Technological developments in Zimbabwe's Rural Water Supply and Sanitation programme

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Zimbabwe has made great strides in providing improved water supplies and sanitation facilities (Government of Zimbabwe, 1998) throughout the rural areas of the country, and has earned an international reputation for its efforts. About half of Zimbabwe's rural population of nearly seven million have access to a "primary water supply" fitted with a hand pump. A further million have access to some form of standpipe fitted with a tap. A quarter million people take their water from about 35 000 family owned "upgraded" wells, with some 55 000 people taking water from springs. All these sources are relatively safe and impose a minimal health risk.

However, another million people living in the rural areas take their water from contaminated sources such as open wells, rivers, streams, dams and ponds. Thus, in theory at least, about 75% of the rural population has access to "safe water" although in practice the percentage is somewhat below this figure because not all improved supplies are operational. A much lower percentage has access to improved sanitation at the household level and in rural Zimbabwe this means a "Blair Latrine". Over 450 000 family owned Blair Latrines have been built since 1980, but these only serve 30% of the rural population, with a further 5% being served by ordinary pit latrines and about 2.5% by waterborne systems. Clearly this is a remarkable achievement, but there is still a long way to go before a satisfactory coverage has been gained.

Whilst the Rural Water Supply and Sanitation Programme grew rapidly after 1980, when peace returned to the land and donor funding became widely available, the foundations for its technological and institutional development were made long before and this sound foundation has greatly assisted the programme ever since. What is unique about the Zimbabwe programme, is that the technological innovations upon which much of the programme is built, are almost entirely of Zimbabwean origin. The hand pump used throughout the country is called the "Bush Pump" and is entirely Zimbabwean. The Blair Latrine - a ventilated improved pit latrine (VIP) was designed in 1973 by the Ministry of Health and first entered the programme in 1975. Its design is also entirely Zimbabwean. Family owned wells have been dug in the rural areas for many decades. The current programme of upgrading them to improve on safety and water quality is based on traditional practice. This paper outlines several of these technological developments and discusses the basic principles upon which they are built (Morgan, 1990).

The Zimbabwe Bush Pump

The Bush Pump has been Zimbabwe's national hand pump for sixty six years and remains the pump of choice for all community settings in the rural areas of the country (Fig. 1). The pump head was first designed in 1933 by Tommy Murgatroyd in Plumtree, Matabeleland and since that time it has undergone several refinements. In the 1960s it was restyled by Cecil Anderson and again in the 1980s when the model known as the "B type" Bush Pump was first tested and then became the national standard in 1989. All the components of the pump are manufactured locally, and this means that spare parts are also available. Some 33 000 Bush Pumps have been installed throughout the rural areas. Remarkably these include a small number of Murgatroyd's original pumps installed in the 1930s which are still operational, reflecting the brilliance of his design.

All Bush Pumps are robustly fabricated in steel and use a hardwood block as a lever and bearing surface. The wooden blocks are made from teak and have a life of some 20 years. They are boiled in oil to provide self - lubricating properties. The handle is made from steel pipe, the diameter and length is chosen to suit the lifting requirement from just a few metres to over 100 metres. "Down the hole" components are made of brass and steel, and, like the pump head are robust and well tested. Most pumps use 75mm diameter brass cylinders attached to 50 mm nominal bore galvanised iron rising main - pump rods are usually 16 mm mild steel.

Making the pump easier to maintain

Whilst the District Development Fund has always been responsible for maintaining the pumps in the

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communal lands, over the past few years there has been an increasing emphasis on user participation in maintenance. This is partly the result of drastic reductions in the allocation given by the government for pump maintenance. Currently, the concept of Community Based Maintenance (CBM) is being encouraged strongly by the government.

Running in parallel with this trend has been a series of technological developments of the Bush Pump which make it much simpler to maintain. Most maintenance jobs on the Bush Pump are undertaken on "down the hole" components and the routine replacement of piston seals is the most commonly undertaken maintenance procedure. On the standard pump this necessitates the removal of all pipes and rods in order to gain access to the piston and its seal, which has a larger diameter than the "rising main" pipe. Such a process takes a great deal of effort and time and also many specialised tools. However, the more recent models of the Bush Pump employ "open top" cylinders which allow the piston and its seals to be extracted through cylinder and up through the steel pipe to the surface. This means that in order to gain access to the piston and change the seals it is unnecessary to lift the heavy steel piping. Three systems have been developed based on 50 mm, 63.5 mm and 75 mm open top cylinders, the 63.5 mm version being the most popular. In this system pump rods are not threaded together but linked by case hardened steel hook and eye joints which makes separation much easier. The system is simple and easily managed - several schools use the system and the children perform routine seal replacements themselves.

Such developments have brought international interest and recognition. SKAT (Swiss Centre for Development Cooperation in Technology and Management) who co-ordinate hand pump development internationally, have incorporated the Bush Pump into the "International Hand Pump Specifications", making it a "public domain" pump (SKAT/HTN, 1999). Computerised drawings are available to developers and manufacturers throughout the world. Perhaps what is most unique about the Bush Pump is that it is one of the very few hand pumps develop in Africa, which has survived through an era of vigorous hand pump marketing. It is the only hand pump on the African continent which is still widely used in the country of its birth. However, one must add a note of caution. Many hand pump programmes in Africa have failed, not because of their technological component, but because of a lack of a maintenance system to back them up. For many decades the maintenance back up system for the Bush Pump, undertaken by the DDF, an arm of Government, has worked well. But allocations to the DDF have dwindled, drastically, and much greater reliance is now being placed on the users to maintain the pumps - a process which may take years to evolve. Whether this will work in practice remains to be seen. It would be such a great shame for such an extraordinary pump to fail because the transition in maintenance strategy took place at a faster rate than was practical in reality.

Fig.1. A bush pump
Shallow well protection

Whilst Bush Pumps are normally used on boreholes and deep wells, Zimbabwe has also introduced two of its own shallow well hand pumps, namely the Blair and Bucket pumps for use on community shallow wells. The Blair pump was first introduced in 1976 and later mass produced in 1980. It was a simple pump made of PVC, little more than two pipes one working within the other, with a ball valve at the base of each. The handle also served as a water spout in order to make things as simple as possible. Several thousand were used in the early 1980s to protect shallow wells, but the pump was phased out of the programme in the late 1980s and replaced by two systems using a windlass, an ageless technology, known and understood at village level. The community "Bucket Pump" was designed for small communities and used a cylindrical bucket operating within a tubewell drilled by a hand operated drilling rig, known as a Vonder Rig, also designed in Zimbabwe. The chain which held the bucket was raised and lowered from a stout windlass held by wooden bearings at the head of the pump. Several thousands of these were mass produced pumps were also used in the programme, but as with so many development issues, a far better concept had evolved alongside these developments and was about to take centre stage for shallow well protection. This was based on traditional methods.

Upgraded family wells

Tens of thousands of windlasses are fitted to shallow wells in the communal lands as a means of raising water in buckets and it is thought that this simple, yet elegant technique, which has its origins in antiquity, had been taken from the mining windlass, used to dig shafts at the turn of the century in Zimbabwe. Most of these "traditional" windlasses are fitted to family owned wells, which are a familiar feature in the communal lands, especially those where the water table is relatively high. Whilst each traditional well varies somewhat, many have common features which improve the strength, safety or water quality of the well. These traditional improvements include lining the well with bricks, providing a well cover of some sort and also fitting a windlass which helps to lift the bucket.

This concept of upgrading family wells by improving the well head without the use of a hand pump, was examined closely by the Blair Institute in the late 1980s and by the early 1990s these features had been improved further and combined to form the "upgraded family well." This technology incorporated not only a fully brick lined well chamber, but also a concrete well slab, apron and water run-off. A raised collar cast as part of the well slab was covered with a tin lid. Each well was also fitted with a strong windlass, mounted on brick supports (Fig.2). The lining of the well and the hygienic nature of the "headworks" lead to noticeable improvements in water taste, because the water becomes less turbid. Also there were significant improvements in water quality. E.coli counts were reduced to between one quarter and one sixth compared to wells less well protected. The cover also made the unit safer for children. Such simple and practical features were very popular with the users and there was much support for the programme in many rural parts of Zimbabwe.

At first officials within the Government viewed the method with some caution. The approach seemed to be almost too simple, from a technical point of view. In addition, material subsidies were offered to individual families, rather than communities. Neither fitted into the guidelines set for national decade objectives at that time. However, the overwhelming response by the users prompted the Ministry of Health and Child Welfare to expand its operations in this area and by the end of 1998 some 32,000 units had been completed, serving ~300,000 persons.

The main reason for the success of this approach, was not only technological, but related to the important issue of ownership and the responsibility for maintenance. Whereas the Blair and Bucket pumps had been designed for community use - with some form of community responsibility for maintenance being essential, but often not forthcoming, the Upgraded Family Well was seen as a family asset by its owners and worthy of being looked after. The method of providing each family with assistance seems extravagant at first, but in fact the cost to the funding agencies was actually much lower, per person served, than providing improved water sources in any other way. The simple reason for this was that once the incentive was provided, in the form of a material subsidy, the owner provided the remaining two thirds of the entire cost himself. This involved a family digging its own well, or deepening an existing one, and lining it fully with fired bricks. The future well owner also agreed to pay a well digger and a trained builder to undertake the task. The family provided bricks, sand and other building materials for constructing the well. In return, the family was provided with three 50 kg
bags of cement, a strong steel windlass and a tin lid. These formed the material subsidy which provided the incentive for the family to proceed with the undertaking.

The success of the Family Well Programme in Zimbabwe is largely due to the fact that there is a genuine demand by the users to improve their own water facilities, and become self-sufficient, particularly at a time when the future reliability of community water supplies is in question. Such an enthusiasm is rarely seen when villagers are asked to participate in community-based water schemes. It may also be an adverse reaction to the considerable distances which must be travelled from the homestead to reach the community pumps, and sadly, the increasing number of community installations which are "out of action."

Communities tend to pay the most attention to communal facilities when there is no other source of water available, where they become vital for survival. If the water exists outside their back door, this is obviously the source which will be most used. There are many spin off effects which follow the completion of a family owned well. Vegetable gardening becomes practical and the nutritional and income generating benefits of such developments are obvious. More water is used within the homestead, which has a direct impact on personal hygiene practice and consequently to the health of individuals. Because the water is close at hand, less water is stored within vessels thus decreasing potential contamination. The collection time is short, making available more time to invest in other activities.

The Upgraded Family Well programme can only take place in areas which have a water table which is relatively close to the surface and generally this has to be less than 15 m. However, such areas are widespread in Zimbabwe and cover districts with the highest population densities. Whilst not every family may be able to afford an Upgraded Well, those that cannot generally have access to wells that are built nearby. The programme compliments the hand pump programme rather than competing with it. Hand pumps which generally take water from deeper aquifers are essential in the drier parts of the country and act as back up sources in areas when shallow wells run dry. They are also essential for schools and other community centres. In areas, where family wells are common, the demand on existing hand pumps is reduced and this has the effect of reducing hand pump maintenance costs. The concept of upgrading simple wells, especially those owned by families, is a logical one, but one that is still overlooked by many governments and donor organisations in Africa. The experience in Zimbabwe shows that the aims of the water decade can be achieved, not only by choosing more modern approaches, but also by updating traditional methods, which may have been in common use for generations.

The Blair Latrine Programme
Perhaps the best known technology used in the programme is the Blair Latrine. This was first designed in 1973 at the Blair Institute and placed on trial for two years before it was used more widely by the Ministry of Health. Recently published records show that about half a million Blair Latrines have been built in Zimbabwe since it was first designed.

**Fig.2. An upgraded family well**

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Since 1980, over 400,000 Blair Latrines have been built at household level with a further 25,000 at schools for staff. In addition, 8,000 multi-compartment Blair Latrines have been built at schools with the number on commercial farms and estates estimated at well above 50,000. Whilst many units built long ago have either filled up or fallen down (12%), the sheer numbers built reflects the huge commitment not only by government, donors and the private sector but also by the users to supporting a "home grown" solution to the very large problem of providing simple yet effective sanitation without the use of water.

The rural sanitation programme began to build up after 1980 when external donor support became available to the country. Before that time the Ministry of Health had been actively involved through its Environmental Health Department in the promotion of hygiene and the improvement of shallow ground water supplies and sanitation. There had been a long history of promotion of improved latrines and wells even before donor-supported schemes began with Health Assistants operated at grass roots level moving through the villages they knew well. Thus a knowledge of the advantages of improved water supplies and sanitation was well known throughout the rural areas before the activities related to the "International Drinking Water Supply and Sanitation Decade" began. This "foundation laying" period is thought to have been vital to the future success of the programme.

Design principles
The Blair Latrine is basically a pit latrine fitted with a ventilation pipe which draws odours out of the pit (Fig.3). The interior of the latrine itself thus remains almost odour free. The vent is screened at the top, and acts as a fly trap as well as a ventilator, since flies are attracted to light and will rise up the pipe if the interior of the latrine is semi dark. Most "Blairs" are built over single pits. The concrete slab covering the pit is caste with two holes in it, one for the squat or sitting hole, the other for the vent. A structure of some sort is built around the squat hole to provide privacy, and covered with a roof to create semi-dark conditions. Vents can be made of tin, PVC, asbestos or cement, or with bricks and mortar.

The standardised Blair Latrine used in Zimbabwe, which lasts for well over a decade before the pit is filled, uses fired bricks and cement mortar in the construction of the pit lining, the superstructure and even the vent pipe. Vent pipes made of PVC, asbestos and other materials can also be used- those made of asbestos having the longest life. Many types of Blair Latrine have been designed including singles, doubles, multi-compartment, very low cost, upgradeable, compost versions etc.

Cost sharing
In the Zimbabwe programme it has been accepted that some material support in the form of hardware will be provided to families who are willing to make considerable investments themselves in the construction of their own "Blair" latrine. This is usually in the form of cement, reinforcing wire and a flyscreen provided through the Ministry of Health and Child Welfare or through NGOs. The value of the material assistance varies considerably, with some NGOs offering far more than the governments recommendation, whilst other NGOs offer less. For example, more generous subsidies may offer families just over 30% of the total cost of the unit, while others such as the Mvuramanzi Trust provides 3 bags of cement, which amounts to about 18% of the total cost and is the lowest to date.

Whilst a wide range of technical options has been designed, the Ministry of Health, has insisted on longer term benefits from the national programme and chose to standardise on durable brick built structures which would also usefully serve as washrooms. A method of offering individual families a material incentive was also developed in the early 1980s and helped enormously in promoting improved household sanitation throughout rural Zimbabwe. A similar approach was aimed at improving sanitation in schools. The construction and use of the Blair Latrine is widely known throughout Zimbabwe and is a household word. It also forms part of both primary and secondary school curricular where thousands of "multi-compartment" Blair Latrines are built and put to use. The rural sanitation programme has provided many sectors of the public and private sector with training opportunities of one sort or another and has led to the expansion of building skills throughout the country with many thousands of builders being trained annually.

Lessons learned
Whilst there are many positive aspects of Zimbabwe's rural sanitation programme, there are also several problem areas which need to be addressed. The current programme is largely dependent on a great deal of funding from outside sources.
the country and much of the programme's success is based on this donor support. An era of donor dependency has arrived in the country and this has a very negative impact on the will to be self sufficient, both by the government and family alike. The steps being taken to reduce material subsidy levels by some NGOs, are attempts to wean families away from the large donor inputs and promote self reliance. It is clear that if these programmes are ever to become sustainable, donor contributions must be cut back even further and eventually phased out altogether.

Currently only one third of the rural population are served with latrines which are acceptable to the Ministry of Health. The current rate of construction of Blair VIP latrines is insufficient to keep up with increases in population, currently running at 3% per annum. The standards of construction of the Blair VIP latrine are high, and whilst many rural families are willing and able to participate in construction programmes, the poorest members of the community are unable to meet the expected input for government run programmes. This does not stop any family building whatever it likes outside the programme and many simple "unventilated" pit latrines which fall well short of governments standards are still constructed. It may be possible to upgrade existing pit latrines, much as simple wells can be upgraded to something that is more hygienic and acceptable to the government. A "step by step" approach may provide the best answer.

Conclusions

In summary, the Zimbabwe sanitation and water programme has taught us that a nation strongly supports something "home grown" which has a national character with Zimbabwe Bush Pump, the Upgraded Family Well and the Blair Latrine serving as excellent examples. It has also shown us that a material incentive used in the family well and latrine programme has a very strong motivating power - and the programme has proved beyond doubt that it makes people willing spend much of their money to improve their own facilities, although the investment cost may be high. The aim, of course with a view to sustainability, is to keep outside material assistance low, whilst retaining its influence on motivation.

The importance of priming the population with a long term national health education programme is clearly revealed in this programme. The years of low-key educational and awareness campaigns, which promoted the importance of building hygienic latrines, using safe water points and practising good personal hygiene has influenced the rural populations. The programme has also shown that there is a need to encourage development on a family or extended family basis because the programme can tap into resources, both human and material, that are unavailable at community level.

Each country has its own lessons to learn and its own methods to follow. What works for one country make not work for the next. Even in Southern Africa there are considerable differences in the ways that rural sanitation and water programmes are run and financed. There are considerable variations in what is found acceptable or not acceptable. There is no universal answer to solving the global problem. In the end each country must solve its own problems in the best way it is able. In Zimbabwe a well researched series of "home grown" technologies have played an important part in ensuring the success of the national rural water and sanitation programme, from which millions of people have benefited.

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References

