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Community well digging in Zimbabwe

INTRODUCTION

Deep well digging has been practised in Zimbabwe for many years and many dug wells constructed in the early 1900s are still functioning. The last major government well digging programme occurred in the 1950s in Matabeleland South after which borehole drilling, using mainly cable tool rigs, was the usual method of exploiting ground water.

After independence in 1980, the Lutheran World Federation (LWF) started a well digging project in Matabeleland South (Ref. 1) initially employing some old workers who had gained experience during the Government Programme in the 1950s.

In 1982 UNICEF assisted the Government of Zimbabwe to establish a well digging programme in ten districts in Matabeleland adopting methods developed by LWF. This paper describes the programme.

INSTITUTIONAL ARRANGEMENTS

The Ministry with which UNICEF cooperates is the Ministry of Water Resources and Development (MWRD) now combined with the Ministry of Energy. This is mainly a technical Ministry without district level representation and whilst it carries out borehole drilling and previously well digging in the rural areas, this is usually on behalf of the District Development Fund (DDF) of the Ministry of Local Government and Town Planning (MLGTP). DDF has a workshop in each district and field officers responsible for maintenance of roads and water supplies for people and livestock. Water supplies to Government Institutions are the responsibility of MWRD. DDF is therefore responsible for hand-pump maintenance, but does not employ community workers and in the past communities were very often forced to engage in projects at the whim of the district commissioners.

The Ministry of Health does have a cadre of community workers, health assistants and now, in addition, village health workers. This Ministry has for many years been supporting community well protection but this has not involved blasting or very deep digging.

A pilot scheme was formulated by UNICEF which rather ambitiously involved the digging of four wells in each of ten districts in Matabeleland. Supervision at district level was to be the responsibility of the DDF field officers with community motivation carried

out by district councillors and health assistants. Apart from the normal difficulty in trying to start a new programme or rather restart an old one, the DDF field officers had a great many other calls on their time and were unable or disinclined to spend much time on well digging. Boreholes, because of their higher technology, were also felt to be progressive and modern. It was also difficult for the two Ministries to work together at district level; each tended to concentrate on its own projects. In the event, only a few wells were completed during 1983.

However, further funds were made available by MWRD and in January 1984 a well sinking supervisor and foreman were employed through DDF in each district. The supervisors were given a one week training course in Bulawayo and then returned to their districts.

DISTRICT ORGANISATION

Zimbabwe is a country with a great deal of mining activity, so in most districts it was possible to find one or two unemployed ex-miners with blasting licences and sometimes well diggers whose licences had expired. One of these was recruited in each district as a foreman well sinker. Well sinkers were sometimes sent to other districts to learn from more experienced workers. Both the foreman and supervisor are paid monthly. The job of the supervisor is to generally supervise well digging in the district under the DDF field officer. In particular the job includes:

1. selecting priority areas in the districts in conjunction with the district councillors and community workers;
2. arranging for a well sinker to sign a contract form for each well site after checking if the site appears feasible;
3. measuring the work done by the well sinkers on a monthly basis and calculating the amount due on the well measurement forms;
4. keeping records of well sinking in the districts;

5. ensuring that well sinkers are kept supplied with equipment, explosives and cement, etc. and ordering equipment from Bulawayo;
6. ensuring that safety regulations are adhered to;
7. selecting trainee well sinkers and arranging with the Mining Inspector in Bulawayo for them to be tested for a restricted blasting licence.

The job of the foreman is to generally assist the supervisor but with special responsibility for training blasters and blasting wells where qualified well sinkers are not available. At the start of the programme sufficient licensed well sinkers were not available and one well sinker often contracted for several wells at a time. This often caused problems as the well sinkers were then not inclined to do much physical work except setting the explosives. As more licensed sinkers became available, this practice has decreased and, in general, one licensed sinker works on one well at a time.

Licences are also required for purchase, transport and storage of explosives and the Government regulations have to be adhered to.

No special transport was provided for the project. The existing DDF transport fleet is used and refunded through a MWRD vote at a standard rate per kilometer.

COMMUNITY PARTICIPATION

The community are invited to participate in the programme in the following ways:

1. form a small committee, which should consist of four people at least two of whom should be women, at each place a well is required;
2. select a site for the well;
3. start digging the well, after the site has been approved, to a depth of four metres or until rock is reached whichever comes first;
4. provide food and accommodation for the sinker and his team;
5. provide clean broken stone and sand for the concrete lining, cattle trough, etc., if available locally;
6. witness the removal of water to check that 100 kibbles are removed on each of two successive days;
7. provide a layer of stones around the well to protect against erosion;
8. construct a fence around the well;

9. look after the well, handpump and surround and ensure that the handpump is properly used;
10. transport the windlass and other well sinking equipment to the next site;

Community motivation and participation has varied greatly from district to district and has depended largely on the enthusiasm of the district councillors for the programme.

WELL SITING

Over about 80% of Zimbabwe, the water table is within 15 m of the surface. Much of the country is composed of igneous rock, granites, greenstone, and basalt and water is contained in fractures and in the decomposed layers.

Selection of the well sites is left entirely to the community. In theory, the supervisors have the power to veto unsuitable sites but as their period of training was so short in practice they often had little more idea of a good site than the rural people.

Site selection however has not been a problem. In only one district has the failure rate exceeded 10% and, as the year progressed, it was evident that better sites were being selected. People are learning by experience. In any case, the cost of a geophysical survey is comparable with the labour cost of digging a well. The yield sought is also relatively low.

As a guide wells were not to be sited closer than 2 km to another protected source but this has not always been observed.

WELL DESIGN

In non-collapsing formations, wells are dug unsupported. Very often the soil cover is only a metre or so. The well is dug with a diameter of 1.5 m reducing to 1.2 m in hard formations. The upper portion is lined with in situ unreinforced concrete with an internal diameter of 1.3 m to 0.5 m above ground level. Wells are covered with a split reinforced concrete cover slab 80 or 100 mm thick.

In collapsing formations plain ended precast concrete rings are used 1.2 m external diameter by 1 m high by 0.075 m thick and reinforced with chicken wire.

The average depth is about 15 m but wells over 35 m have been dug. 30 m is the advised maximum and windlasses are normally supplied with 30 m of 10 mm wire rope.

As dewatering is done manually, dug wells cannot yield much more than 5 cubic meters per day, unless they are quite shallow.

This is sufficient for about 100 people or ten kraals.

WELL DIGGING AND CONSTRUCTION TECHNIQUES

A well digging team usually consists of a well sinker and three labourers. The team is presently paid Z\$20 (Z\$1 = £0.58 16/2/85) per metre for digging in any material and Z\$38 per metre for blasting. The first four metres are dug voluntarily by the community. The rates are increased by 50% when the well is producing more than 1½ cubic metres of water per day. Water is removed using a 50 litre kibble and a simple steel windlass, also used during digging. A well is considered to be adequate when it is producing more than 5 cubic metres or 100 kibbles per day. For each kibble of water removed the well sinker places a stone to one side for subsequent checking by the supervisor. Removing 5 cubic metres of water from a deep well can take 5 or 6 hours of hard work.

Holes for blasting are drilled by hand, normally using tungsten carbide tipped solid hexagonal drill steels with 27 mm tip and 22 mm shank and 4 lb hammers. Sometimes untipped drill steels are used which can be sharpened by village blacksmiths. Well sinkers, however, prefer the tipped steels the top end of which wears down before the carbide tip becomes blunt. Short steels are used for starting the holes which should be at least 650 mm deep. Ammon gelignite 60% in 25 x 200 mm sticks is generally used for blasting. It has good water resistance, good blasting strength, and is very safe to handle. Factory made connector capped fuses with No. 6 strength detonators are used. These tend to be more reliable and waterproof than on site fuse-detonator connections. Slow burning igniter cord connects the fuses together and is either lit down the well or at the surface. The latter is recommended but many well sinkers prefer the former method. Good well sinkers can achieve 0.5 metres per blast. Some well sinkers use ammon nitrate/diesel mixture as an explosive. This is considerably cheaper but needs a stronger detonator and is not water resistant.

Trainee well sinkers have to work for at least three months under a licensed sinker before they are able to take the blasting test. If they pass, they are issued with a restricted blasting licence by the Mining Inspector of the Ministry of Mines. Knowledge of the safety regulations and how to deal with misfires are important aspects of the test. For each successful test, the well sinker who was responsible for the training receives a bonus. To date 57 licensed well sinkers are working on the programme.

The well sinking team also receives payment

of Z\$12 per metre for lining the well with concrete. Steel shutters 1 m high by 1.3m external diameter are used for this together with a wooden or steel platform suspended by ropes from the legs of the windlass. Occasionally the well sinkers make the cover slabs but it has been found preferable, from a quality control point of view, to have these made centrally at the DDF yards.

HANDPUMPS

Two types of handpumps are used on the wells. For deeper wells, a modified version of a handpump developed in Zimbabwe in the 1930s by Mergatroyd is used. The main features of the pump are a large wooden bearing block and generally simple but sturdy construction. The pump stand is concreted in beside the well. Conventional down hole components are used consisting of 50 mm brass foot valve, 75 mm brass cylinder, 12 mm galvanised pump rods and 40 mm galvanised steel pipe all locally produced. The present cost of the pump for a depth of 30 m is about Z\$ 540.

For shallow wells, down to 12 m, a direct action pump called the Nsimbi is used. This was developed by Jellema of LWF in Bulawayo based on work he did in Malawi. Above ground components are painted steel with PVC used below ground. The pump rod is 32 mm Class 16 PVC pipe and the riser pipe 50 mm PVC pipe either Class 10 or Class 16. The 50 mm Class 16 PVC cylinder is fitted with a brass foot valve and the piston is a standard rubber piston used in hydraulic machinery and has to be imported. The piston is drilled and fitted with a rubber valve. The pump is not yet available commercially but at present costs Z\$146 for a depth of 12 m compared with about Z\$ 360 for the deep well pump. The Nsimbi pump is much simpler to install and repair and has proved to be reliable.

For both pumps, most problems have been caused by incorrect installation. Installation and repair is carried out by DDF workers who have received little or no training. This aspect is now receiving attention.

PROGRESS

Progress from January to December 1984 is as follows:

Wells completed and fitted with handpumps:	132
Wells completed but awaiting handpumps:	82
Wells in progress under contract:	201
Abandoned wells:	60
(48 in one district which at present has no blasting capability)	

Completed wells are costing on average about Z\$1,500 each including handpumps.

One of the major constraints has been due to the fact that whilst DDF is the main operating agency for the project UNICEF is officially co-operating with MWRD. Consequently DDF has not yet fully adopted the programme and it tends to be sacrificed, for instance when there is a conflict over transport. In addition, because well digging is not part of MWRD's normal activities, supporting staff has not been readily available.

Lack of very effective community motivation has also been a problem. This has largely been due to the shortage of health assistants soon to be rectified and has sometimes resulted in DDF undertaking tasks which should be done by the community.

Progress has also been hampered by the security situation which has very often made it necessary for Government vehicles to carry armed military escorts.

CONCLUSIONS

It is estimated in Zimbabwe that from purely hydrogeological consideration well digging would be more effective than borehole drilling in about 40% of cases. In these sites the depth of decomposed rock is insufficient to provide adequate inflow to a borehole whereas the larger diameter of a dug well provides storage and therefore allows inflow to occur over a longer period.

In addition it is considered that a well digging programme has the following advantages:

1. no high technology equipment requiring imported spares or expertise is required;
2. considerably lower cost; in Zimbabwe a dug well costs about one-quarter the cost of a borehole;
3. well digging is labour intensive and thereby provides a positive transfer of resources to the rural areas;
4. by providing jobs and skills training in the rural areas, rural self sufficiency is enhanced and the drift to the urban areas in a small way reduced;
5. more scope for community participation;
6. as the skill remains in the community, dug wells can be deepened and cleaned if necessary without resorting to complicated machinery;
7. by training people in well digging, private well digging is encouraged;
8. water can still be obtained from a well using a bucket even if the handpump is broken;

9. well digging, being community based and with no tempting machinery, provides less target for dissident activity.

Paying well diggers on a piece work basis, although contrary to Government practice, has proved to be effective. Well digging is hard and unpleasant work and little progress can be expected if workers are paid monthly. By paying the well diggers for work done, supervision, notoriously difficult in remote rural areas, becomes easier. If the well diggers are not working, they are not being paid. Conversely, if the supervisor is not doing his job, the well diggers are soon out for his blood.

In general, the programme has been well accepted by the people and government workers at district level where the advantages are self evident. The LWF programme, on which this Government programme is based, executed with freedom of action of an NGO, continues to make very good progress.

No explosive related accident has been reported in the Government programme and only one accident of any kind. All workers are supplied with locally made safety helmets.

The programme does depend on a well organised Ministry of Mines and availability of explosives. It is perhaps curious that a simple technology such as deep well digging may be more appropriate in a country with a relatively well developed infrastructure than in less well organised countries.

In conclusion, it is suggested that, whilst this type of programme may not be replicable in every country in Africa, it does have a major role to play in achieving the goals of the IDWSSD in Zimbabwe.

REFERENCES

1. T E VELDE P. Organisation and Implementation of a Dug Wells Programme. Paper, 9th WEDC Conference, Harare 1983.