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Low-cost rural water supply in Africa

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An estimated 1,800 million rural people will have to be provided with improved water supplies in the fifteen years to the end of this century if developing countries are to approach coverage targets of the International Drinking Water Supply and Sanitation Decade (IDWSSD). In Africa, present progress rates may leave at least half of the rural population still without safe and adequate water supply by the year 2000. Accelerated progress is hampered by financial, technical and institutional resource constraints faced by many African countries. The problem is also aggravated by the growing number of completed projects which are broken down and abandoned, or functioning well below their potential capacity. Attempts to increase the pace of providing improved community water supplies have often been frustrated because the technology used is impossible to sustain under village conditions.

THE SYSTEMS APPROACH

To make a lasting impact, rural and community water supply strategies must be based on sustainable and replicable technologies and management systems. Such systems must involve a combination of hardware and software technology and institutional/organizational elements. Global experiences show that the systems approach to rural water supply implementation involves consideration of a number of key issues, each individually important:

1. Direct involvement of the community in the design, implementation and maintenance of the water supply systems, and later in the financing of planned improvements, with promoting agencies providing technical assistance and support services as needed. Community needs and wants have to be reconciled with the national and regional capacities as well as with the willingness to pay for the level of service planned.

2. Provision for full maintenance cost recovery, with support of construction costs for basic supply to poorer communities offset by full recovery where higher service levels are provided.

3. Maximum feasible involvement of in-country industry in the supply of end products, services and materials for project construction and maintenance. Quality control and reliability must be assured. Local industry which has no competition, is protected and produces low-quality products may be as harmful as importing the wrong technology.

4. Technology chosen to match the financial and human resources available in the region or country.

5. Institutional and human resources development programs matching the needs of the planned water supply system.

6. Parallel programs in health education and sanitation improvements to assure long-term health impact.

Choices may have to be made between surface water and groundwater as the source of supply, and between handpumps and mechanized supply via public standpipes or yardtaps as the method of distribution. Groundwater in Africa has significant advantages over surface water as a source for rural water supply improvements for the great majority of the expected future population, the main advantage being that no treatment is generally needed to produce safe water during either the rainy or dry spells. The resource demands (financial, logistical and human) of water treatment plants needed for reliable surface water sources are beyond the reach of most rural communities.

As stated, the three main technology options represent progressively increasing service levels, and call for increasing financial and technical resources for their implementation, operation and maintenance. The costs involved in the trucking of diesel fuel and in the maintenance of diesel engines and piping networks, as well as the potential water wastage, create prohibitive conditions in many cases for public tap or yardtap options. Isolated groups may be served by gravity systems; however, they represent a small percentage of the total number in need.

Capital costs of the three main systems generally range from US$ 10-30 per capita for wells equipped with handpumps to US$ 40-60 per capita for motorized pumping and standpipes and US$ 80-100 per capita or more for yardtap services. For Africa, cost estimates for meeting rural water supply needs to the year 2000 therefore range from US$ 10,000 million to US$ 50,000 million depending on the choice of technology system. Where financial resources are scarce even for the basic option, rapid progress in meeting basic needs can be achieved only if a large proportion of the rural population in need initially receives services at the lower end of the cost range. Potential upgrading is then available as affordability increases. Clearly the significant difference between handpump-based projects and those based on piping networks is the capability of moving to mechanized pumping. This leads to the consequent need for dependable power/fuel supplies and skilled mechanics.

THE HANDPUMPS PROJECT

In 1981, as one of the activities in support of the IDWSSD, the United Nations Development Programme (UNDP) through the Department of Global and Interregional Projects (DGIP), and the World Bank initiated a Global/Interregional Project for the testing and technological development of designs and implementation strategies to improve the reliability, sustainability and replicability of schemes based on point-source supplies, primarily groundwater and handpumps. These schemes are managed by the communities and therefore replicable on a large scale. Since its initiation, support for and promotion of the Handpumps Project has been provided by UNICEF, WHO, UNEP and leading bilateral agencies in the sector.

The Project has conducted laboratory tests in the UK and field trials in 17 countries on a total of 2,800 handpumps representing approximately 70 different models and has carried out extensive tests on 45 different models of pumps. The interim results, which have led to significant improvements in the equipment on the market, are already assisting governments of developing countries to provide improved, more reliable water supplies to their rural and urban-fringe populations in need.

From the beginning, the Project has promoted the concept of VLOM--Village-Level Operation and Management/Maintenance--as a means of overcoming some of the major obstacles to sustainable and replicable water supply systems. It is now recognized by most experts in the sector as the fundamental principle of handpump design and rural water supply project planning. The VLOM management concept seeks to avoid the high cost, long response time, unreliable service and other operation difficulties in the repair of handpumps through central and mobile maintenance systems. Many past failures of rural water supply systems can be blamed on the inadequacies of central maintenance, in which a water authority dispatches teams of skilled mechanics with motor vehicles from a base camp, often serving a large district, to respond to requests for repairs or to carry out routine maintenance. Instead, maintenance should be a community responsibility, and this in turn means that the pump design has to be suitable for repair by a trained caretaker or area mechanic with basic tools, and that spare parts should be affordable and readily available to the community.

The Project staff in Africa strongly advocates the delegation of pump maintenance to village committees. Government policies and manufacturers must therefore focus on pumps more suitable for village-level maintenance and/or maintenance by an area mechanic with a bicycle contracted by the community. This is a significant departure from previous practice, particularly in Africa, where unsuitable pumps have often been brought in through donor assistance and recipient agencies have taken on unmanageable maintenance commitments depending on public sector mobile maintenance teams.

Few rural water supply system failures can be blamed solely on the pump. Other major causes identified have been (1) inadequate or unrealistic provisions for maintenance; (2) poor well design or construction, allowing sand to enter and damage pumping elements; and (3) the corrosive effects of groundwater which are much more extensive than had previously been assessed.

Policy recommendations as conclusions of the Project's Phase I for the planning and implementation of rural water supply projects using wells equipped with handpumps are as follows:

1. Community Involvement. The highest potential for sustainability is achieved when the community is involved in all phases of the project, beginning with the planning stage.

2. Community Management of Maintenance. Under the recommended system, the community organizes and finances the repair and routine maintenance of the handpump. Work is carried out by either a designated community member with basic training and basic tools, or an area mechanic covering several villages or pumps.

3. Aquifer Analysis. Competing demands for other water uses, such as irrigation pumping, have to be taken into account when evaluating aquifer potential for handpumps-based projects. Much of Africa's basic rock aquifer is adequate for low-cost discharge

manual pumping and is limited for high-discharge irrigation pumping.

4. Well Design and Construction. Wherever the rock formation is not fully consolidated, screens and filter packs are essential to prevent sand and silt intrusion. Supervision of the drilling operation is essential to achieve the necessary reliability.

5. Handpump Selection. Quite a number of factors influence handpump selection, in addition to the cost of the pump itself. Among the most important are the suitability for the intended maintenance system, durability and discharge rates. Pump choice will depend on the required lift and the planned number of users per pump.

TODAY'S HANDPUMPS

The standard test procedures used in the laboratory and field trials revealed many shortcomings in existing handpump designs. Manufacturers responded well, by modifying their products and introducing new models, and there are now many more pumps on the market which are durable and which allow for substantial involvement of villagers in pump maintenance. Manufacturers from industrialized countries are also being encouraged to combine with enterprises in developing countries to manufacture pumps under licensing or joint-venture agreements. Local manufacture strongly improves the likelihood that spare parts will be available when needed, and facilities standardization on pump types in a country to simplify caretaker training and stocking of spare parts.

Encouraging as these development are, there remains a scarcity of handpump models which can be described as VLOM and are suitable for lifting from depths of more than about 25 meters (though the majority of the rural population lives in regions where the water table is not so deep). The depth of installation and heavy pump construction make removal of downhole components difficult. An added problem is that, due to the high cost of the well, deep pumps tend to serve more people per well and so suffer rapid wear.

For low lifts (up to about 12 meters), direct-action pumps have a number of advantages. Elimination of the bearings that are part of lever- or flywheel-operated pumps reduces maintenance needs, and the pumps can be manufactured in developing countries at a relatively low cost. They make extensive use of plastic materials, which make the pumps light-weight and corrosion-resistant. Direct-action pumps have the great advantages over suction pumps that they can lift from more than the 7-meter limit for suction (important since groundwater levels are falling in many parts of the world) and that they do not need priming and therefore avoid the risk of contaminating the well with polluted priming water.

For high lifts (down to about 45 meters), a below-ground design which allows extraction of the piston (and footvalve if desired) without removal of the cylinder and rising main appears to be the most promising VLOM design. However, low-cost, durable and corrosion-resistant VLOM designs for below-ground components have only been used successfully in preliminary tests for lifts of up to 25 meters. Development of VLOM pumps below 25 meters remains an important task for the next phase of the Handpumps Project -- and for manufacturers and implementing agencies.

Attempts are also now being made to develop designs in which some of the same components can be used for pumps operating in different depth ranges. In East African development work, for example, a standard 50mm diameter cylinder with the same piston, footvalve and pumprod is being tested with different pumphead configurations for the whole range of lifts from 0 to 45 meters. For low lifts, the below-ground components are connected to a T-bar handle to be operated as a direct-action pump; at higher levels, a lever handle is used, with the handle length varying (two options) depending on the lift.

It is clear that some pumps are much more suited than others to conditions in developing countries, and that as pumping lift increases, the number of pumps suitable for village-level maintenance declines rapidly. Nevertheless, the Handpumps Project has shown that, even from the pumps presently on the market, it is possible to design a handpump-based water supply system for the vast majority of conditions prevailing in developing countries, which can be sustained in reliable operation without dependency on a significant level of support from a central authority.

THE FUTURE

The need to accelerate large-scale implementation of rural water supply schemes to meet the urgent needs calls for a more systematic evaluation of past and proposed strategies. Detailed guidelines for implementation at the regional and possibly the country level should be prepared. Lessons and conclusions about the implementation, operation and maintenance of comprehensive handpump-based community water supplies may have to be implemented initially through demonstration projects in specific regional conditions. The demonstration projects will also include evaluation of measures to enhance the benefits from rural water supplies, to develop recommendations on the synchronizing of related health and other interventions with water supply improvements. The proposed comprehensive rural water supply package therefore includes:

1. Community participation in planning, construction and management of maintenance;

2. Adequate well design, construction and development;

3. Implementation of projects with VLOM handpumps;

4. Selection and training of caretakers, establishment of incentive schemes and an increase in the role of women in the community responsibility of water supply;

5. Spare parts supply and distribution;

6. Implementation of sanitation components;

7. Health education;

8. Cost recovery by the community to cover at least recurrent costs;

9. Measures to reduce capital and recurrent costs; and

10. Non-domestic water use, such as micro-irrigation and cattle wherever applicable.

A joint effort is needed by donors and developing country governments to initiate demonstration projects on a large enough scale to permit development and analysis of country- or region-specific ways of implementing relevant items of the package. There may, for example, be several different ways of organizing spare parts supply and distribution, which make best use of private and public sector activities in particular countries.

From the demonstration projects, guidelines on implementation of each package element will set the stage for large-scale implementation of rural water supply schemes at a comparatively low cost to the public sector, managed by the users at affordable cost -- in other words, schemes with a good chance of providing a satisfactory service for many years to come.