The handpump phenomenon

by Dr Peter Morgan

At the request of our readers, the theme of this issue of *Waterlines* is devoted to handpumps which are a critical part of the Water Decade. Dr Peter Morgan contributes this first piece about handpumps in their widest context. He looks especially at technological choice and the importance of making the right one by taking into account local conditions.

THE 'HANDPUMP OPTION' is currently cited by many leading agencies as the most promising and cost-effective means of delivering potable water to the rural poor throughout the world. As a means of providing water it is considered cheap compared to piped supplies, since in most cases water is derived from natural underground reservoirs, making storage and purification unnecessary. The energy needed comes from the users themselves, and the wastage of water is minimal. Handpumps suit the needs of developing countries well, since they can be used to raise water from a great range of depths and their distribution can be adjusted to suit local circumstances.

The handpump is nothing new: it was well established as a means of lifting water over 2,000 years ago, and the basic parts of the modern handpump, the piston, seal, barrel and foot-valve were already well known by the sixteenth century. Handpumps were common and successful in Europe and the USA in the nineteenth and early twentieth century, and many survive today, their secrets hidden and little documented. A few countries can boast of over half a century of active experience in rural handpump programmes.

New technologies

As funding became available through the initiatives of the IDWSSD, more attention became focused on the handpump again. This led to a proliferation of designs, many being promoted with exaggerated claims as to durability and ease of maintenance. The term 'VLOM' was coined (village-level operation and maintenance), and many felt that the new generation of pumps, with their modern materials and techniques, would far surpass the performance of their predecessors. In 1988 the World Bank published a technical document which discussed the state-of-the-art of handpump design, after making an assessment of more than 50 selected models from all over the world.[1]

Despite all the technical debate in high circles, handpumps struggle to survive in many developing countries, simply because they are overburdened and inadequately maintained. Huge sums of money and great effort are spent on prestigious handpump-installation programmes, with aspects of maintenance cast into a shadow, left at the door of recipient countries, who are usually little able to cope. To complicate matters there has been much heated debate in international circles as to which handpumps should be used and which should not: in some countries a dozen or more different handpumps may be used, each being supported by their respective donors. This situation leads to chaos and dependence on the donors for spare parts, a situation which is inexcusable.

Logic demands that whatever pump is chosen (and all modern handpumps have their merits and drawbacks), the number of options should be kept to a bare minimum. The final pump choice should always be left to the national government, and the pump itself should be locally made, thus ensuring a supply of spare parts. Ideally only one major pump option should be chosen. Having concentrated on singling out the most suitable pump, the government can then begin to attempt to tackle the overwhelming problem of maintenance, for unless the country in question sorts its own problems out, it will forever depend on the whims of the donors.

Maintenance

Many points of view have been expressed as to the best method of maintaining community-based handpumps. The three-tier system advocated by the United Nations for the India Mark II pump in India has been scrapped and replaced by a single-tier system of so-called 'barefoot mechanics': paid villagers

V. Holbroke / UNICEF

The India Mark II handpump was developed for rural areas.

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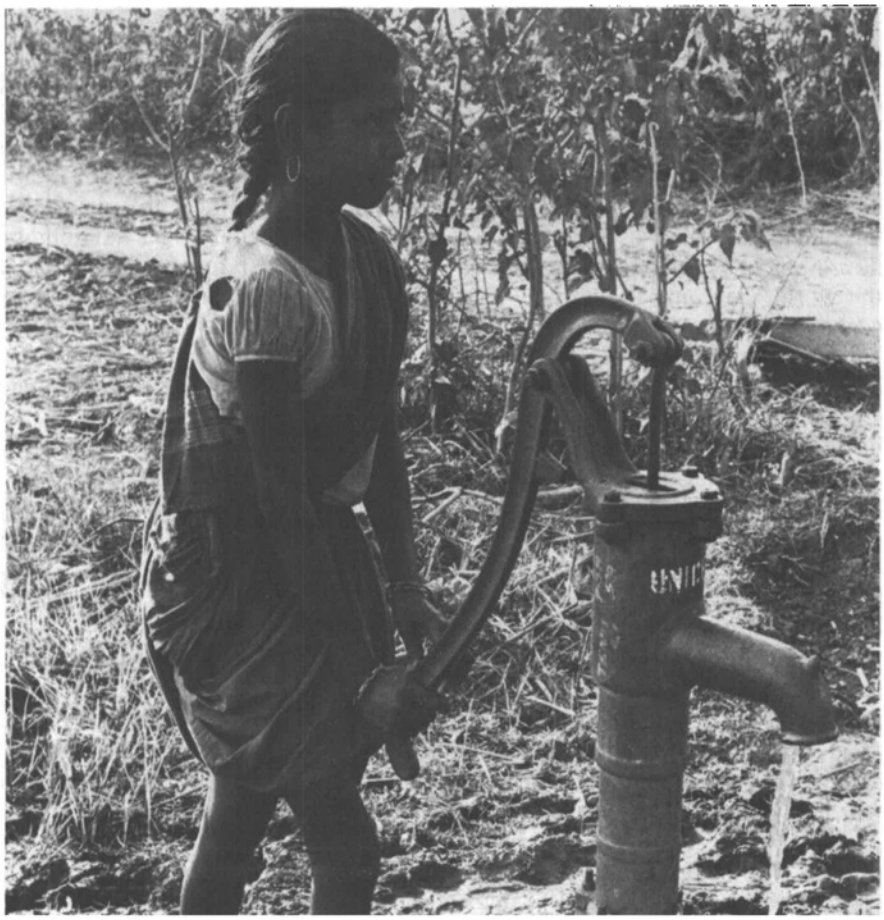

Sophie Baker

Handpumps struggle to survive despite being overused and under-maintained.

who have practical skills and are chosen by the community to maintain their pumps. Lorries are being replaced by bicycles with associated cost reductions. On the other hand, district-based government-run handpump maintenance systems have been successful in some countries for decades, and even privatization of the maintenance system is advocated in some circles.

The evidence in favour of different maintenance systems is conflicting. Where handpumps are essential for survival, in areas where water-tables are deep and there are no alternatives, communities are far more willing to contribute their time and even their money to keep pumps working, since a high value is placed on water. Where pumps are placed in areas having alternative sources of water close by, then the same principles may not apply; the users are less inclined to contribute to community maintenance, preferring to take their water from the nearest unprotected source, usually a water-hole or river, if the pump breaks down. In areas where family wells are common, these are often used in preference to communal supplies, since they are usually closer.

Whatever the situation, there seems little doubt that the encouragement of community participation pays off in many ways. Installations which are put in place with active community support are much more likely to survive than those in which the villagers have neither been consulted nor involved. Representatives of the community should be involved in siting and installation, and have some basic idea of simple maintenance procedures, even if this boils down to no more than tightening nuts and bolts. Pumps that come with spanners may have a big advantage in this way.

In most practical situations, certainly in Africa, villagers may find it difficult to maintain their own handpumps without considerable outside support, usually villagers are provided with limited training and scant access to spare parts. In the eyes of most village people, the modern community handpump is complex and foreign; it does not generate a feeling of ownership, so there is little obligation to pay for its maintenance. The importance of health education campaigns which emphasize the benefits of improved water supplies, may help to generate a feeling of community ownership, which is essential if handpumps are to survive in areas where alternative water sources are easy to find.

Fresh approaches

Many field-workers operating at the grass-roots level in this sector are now beginning to wonder whether some basic questions need to be asked once again. Are fresh approaches or even new definitions required, if the goal of providing potable water for the rural poor is ever to be achieved? According to Webster's International Dictionary,

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The national government should choose the pump, and it should be locally made.

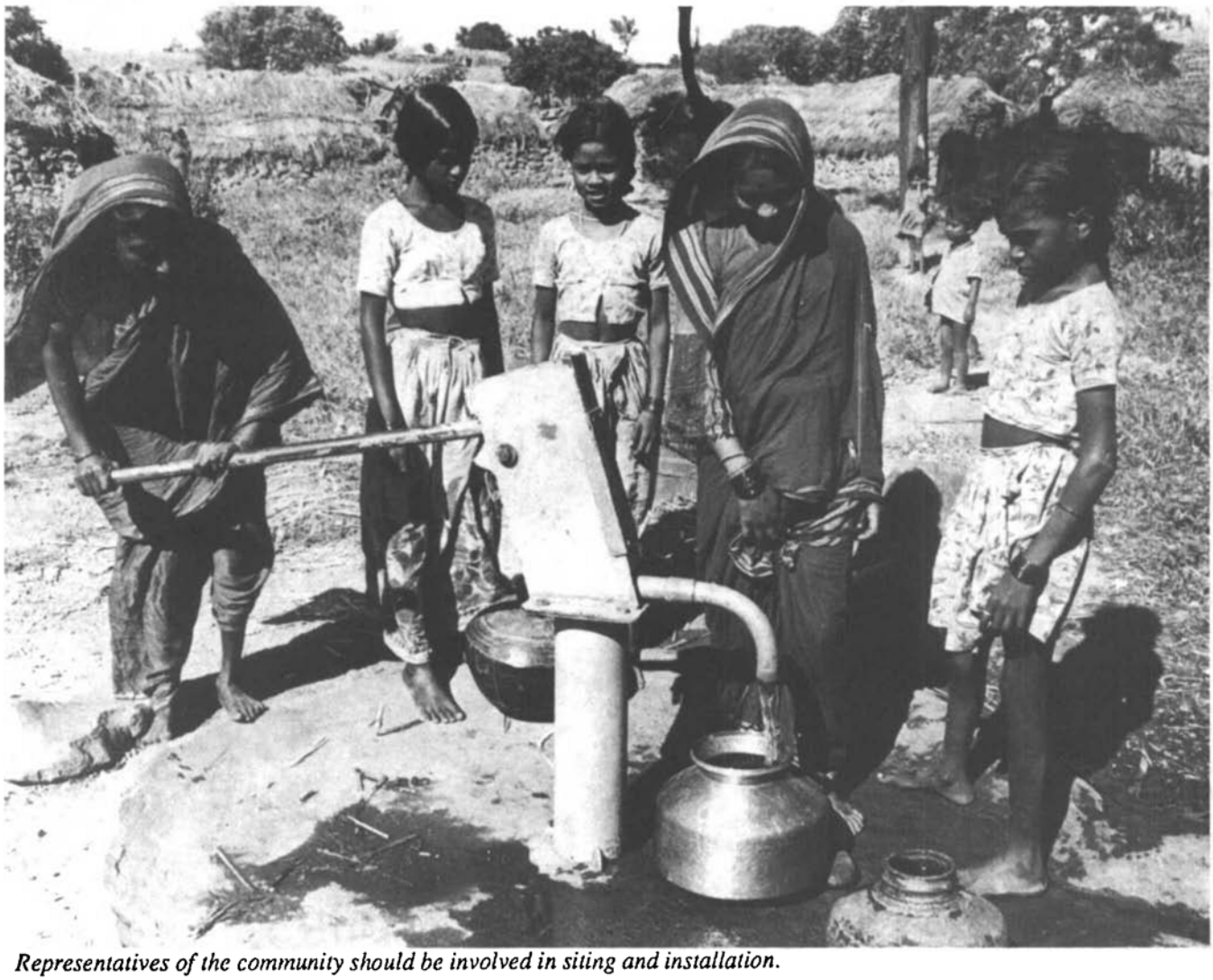
Christian Aid

Arguments will continue about the best way to assure a pump's continuing maintenance.

a pump is a machine that raises a liquid. Does this mean that a slight academic twist of the word might therefore encompass the most successful 'pump' of them all — the bucket and windlass — used in many parts of the world for hundreds, and in some places thousands, of years? In many, it remains the most common and most successful water-lifting device ever designed. And yet this simple and elegant method has been cast aside, as being insanitary and unsuitable for official use in most rural development programmes throughout the world. Certainly its delivery rate cannot be questioned for family use — but what of water quality?

There is scant proof that the consumption of water containing a few bacteria is harmful to health. On the contrary, it could be strongly argued that improved living conditions, coupled with a better diet and improved personal hygiene, are likely to have a far greater impact on the health of an individual. In a family setting, the delivery rate of the system is less important than its proximity, and the manner in which the water is used. Where family wells are common, a simple upgrading process which involves the use of windlass and surrounding apron, may be the best practical solution. Well safety and water quality can be significantly improved without the use of a handpump at all, which is certainly one method of overcoming the problem of maintenance.

Reciprocating plunger pumps still remain the most common type of handpump in use throughout the world, although they are infinitely variable. In recent years handpump research has often focused on nut-and-bolt issues rather than the development of maintenance systems, although both areas have their importance and are inter-related. Several attempts have been made to simplify maintenance procedures by modifying pump design, but this is nothing new. Many community handpumps fitted in Europe nearly a century ago were fitted with extractable valves to make maintenance simpler. Several modern pumps are specifically designed with extractable valves, the Afridev and the Volanta being examples; the former is strongly promoted by the World Bank. Other pumps, like the India Mark II, have been made and distributed in exceptionally large numbers partly because they are backed by other UN agencies. The successful histories of some less well-known models have yet to be revealed.



Maggie Murray / Christian Aid

Representatives of the community should be involved in siting and installation.

Materials

The use of conventional GI steel-raising mains and threaded mild steel rods has been questioned by the World Bank in its campaign to promote the use of lighter PVC piping and easily separated rods. Examples of galvanized rods and rising mains failing within a few months in places like west Africa are often mentioned in the literature, which has chosen to ignore conflicting evidence in favour of using more conventional hardware, which unlike its modern counterpart, is time-tested and proven in many countries. While corrosion and weight are certainly problems which are encountered with steel pipes, the use of PVC is also questionable, because of fatigue, especially in locally fabricated pipes that are ageing. Remarkably, the use of brass cylinders has also been questioned, when the evidence suggests that huge numbers of units cast many years ago remain in active service today.

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Pump installation programmes must not outrun maintenance arrangements.

Pump designs

Similar arguments have been applied to the design of pump heads and the bearings within them. Internationally, there has been a move from steel pins to roller bearings, and then to specialized units made of acetal/nylon. It is now acknowledged that steel roller bearings readily yield under the sustained pressures of community use, and it remains to be seen whether the more modern materials will stand up to these extreme demands. In the meanwhile, examples could be cited of simpler and more elegant bearings made of hardwood, tested in demanding conditions for over half a century, and still proving themselves today.

Many advances are being made in the design of watertight seals fitted to pistons, with conventional leather seals being replaced more and more by neoprene and rubber components, with claims of longer life and endurance. The analysis of pump breakdowns indicates that most visits are made to replace worn seals. There seems little doubt that if the seal life could be prolonged, then the number of visits and the resulting costs of maintenance can be much reduced.

Recently direct action pumps like the Tara of Bangladesh have been advocated for use in shallow well settings, while lever-acting pumps are recommended for use in deep settings. In some cases the pump head can be adapted for use in both types of situation. Many direct-action pumps, however, use a high content of PVC, and whether this material can withstand years of community use remains to be seen. Certainly steel-bodied pumps are far more durable, and although usually more costly and complex, they do appear to be a better investment.

What remains clear is that the handpump will always have an important role to play in providing potable water in the rural areas of the developing world. Constraint is required at the planning stage, however, to ensure that programmes of installation do not proceed at a faster rate than related back-up maintenance systems, which are terribly difficult to sustain but are ultimately more important. Alternative sources of water such as gravity-fed and rain-water catchment systems of family-based well programmes should always be investigated for use as alternatives to the handpump option, if these are technically viable in a particular area.

If the goals of the International Water Decade are ever to be realized, it is vitally important that the developing countries themselves take a much more active role in deciding the best strategy for the future. The major international and bilateral agencies must be prepared to re-examine the lessons learned from the past, and adjust their programmes accordingly, while lending a more sympathetic ear to the opinions of the developing world itself. Full support of the country-based initiatives will be essential if truly sustainable progress is ever to be achieved.

Reference

1. *Community Water Supply: The Handpump Option*, Rural Water Supply Handpumps Project, produced jointly by UNDP and The World Bank for the International Drinking Water Supply and Sanitation Decade, 1987.

Coming in the January issue

January's issue will look at the progress of an individual country — Thailand — in meeting the clean water and sanitation requirements of all its inhabitants. Thailand has made impressive strides in achieving the Water Decade's goals and the January issue will describe some of their accomplishments. Individual articles will tell you about work on rainwater catchment programmes, activities of NGOs and the full participation of women in their own projects.