquifer which is widespread over the plateau areas of Malawi, although it is relatively thin (commonly 10-30m). The extent of weathering and unconsolidation increases from the fresh bedrock upwards. It grades through a zone of broken and hydrated rock where the surfaces are chemically weathered, into a zone of crumbling and decomposed bedrock, often of sandy texture, which is the main aquifer. The weathering processes result in increasing clay content upwards and the more permeable layers are partly confined by an overlying thickness of compacted clays and latosols (commonly 5-20m thick).

Potential borehole yields are low (usually less than 60 litres/min) but these are sufficient for handpump supplies where typical abstraction rates are 20 litres/min. Dug well abstraction rates are in the order of 10 litres/min. The weathered basement is thus an important source for rural domestic water supplies.

The water table is shallow and groundwater is usually first struck at depths of less than 20m. The choice of waterpoint depends on the depth to water and is the unique decision of the Project Hydrogeologist. Where the water table is less than 4m below ground level a dug well is constructed; where it is more than 6m deep a borehole is drilled, and where it is 4-6m deep either type of waterpoint is constructed.

Project Implementation

In each area there are 4 cable tool drilling rigs and 2 well digging teams. Keeping them in close proximity allows greater supervision of the construction by professional staff and considerable reduction in the transport costs. Motor cycles are used by professional staff, bicycles by drilling crews, a tractor and trailer for moving the rigs from site to site, and a small pick-up truck for transporting materials. There is thus a high operating efficiency whilst keeping overhead costs as low as possible.

Borehole Designs

Most of the existing old-design boreholes in Malawi are very inefficient, and expensive to construct and maintain. The majority are drilled very deep (40-60m) into hard fresh bedrock, with the more

porous, and permeable water-bearing weathered zone cased out. Expensive steel lining (commonly 150mm diameter) is installed and the screened sections of this are usually only short lengths at lower levels in the hole. These sections have relatively few torch or hacksaw cut slots of large diameter. Together with the thin, ineffective pack of very coarse crushed roadstone (6-12mm) these allow the ingress of sand into the borehole. As a result there is often rapid wear on pump components, frequent breakdown of handpumps and high maintenance costs.

An understanding of the hydrogeology has led to the matching of the borehole design to the aquifer. The improved design low-cost boreholes are drilled only as deep as is necessary for the required yields (30 litres/min for rural domestic supply) and they tap the weathered basement aquifer. Borehole depths are commonly only 20-30m and they require only about 4-5 days for construction. This is between about a third and a half of the time taken for old-design boreholes in the dispersed drilling programme.

Locally manufactured PVC pipe (110mm diameter) is used to line the boreholes. Slotted pipe is installed below the depth where water is first struck. There is a much greater open area of the screened sections (9%) although the slot sizes are only 0.75mm diameter. Coarse sands (1-2mm) from the shores of Lake Malawi are used as a pack to fill the annulus between the lining and the walls of the borehole (drilled at 200mm diameter). Development by overpumping is carried out until the discharge is clear to remove the fines and increase borehole efficiency.

Dug Well Designs

Dug wells are at present being constructed at 1.5m or 2m diameter and are being lined with porous concrete rings and/or bricks. They are protected by a concrete top slab and equipped with handpumps. Tests are being carried out on other lining materials eg sisal cement and different dug well designs in order to improve the sanitary completion, increase the ease of construction and minimise costs. Digging takes place during the dry season, and aims to reach depths of 4m below the minimum water level although this cannot always be achieved. A pump is used to dewater the well for digging below the natural water table.

Backfilled wells have been tried in order to increase the protection from pollution; however there are difficulties of access if deepening or pump repairs are required. As a result, this design is likely to be superseded.

Waterpoint Surrounds

All waterpoints are completed with the construction of an apron to prevent water collecting around the pump pedestal and its ingress into the borehole or dug well, and to ensure good drainage away from the area. A washing slab is incorporated into the apron and this has proved to be very popular with the communities, encouraging the use of the clean protected water rather than traditional water sources in the rivers.

Target Costs

Using the integrated approach the target cost for borehole construction has been reduced to MK 1500, and for dug wells it is MK 750. These represent MK6 per capita, and are inclusive of handpump, waterpoint surround and Project overheads.

*MK1 is approximately equivalent to US$1.

Community Participation

Community participation is considered to be vital to the long term success of the rojects. The involvement of the local people in as many activities and decisions as possible is important in order to build up a feeling of ownership of the waterpoint, even where it may reduce the efficiency of the construction. It must be remembered that the implementation phase is only the start of the Project, and smooth operation and maintenance will hopefully continue for many years.

Local meetings are held with community leaders to explain the aims of the Project and what tasks the villagers will be expected to carry out. A water committee of 4-5 people (if possible including some women) is formed in each village; these are responsible for organising all the duties carried out by the community.

The waterpoint sites are chosen by the village themselves after advice from the hydrogeologist. Detailed geophysical surveys are not usually necessary because the yields required for handpumps are very low and available over widespread areas. Guidance over siting in relation to existing pit latrines and cattle kraals is important to avoid risks of water pollution. Seasonally waterlogged ground and areas near the outcrop of fresh bedrock are avoided.

The community also pays in kind by the provision of bricks, stone, sand and water, and by their own physical effort in digging the wells, crushing stone for the aprons and providing labour to help wherever possible in the construction of the water-point. A sense of village ownership is thus created, and as a result there is likely to be more care of the pump and surroundings and the possibility of village level maintenance.

Handpumps

The locally manufactured lever-action Maldev handpump has been developed in Malawi with ease of maintenance as a major design feature, and has been installed on the majority of boreholes in the Integrated Projects. Preventive maintenance by village caretakers is commencing in the Livulezi Project with regular tightening of nuts and bolts. The downhole components can be removed through the cover plate on the top of the pump without any dismantling. This offers scope for simple repairs at village level, but this is dependent on the development of easily replaceable, cheap downhole components, which is currently under research in Malawi and also by the Consumer Association in UK and the World Bank Global Handpump Testing Project.

It should be noted that the key to good handpump performance is good borehole design. Good pumps cannot function well on boreholes which allow sand ingression and wear on pump components. On the other hand, none of the 24 well-designed boreholes of the Livulezi Feasibility Project fitted with conventional pump cylinders have required replacement of the cup leathers over a period of 1½-2 years.

The dug wells are equipped with locally manufactured, shallow-lift, direct-action handpumps. The designs are still being improved to allow village level maintenance.

CONCLUSIONS

In summary, the Integrated Project approach has resulted in low-cost groundwater supplies in the following ways:

a) boreholes drilled only as deep as is necessary for handpump supplies and constructed in a shorter period.
b) use of locally available materials wherever possible
c) site selection by the communities
d) considerable reduction in transport costs
e) greater supervision resulting in high standard and high success rate of water-point construction
f) labour and materials provided by the community.

The involvement of the community during the implementation stages is seen as the vital factor for the successful long term operation and village level maintenance of the Project.

REFERENCE

CHILTON P J, GREY D R C and SMITH-CARINGTON A K, 1982. Manual for Integrated Projects for Rural Groundwater Supplies. UNDP/ Department of Lands Valuation and Water, Malawi Government.