



A Malaysian villager demonstrates the power of plastic.

FROM WATERLOO TO THE WORLD

THE PVC PUMP BRANCHES OUT

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Three quarters of the estimated three billion people living in developing countries do not have access to adequate potable water supplies or sanitation facilities. In some places, such as the Sahel, water is not available without complex technology and high-cost construction. In many cities of the Third World piped water is available but is inefficiently used and inequitably distributed. Although these water systems are expensive and their cost a contributing factor to the national debt, they often benefit only a select proportion of the population.

Both of these problems are difficult to solve, but the majority of the world's population lives in rural areas where water is available, but is far from home and/or polluted with disease-carrying organisms. This situation does have a solution and IDRC has been a pioneer in developing a inex-

pensive and easily maintained handpump to supply villagers with clean water close to home.

The traditional local water hole, pond, creek or river serves reasonably well when population density is low. People, most often women, have carried water up long hills for thousands of years but as our world becomes crowded, many of these sources of water have also become sources of cholera and other water-borne diseases.

SOIL: A NATURAL FILTER

Luckily, almost every place in the world has a natural filter that can produce clean, safe water. That filter is the soil and the source of clean water is found below the ground. In order to tap the groundwater a well must be dug or drilled and to keep

the water that collects there free from contamination it must be sealed off from the surface, and pumped from the well.

The development of reliable handpumps that can be locally produced, installed and maintained at a reasonable price would be a major step toward providing reliable safe drinking water. The average pump costs about CA\$200 and more than 20 million of them are needed — the task is enormous. If any significant headway is to be made, it will not be just through governments and aid agencies but through the efforts of the rural people themselves.

HIGH STRESS, HIGH FAILURE RATE

One of the most important problems in rural water supply programs is the high failure rate of conventional manual pumps. The pumps break down because they were not designed for the level of stress and abuse they routinely receive in the rural areas of developing countries. Because the materials from which conventional pumps are made — mainly cast iron and steel — are not only expensive, but are not readily available locally, many developing countries must rely on imported pumps and parts supplied by international and bilateral donors. This presents difficulties in terms of maintenance requirements and procurement of spare parts.

Since 1976, IDRC has been supporting research on the development of more effective pumping systems for rural water supplies. The implications of new materials and improved pump designs were examined systematically. In view of the widespread introduction of plastics technology that has taken place in developing countries in the last decade, particular attention was focused on the polymer resins, specifically polyvinyl chloride (PVC) and polyethylene (PE). Both materials are widely available throughout Africa and Asia. In many respects, plastics technology is to developing countries what cast iron was to industrialized countries many years ago. The vast potential of plastics for use in handpump components has only recently been explored.

INTERCHANGEABLE COMPONENTS

The IDRC-sponsored design work centred on developing a simple, low-cost PVC piston and foot valve assembly for a manual, shallow-well pump. These below-ground components — the piston and foot valve — were designed to be interchangeable, thus saving labour costs in manufacture, simplifying maintenance procedures, and keeping the required number of parts to a minimum.

Early development research was carried out by a Canadian university, the University of Waterloo, and was completed in April 1978. The prototype pump assembly was then tested in England as part of a project sponsored by Britain's Overseas Development Ministry.

The Waterloo design was found to be reliable and efficient and differed from the others in the testing program in that it was designed specifically for manufacture in developing countries, using existing, locally available resources.

Believing that the straight transfers of technology are rarely successful, IDRC has a three-phase program for introducing the pumps to the potential users. Phase I was the field testing of the pump in Malaysia, the Philippines, Sri Lanka and Thailand in Asia and Ethiopia and Malawi in Africa. Research projects within the six countries tested the Waterloo design under a variety of environmental conditions, and appraised the appropriateness of the pump for local manufacture and for village-level maintenance. The original design was modified according to the availability of local materials in the villages.

The entire concept of a PVC pump was inappropriate for Ethiopia because PVC pipe made there is of poor quality. They have opted for a metal pump. The project in Malawi encountered a problem that it would have been hard to predict from Canada. Hyenas seemed to think the white PVC pipe on the pump looked like bone and chewed on the plastic fittings and spigots.

LEATHER VS POLYETHYLENE

In Sri Lanka, the PVC pipe has a rough inside surface which wore the polyethylene piston rings and prevented the formation of a really good seal. So the researchers replaced the polyethylene rings with leather cup seals which can easily be made in the villages. Another hitch — the solid PVC stock required to make the pistons and foot valves were not locally available. The team tried to make a "solid" cylinder by gluing progressively smaller PVC pipes inside one another but the ends tended to break off when the grooves were cut for the piston rings. Researchers tried to fabricate the piston and foot valve from wood but the piston rings stuck in the wood when it got wet and expanded and did not seal properly against the walls of the riser pipe. It was finally decided that importing pistons and foot valves from Malaysia was an inexpensive and efficient solution to the problems of quality control.

This unsophisticated wood and leather design makes local fabrication and repair possible, and has proven its reliability under field conditions. The use of leather instead of polyethylene rings meant that the seals wore out sooner but it also meant that villagers, who could readily obtain and work with leather, were able to replace the seals by themselves. Also, in Sri Lanka leather is less expensive than polyethylene.

In the second phase of the research the Sri Lankans are manufacturing their version of the pump through a network of cottage industries operated at the village level entirely by women. This research project is testing the feasibility of involving primary

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users — women — in all aspects of handpump development, from manufacture to installation and maintenance. (See article "Women of the pump".)

By promoting handpump manufacture as an income-generating activity, it is hoped that self-sustaining village-level industries can be established. It is also anticipated that by locating the industries as close as possible to the sites where the pumps will be installed any problems in pump operation and maintenance can be resolved easily.

In Malaysia, researchers found that despite obvious satisfaction and acceptance of the PVC pumps, the villagers seemed reluctant to purchase them, claiming they were too expensive. Local mass production is now making the handpumps more affordable. Research is currently under way

into mass producing them by injection moulding of plastics. The Malaysian government has supported the manufacture of 550 mass-produced models. The pumps will be installed and monitored by the Ministry of Health and experiments will also be done on their performance in medium and deep wells.

There are now four designs that have developed from the original Waterloo pump and there may soon be more because this second phase evaluates the pump, not only in terms of the production process but also in light of the "software" aspects of their use. How will the pumps be brought to hundreds of thousands of villagers, who will pay for them and who will maintain them? Patterns of village life will change with the introduction of the pumps and the pumps will be modified for specific conditions of local use.

A handbook illustrating the installation, maintenance and repair of the pump has been produced for use in the Philippines and Malaysia. A similar manual will be produced and distributed with the pumps in Indonesian and Thai villages.

The third phase of IDRC involvement with the pump will explore its commercial production. All too often development agencies consider their role to be the design and testing of a technology that may never be produced. Rather than assume that a proven innovation will attract commercial producers, IDRC is planning to take the pump to the entrepreneurs. It will support marketing studies, consult with lawyers about licencing and patents and work with governments and businessmen to establish controls over quality, pricing and installation of the pumps.

EXCITED ABOUT POTENTIAL

IDRC program staff are excited about the pump's potential for supplying clean water to rural people in developing countries. They are also pleased with the way the technology has been developed as a cooperative effort between researchers and users. They think that field testing and modification, incorporating the views of the users, is essential for the effective transfer of technology to the village level. If this strategy proves successful, it could be a useful model for the dissemination of other technological innovations.

It must be remembered that transferring a technology is not a simple case of financial resources, trained experts and a good design. It also involves complex social, cultural, political and economic considerations that are best — perhaps only — understood by the people themselves. Technology cannot be "parachuted" in. It must be examined, tested and modified according to local needs and available expertise and materials. □

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