# A TECHNICAL/MANAGERIAL REVIEW OF AID HANDPUMP PROGRAMS IN SRI LANKA, THE PHILIPPINES, HONDURAS, AND THE DOMINICAN REPUBLIC



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Health is a fragile thing. Adequate quantities of safe water delivered near to the point of use are needed to maintain it. For many, a handpump is the first step toward a protected water supply.

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## EXECUTIVE SUMMARY

In the late 1960's AID decided that if the tens of millions of people in developing countries living in the smallest villages and dispersed in the rural areas were to have adequate quantities of safe drinking and domestic water close to the point of use more use would have to be made of the handpump concept.

To develop the best physical device possible, Battelle Memorial Laboratories (BML) was contracted to design a robust handpump that could be manufactured in-country and which would require a minimum of maintenance. BML first examined how existing handpumps were being used throughout the world. Then they looked at what resources and materials were available in the developing countries. From this they developed what has come to be known as the "AID" handpump.

By the 1970's and early 80's AID had examined over 12 locations to see if there was interest on the part of the mission and/or the country as well as the human and technical resources to support a locally based handpump effort. AID Missions in ten countries (Nicaragua, Costa Rica, Indonesia, Sri Lanka, the Philippines, Tunisia, Honduras, Dominican Republic, and Ecuador) were assisted in developing and implementing such projects as part of technology transfer activities.

A typical country project was conceived as a multidisciplinary/multiphased effort. In those countries that expressed an interest in having handpumps as part of their rural drinking water programs, the AID Office of Health worked with Mission and government staffs to develop pilot demonstration projects. To carry out the pilot projects the Office of Health had a contractor (first Georgia Institute of Technology then WASH) work with the Mission to 1) identify a local firm that could manufacture a limited number of AID type handpumps, 2) identify a government agency (Ministry of Health, Ministry of Local Government, National Water Authority, etc.) that was interested in working with AID to field test the pumps, 3) work with the manufacturer to produce a limited number of pumps (100 to 200), 4) work with the government to install a limited number of pumps (50 to 100), and 5) monitor field results and make recommendations as to the types and kinds of human resources that would be needed per 100 pumps installed (x numbers of promotors, y numbers of installers, z number of maintainers, etc.), the types of national and local infrastructure that would be required, and the numbers and kinds of spare parts needed.

Based on the results of the pilot testing it was envisioned that the country and the Mission would design a handpump program that would realistically reflect the human, technical, and managerial abilities of the nation. What happened, however, was that the contractor emphasized the hardware aspects of the problem (i.e., manufacture and installation) and because the software for maintenance and user education was usually considered the responsibility of a local government agency it received less attention. Because of the limited time available, often the pump installation was contracted out by the AID contractor, and maintenance was carried out by the contractor during periodic monitoring visits. This further weakened the countries' participation in the process. Thus, usually only one manufacturer was capable of producing the pump in a country (often resulting in a future sole-source procurement problems), and there was only limited understanding of the infrastructure and human requirements to support a full-scale program. By early 1983 only two programs (Indonesia and Dominican Republic) had passed out of the pilot testing stage into wider national efforts.

To develop this report the author visited five countries and has worked with AID's handpump effort in three other countries. This experience resulted in the development of 17 recommendations in eight different areas. The report devotes a short section to defining a handpump program. It then moves on to look at the ten phases of technology transfer as they relate to the handpump effort. Next, comes the heart of the report which includes the comments, conclusions and recommendations. This is followed by an extensive report on each of the countries visited for those who want more details. The following paragraphs highlight the various recommendations.

It is clear that the effort to date has served as a catalyst for many of the activities being carried on by the World Bank and UNICEF. At the same time it is clear that the current AID pump design needs to be updated to incorporate such innovations as 1) roller bearings vs current pin and bushing, 2) the ability to pull the deep-well cylinder through the base vs the present need to remove the base, 3) the use of a welded steel body vs current use of cast iron, and 4) the use of "space age" materials for drop pipe and rods.

The efforts to date, especially those in the Dominican Republic, have highlighted the tremendous need for a better understanding of the managerial and programmatic aspects of the effort. This is manifested through the need for developing quality control measures in all phases of the effort. In one country 36 out of 200 pumps were rejected at a warehouse inspection after delivery by the manufacturer. Field visits showed the need for developing local user schemes for maintaining and repairing pumps (many times 30 to 50 percent of the pumps were down for repairs at the time of the visit). Too often it was found that locally no one knew how to repair a non-functioning nor was anyone sure where to go to get help!

All of the above calls for a better understanding of how many and where different workers are needed, as this is the first step toward designing schemes to obtain and/or train the human resources needed for local maintenance, user education, and logistical support schemes. This understanding is essential to helping the country develop viable long-term institutions that can and will be able to manufacture, install, and maintain at a reasonable price that number of handpumps required to provide decent water supplies to those tens of millions of people who have so long been neglected.

In addition, the efforts to date have shown the need to develop "packages" of materials and documents to help Missions and countries understand how to develop a handpump program. Much of this material is already available. On the technical side the materials only need to be developed into useable packages that would include a sample pump, a typical program description, a typical bidding package of specifications and quality control measures, a sample set of jigs/fixtures and guage kits, and a short course to introduce potential bidders to what will be required of them.

To help the governments design their own efforts, the experiences to date should be developed into coordinated sets of standardized designs (sanitary wells, pump platforms, etc.) maintenance brochures, user education materials and program resource requirements (for example: x number of user education staff per 100 pumps). A short course to present this material is an essential start-up procedure.

# Chapter 1

## GENERAL CONCEPTS REGARDING HANDPUMPS

### The USAID Robust Locally manufacturable Low-Cost (RLMLC) Handpump

## 1.1 What Is a Handpump Program?

One of the fundamental premises of the WASH project is that water and sanitation programs require a multidisciplinary approach which integrates the technical (i.e., hardware) and managerial (i.e., software) if there is to be any meaningful improvement in water supply and sanitation. For handpump programs there is a strong temptation to pursue a technical "fix" alone because there is a physical device--a handpump--for a clearly definable problem. Experience has shown, however, that technical "fixes" are seldom successful.

To be truly effective, any program to install handpumps must be made up of two elements: 1) efforts to identify and install the physical devices, and 2) efforts to organize the various schemes for promoting, installing, using, and maintaining the handpumps chosen.

The handpump is a device that was developed to provide drinking water for individual families, but over the years it has been adapted to provide service to groups of families. This shift in the end users has resulted in a number of changes in how the device is used and maintained. For example: 1) the installation decision is now a collective one vs. that made by a single family, 2) the use factor is up to 200 times higher in some cases for a device which is essentially the same as that used for single family use, and 3) the maintenance responsibility is now very diffuse whereas before it was very specific. Each of these changes has widespread organizational implications that now require multidisciplinary solutions. Take for example the question of well siting. When the handpump served individual families the siting decision was made by one family. When the pump is intended to serve more than a single family the decision becomes a community decision. Thus, when a country decides to install tens of thousands of community handpumps they create the need for an infrastructure that can work with thousands of communities to site, install, and operate the tens of thousands of handpumps that will be required.

To be successful a handpump program must be multidisciplinary in nature and multiphased in application. The program must be such that it is able to identify potential technical solutions and then organize available human resources into a national program that will have local representatives who assist the users to improve the convenience, quantity, and quality of their drinking water supply and maintain the system.

## 1.2 A Handpump As a Part of a Process

Historically, the "handpump" was a device that grew out of the family's need to reduce the time and effort it spent in bringing drinking and other water closer to the point of use. It is clear that as more time was needed for "productive" labor, ways were sought to reduce such "non-productive" time-consuming daily tasks as carrying water for drinking, bathing, dish washing and laundry. Seen as such a labor saving device, handpumps became a giant step toward the goal of providing adequate quantities of safe drinking water as close as possible to the point of use. Handpumps moved the water source from an oftentimes unsafe distant well or spring to a protected source located closer to the house. The next step was often water piped into the house or to public fountains.

The handpump is not a new solution to the ancient problem of developing a safe and abundant source close to the users dwelling. Oftentimes, the handpumps being proposed today are merely updated versions of devices that can be found in 16th century texts! What is new is the number of people the pumps are trying to serve when it was originally conceived as a domestic appliance.

To understand the handpump concept in its developmental context one must envision it as part of a dynamic process in which an individual's drinking water source is upgraded over time. This process starts with an unprotected spring, moves to a handpump, continues with a connection in the patio of the house and finally culminates in a series of taps in the house. While this has been the process in the developed world and is one that we can expect will be followed in the developing countries, one must be careful about judging the time required for each phase. It is very easy to seek "temporary" solutions unless one realizes that each phase (i.e. wells, handpumps, patio, and house connections) may require up to a generation each. Therefore, how fast a group of people can move from one phase to the next depends on the human, financial, and technical resources the community can marshal.

## 1.3 Why a Robust Locally Manufacturable Low-Cost (RLMLC) Handpump?

As countries seek to provide increased amounts of safe drinking water for their inhabitants, the questions of social vs. financial costs, people's ability to pay vs. government's picking up operating costs, and foreign exchange costs vs. local manufacturing costs all must be realistically considered.

Any realistic long-term solution for providing drinking water must examine the users long-term ability to operate, maintain, and pay for that solution. In view of the fact that handpump programs tend to be considered "social" programs (i.e. the government bears the major program costs) one must seek to optimize the benefits while minimizing total costs. The cost of a handpump program is often seen as that of the cost of installing wells and manufacturing physical devices only. Too often only lip-service is given to the cost of developing a viable long-term infrastructure that responds to the program's need for maintenance and user education.

Realistically examining total program costs must be one of the major considerations for a developing country. For example, consideration must be given to the cost of obtaining "hard" currency for making purchases outside the country, because if the handpump is manufactured outside the country it and any spare parts must be purchased with such currencies.

To help the countries address these problems, USAID has developed a robust, locally manufacturable low-cost (RLMLC) handpump. This device and its necessary support systems have been packaged in such a way that they can be adapted to the national availability of human, technical, managerial, and financial resources. Because of its flexibility and its consideration of the total problem, the RLMLC handpump concept is a viable one for these countries that have 1) a foundry/manufacturing capability for producing several thousand pumps per year, 2) a market for absorbing several thousand pumps per year, and 3) the organizational capacity to purchase, install, and maintain the pump.

## 1.4 The Technology Transfer Concept

In his book entitled the Uncertain Promise, Denis Goulet points out that too often the technology transfer process is seen as the "transfer or exchange from advanced to developing countries of [those] elements of technical know-how which are normally required in setting up and operating new production facilities and which are normally in very short supply or totally absent in developing economies" (1). He goes on to indicate that the above definition is not broad enough because there are many technologies that are not directly product related. Because of this he broadens the concept of transfer by stating that "the concept of transfer must also embrace the circulation of the know-how used to conduct feasibility or marketing studies and to manage services..."

Thus, in attempting to transfer a technological concept it quickly becomes evident that if one is to be successful one must, as a first step, find that combination of hardware devices and software support systems that can be provided from and supported by existing locally available human, technical, and financial resources. Thus technology transfer must be seen as a bottom-up process rather than a top-down one. As applied to the handpump process, technology transfer means that once a potential physical device (for example: the type "A" handpump) has been identified as being capability of meeting the defined problem (i.e., deliver X gallons/person/day for Y years) one must do two things: 1) identify the various subsystems (i.e. software) that are needed in order for that device to function in the culture in which it is expected to operate and 2) develop a full understanding of the local resources that will be required for the necessary support systems (maintenance, user education, management, financing, etc.). The availability of local infrastructure for one or more of these support systems may be the key factor in selecting the hardware to be manufactured. (For example, if there is no local system for the provision of spare parts or no local maintenance system can be realistically established then a perhaps more expensive low-maintenance pump should be considered rather than a less expensive high-maintenance one.) Table 1.1 shows the various elements that should be considered in selecting the technology to be transferred or in this case which model pump to recommend.

The decision of which technological device to transfer is a unique decision for each country and it must be arrived at after comparing: 1) the existing locally available resources; 2) the needed subsystems, and 3) the costs and possibilities for upgrading each. The development of life-cycle costing excercises similar to that being done by WASH for the AID and Moyno handpumps in the Dominican Republic and Haiti is one of the most effective ways of formalizing such a decision. Table 1.2 show the various elements that should be included in such a cost analysis.

Table 1.1
Elements To Be Considered in Transferring Any Handpump Technology

| Hardware | Software |
|---|---|
| What do you want the device to do?<br><br>- How many people to be served?<br>- What depth is the water?<br>- How many years of service is expected?<br>- Local water is of what type? | What subsystems are needed to support the selected technology?<br><br>- Maintenance?<br>- Spare parts?<br>- User education? |
| What manufacturing facilities are available?<br>How will device be transported?<br><br>- How much will it weigh?<br>- How fragile is it? | How will the various subsystems be paid for?<br><br>- User fees?<br>- Cross-subsidies |
| How will device be installed?<br><br>- Will it require special tools?<br>- Will it require special training? | What resources are available?<br><br>- Human?<br>- Managerial? |

Table 1.2
Elements To Be Included in Life Cycle Cost Analysis*

| | Pump No. 1 | Pump No. 2 |
|---|---|---|
| Item To Be Considered | Annualized Present Cost | Annualized Present Cost |
| 1. Installation cost ($/installation) | | |
| 2. Expected life cycle (years) | | |
| 3. Pump cost ($/life cycle) | | |
| Foreign | | |
| Local | | |
| 4. Yearly maintenance ($/yr) | | |
| Foreign | | |
| Local | | |
| 5. Output per pump (liters/year) | | |
| 6. Consumption/person | | |
| 7. No. of pumps needed to serve unit population (i.e. 100 people) | | |

*Assumption: All pumps draw from same type of well and from same depth.

## 1.5 Transferring Handpump Technology

To help explain the sequence of events through which an idea must flow as it moves from a concept to an operational program, Figure 1.1 has been developed.

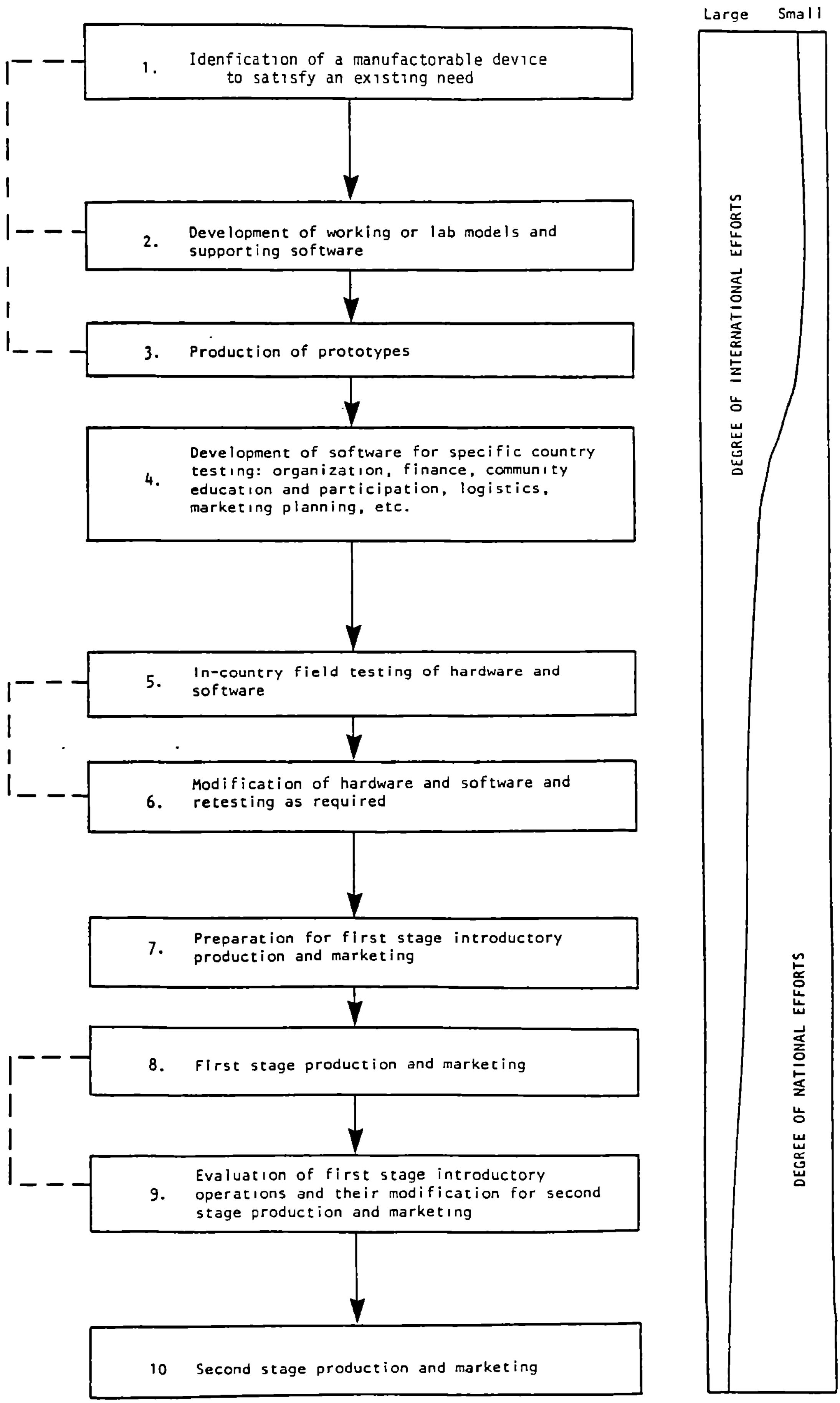
As can be seen there are are ten steps that a RLMLC handpumps would have to go through to move from concept to operational program. Experience to date indicates that to move from Phase 1 through 8 takes on the order of five to eight years and that those phases which are related to development of software are the most difficult.

In the case of AID's RLMLM handpump the first three phases were developed by S&T/HEW/WS (i.e. the Battelle handpump contract) and were presented to all USAID missions for their consideration. Of these, 11 decided that they had enough need, resources, and opportunity that field testing the concept (Phase 5) was worthwhile. To date only two countries (Indonesia and Dominican Republic) have carried the process as far as Phase 8 (see Table 1.3).

The experience to date has shown that often the technology transfer process is such that the basic research and development (R&D) and prototype development Phases 1 through 3 are of such a magnitude that they need to draw on multi-country experiences. Thus they are best done at a central level rather than by an individual country, whereas Phases 4 and 5 are closely linked to country resources and this must be carried out in collaboration with a national agency. Phases 6 through 10 are so closely linked to the resources of the country that the impetus to compute those phases must come from within the country if they are to succeed in the long-term. The divisions between the different phases should not be considered as distinct lines but more as grey areas in which the degree of international assistance varies according to the countries resources and experience.

FIGURE 1.1

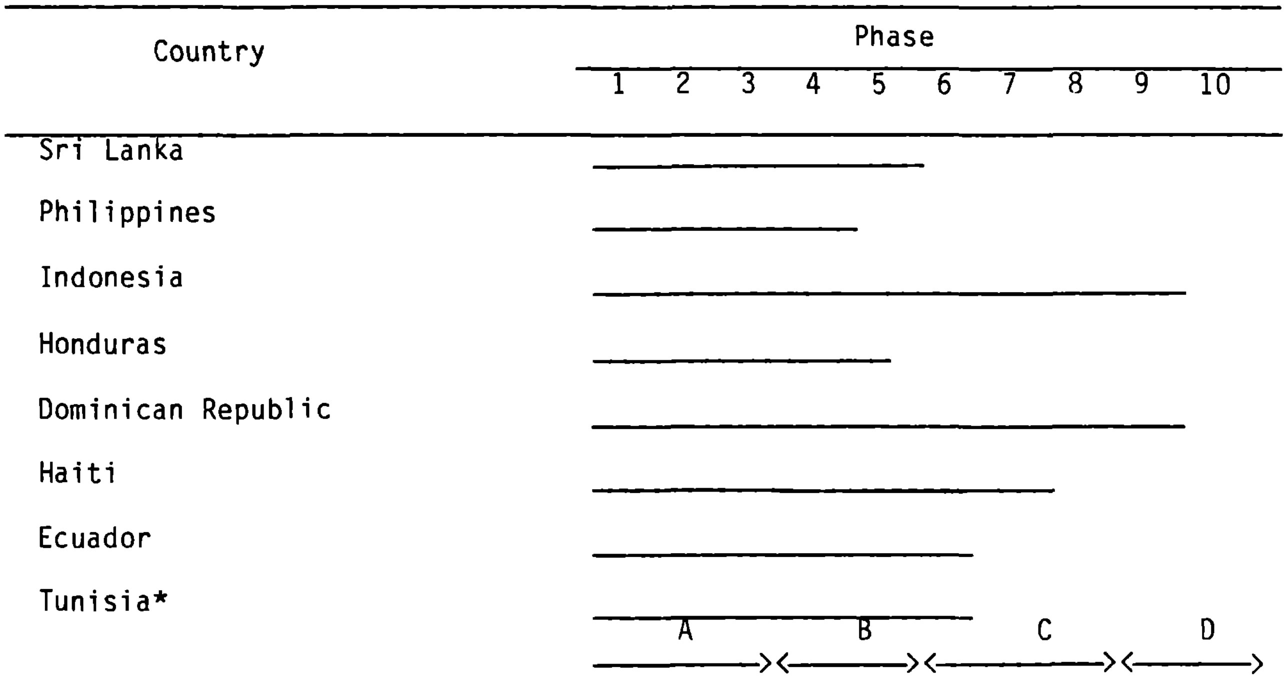
Sequence For Technology Transfer Phases in Manufacturing and Marketing RLMLM Handpump concept for Developing Countries




Notes:

1. Solid lines are action flows
2. Dotted lines are illustrative information feedback to improve interative actions
3. Phases may overlap in time and scope

Table 1.3
Status of Handpump Concept in Eight Countries




A. Carried on mainly by S&T/H/WS
B. Carried on mainly by GIT
C. Carried on mainly by country assisted by WASH or GIT
D. To be carried on by country program
* Field test terminated at Mission's request.

Chapter 2

# CONCLUSIONS AND RECOMMENDATIONS

A handpump is the device by which about 25 percent of the world's population obtains adequate quantities of safe drinking water near their home. This simple fact is a key element in improving and maintaining the user's health.

A handpump that works can be the focal point for a community's health and economic development. One that does not work is a drain on the economic resources of the community.

## 2.1 Country Specific Comments

In the OTD S&T/H/WS requested that WASH examine 11 items in regard to each of five countries. The author was only able to visit four countries (Sri Lanka, Philippines, Honduras and Dominican Republic). With S&T/H/WS's concurrence the author visited Haiti where AID has installed 25 Moyno type handpumps. Other members of the team visited Indonesia, and thus the author was able to draw on their experience. In addition, the author has been deeply involved in the handpump OTD's for Tunisia and Ecuador as well as the testing efforts at GIT.

As a result of the above mentioned visits and the efforts in Tunisia, Ecuador and at the Georgia Institute of Technology (GIT), the author presents his replies to the specific questions raised by the AID Office of Health and then goes on to provide a set of generalized recommendations for the improvement of AID's handpump program.

### 2.1.1 Sri Lanka

Ninety quality handpumps were produced and installed in the field and they were monitored for about a year. Few cost data were kept that would permit either life-cycle comparison with other handpump systems or the design of managerial support systems (i.e. spare parts, maintenance, etc). It was established that there were local manufacturers that could produce a robust, low maintenance handpump for about US$150 providing enough technical assistance is provided to a manufacturer. It was concluded that a great deal more work needed to be done in developing the managerial and administrative support systems for such areas as user education, spare parts logistics, maintenance, back-up, and promotor training. As of yet there is no follow-on program.

Question A: A total of 15 sites were visited and 32 pumps were observed. Of those visited 75 percent of the handpump were operational at the time of the visit.

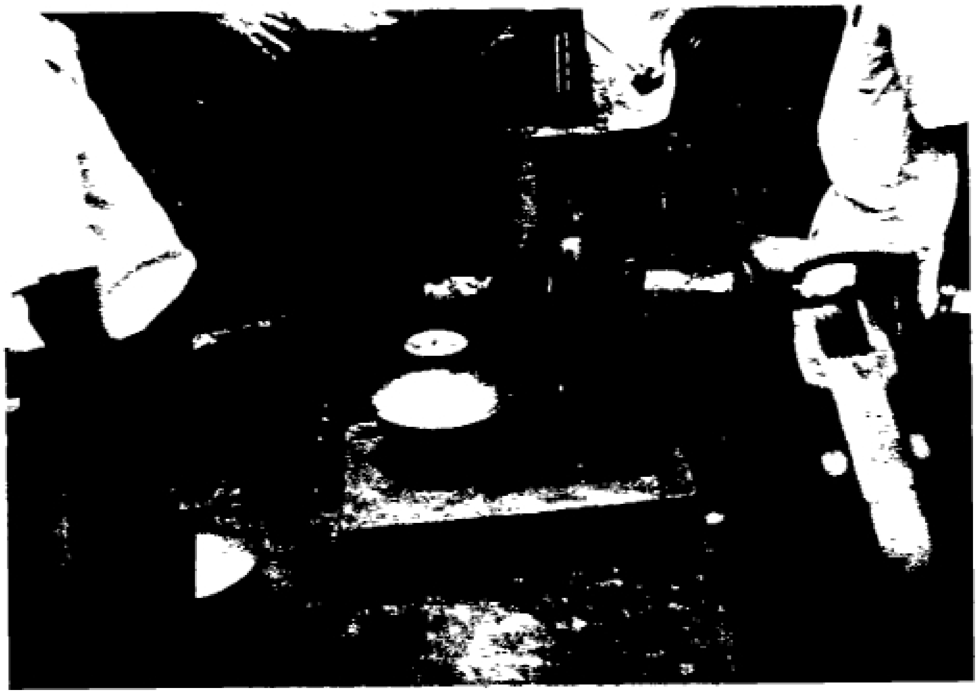
Question B: The original foundry (Somasiri Huller) is still producing pumps as per the specifications provided by GIT staff. No major changes were introduced by the manufacturer.

Question C: During the visit the team found that the German donor agency GTZ was trying to purchase a limited number of pumps for field testing and possible inclusion in their programs. This was the only other non-government program contemplating the use of the AID-type pump.

Question D: While no sales had been made to the private sector. The manufacturer had developed a spare parts brochure and was contemplating trying to sell to this market. He had no specific market plan.

Figure 2.1

Conditions Needing Correction for AID-Type Handpump



Misalignment of Pump and Receptacle Base (Sri Lanka)

Leakage at Base Threads and Base Bolt that Are Constantly Wet and Will Be Rusted in Place Shortly (Philippines)

Question E: The communities have very limited locally available spare parts, thus their maintenance ability is often poor. Too much reliance has been placed on GIT staff visits to provoke local maintenance activities. One can note the lack of such basic action as lubrication of the pumps (21 percent of the pumps visited lacked lubrication, and 34 percent required some type of maintenance at the time of the visit).

Question F: Most of those trained were still involved, but due to the low salaries of these jobs one can expect a continuous turn-over of these types of personnel.

Question G: No, as there has been little demand for the product.

Question H: The effort to date has been: USAID/SL as the promotor and the GOSL as an "interested" receiver. Even though other agencies have handpump programs (UNICEF, GTZ, the World Bank, and Finland) there has been little or no interagency collaboration.

Question I: Only ten deepwell pumps have been sold after the original order.

Question J: The Mission Staff and Director are aware of the handpump effort and thought highly of it. They felt that this was a private incentive that could help improve the health sector's effort.

Question K: The lessons learned are that more attention must be paid to the managerial and programmatic aspects of such a program.

Summary for Sri Lanka

- 75 percent of the pumps were operational at the time of the visit.
- 21 percent of the pumps lacked lubrication at the time of the visit.
- 34 percent of the pumps required some maintenance at the time of the visit.
- No major changes were introduced in the AID design.
- No major sales have been made to anyone other than AID.
- While there has been interest on the part of the GOSL there have been no purchases of AID pumps.
- There was a tendency to concentrate on the hardware side of the program and not enough is understood of the social, human, and organizational needs for a GOSL handpump program.

### 2.1.2 Philippines

While a robust, low-maintenance handpump was manufactured locally the manufacturer has since gone out of business. The lack of an adequate (in size and/or time) field test program has prevented the collection of field data that would permit any life-cycle cost comparisons and the design of appropriate managerial support systems. While a major rural water program is being contemplated for the 1980's and 90's little effort is being put forth to put the AID handpump concept--and specifically the Barangay Water Program (BWP) pump--into the Philippines planning process. No follow-on program is contemplated.

Question A: A total of six sites were visited and six AID pumps were observed. Of these visited 83 percent were operational at the time of the visit.

Question B: The handpump manufacturer (Tristar) is no longer in business.

Question C: Only the AID sponsored Barangay Water Project is contemplating using the AID pump. The Philippine Rural Water Program uses a locally produced Jetomatic handpump.

Question D: Not applicable. See answer B. Of the 150 pumps produced only ten where installed in the field. The remainder are stored in an AID warehouse.

Question E: Spare parts are not available locally. Only half of the sites visited were maintained by the local users. The rest were done by the test monitors.

Question F: No field evidence was seen of any continuous involvement in the handpump program by those trained under this OTD.

Question G: Not applicable. See answer B.

Question H: Other than a very limited involvement by the Barangay Water project there has been little or no involvement in this effort by the GOP.

Question I: None.

Question J: The project officer for this effort had just changed at the time of the visit. It was difficult to obtain any impression as to the Mission's perception of this effort. It was determined that there were no firm plans to continue effort or to integrate it into some other program.

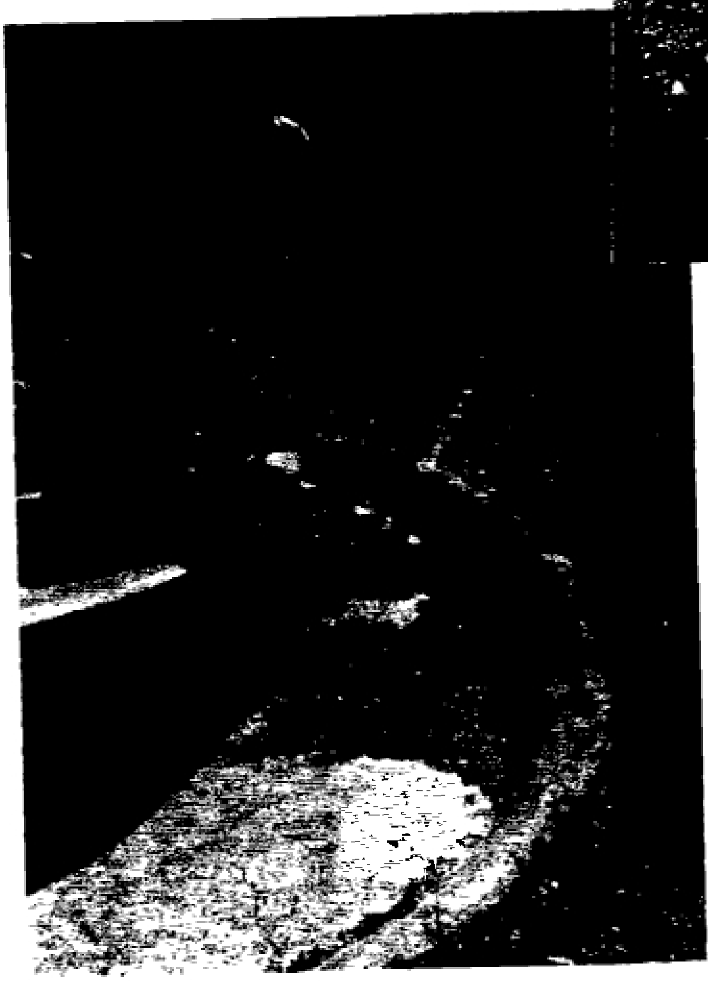
Question K: The lessons that were learned from this effort were: 1) such an effort should help more than one manufacturer; 2) such an effort should be linked to an AID sponsored follow-on program; and 3) more than one agency should be involved in the pilot and field testing effort.

Summary for Philippines

- Only 150 pumps were produced and only ten were installed in the field.
- Of those visited 83 percent were operational at the time of the visit.

Figure 2.2

Poor Drainage
at Handpump Site
in Honduras



Good Drainage
at handpump Site
in Honduras

- Of those visited 50 percent needed some maintenance at the time of the visit.

- While there is an active rural water program, no effort was made to link this effort to it.

- No further purchases of handpumps are contemplated by USAID/Philippines or by the Philippine Government.

- Little operational data or programmatic experience can be expected from this effort because of the limited size of the field sample (that is, only ten AID type pumps have been installed).

### 2.1.3 Honduras

Of the 150 quality AID handpumps produced 34 have been installed in the field and are currently being monitored. As the field test is still being conducted it has been of limited assistance to the AID-sponsored rural water program that is currently behind schedule. The effort to date has established that there are manufacturers in Honduras who can produce a quality AID type handpump. To date one manufacturer has been producing the AID type pump and has not as yet seen fit to try to market the pump on his own. Lack of hard cost data from the field precludes comparison of performance between the AID pumps and others being used (Baker, Dempster, and locally made Sanpar).

Question A: A total of 18 site were visited and 21 pumps were observed. Of the AID pumps observed 89 percent were operational. (It should be noted that the program had been notified of our plans and had visited the sites the week before our visit.)

Question B: The original manufacturer has not produced any pumps other than those made for USAID/Honduras. No major changes were introduced during the manufacture of these pumps. A change to the foot valve is contemplated but no definite plans were put forth by the manufacturer.

Question C: While there are a number of other handpump programs in the country (EEC, CARE and Swiss) none of them is planning to use the locally made AID pump.

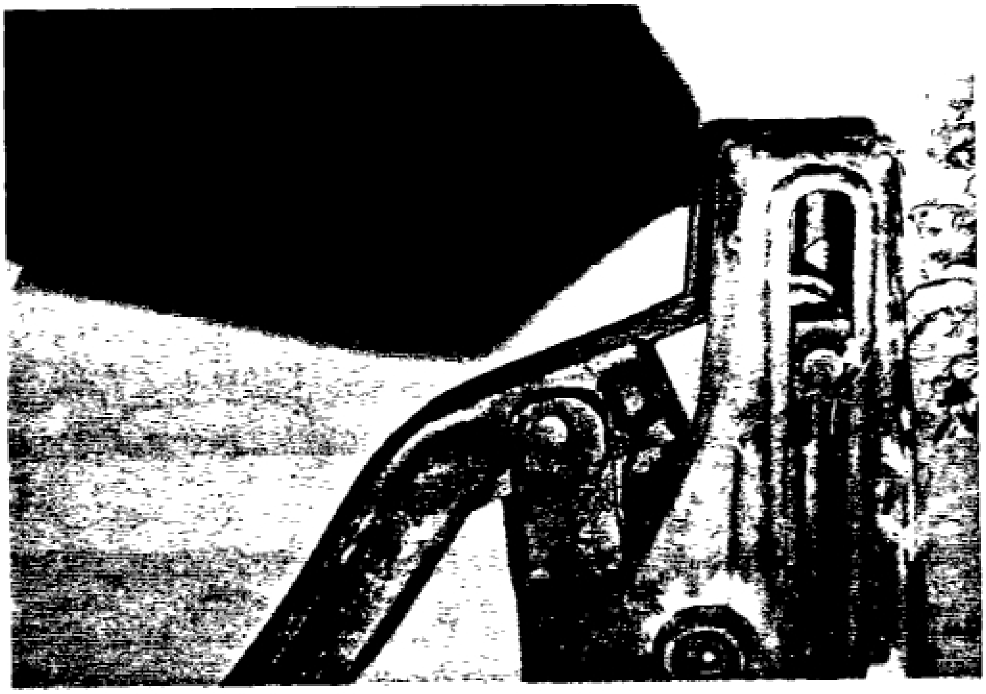
Question D: No pumps have been sold on the open market and the manufacturer has no plans to develop any effort to sell them there.

Question E: No spare parts are available locally. The communities are only slightly involved in the maintenance of the pumps. Up to now the major driving force for user involvement has been GIT staff visits. This involvement will drop off as GIT is phased out.

Question F: Yes, but the GIT phase is still active. Long-term training is, and will continue to be, a problem.

Question G: No additional orders have been received. Thus there has been no change in price.

Figure 2.3



Pump Failure Due to Poor Lubrication and High Usage (Sri Lanka)

Use of Sealed Bearings in Philippine Liberty Pump
as Example of Upgrading of Traditional Design (Philippines)

Question H: No other agencies and/or institutions have been involved in the development or use of this pump (See Answer C).

Question I: No pumps have been sold since the initial order.

Question J: The current AID Director and Staff are aware of the handpump program and its linkage to the on-going rural water program. They are interested in having a handpump program, but are undecided between the AID pump and a Dempster pump. They currently have approximately 1,000 Dempster and 100 AID pumps in storage because the rural water program is behind schedule.

Question K: No new lessons were learned beyond those stated for Sri Lanka and/or the Philippines.

Summary for Honduras

- Only 150 pumps were made and 34 were installed in the field.
- Of those visited 89 percent were operational.
- Of those visited 27 percent needed lubrication or some lubrication at the time of the visit.
- While the handpump program is just drawing to a close, the rural water program is about two years along and far behind schedule. In the future the two should be better coordinated.
- Data are not being collected in a way that it will be useful in designing future user maintenance and operational schemes.

### 2.1.4 Dominican Republic

This is the only country visited were the effort has moved from a pilot demonstration to a full scale program where AID type handpumps are being purchased (2,000) and installed (700 to date) in quantity as part of a regularly operated national health program. The effort to date has highlighted the needs for manufacturing quality control and a strong well-managed program that includes maintenance schemes, user education, and effective managers.

Question A: A total of 19 sites were visited and 19 pumps observed. Of those visited 63 percent were operational at the time of the visit.

Question B: A visit was made to one of the two manufacturers that were given assistance. That manufacturer still had the patterns and had sold approximately 20 pumps during the last "several" years. The current manufacturer, one that had not been assisted, is finishing up the remainer of his 2,000 order.

Question C: No other agencies or organizations have large handpump programs. The Fundacion Para El Desarrollo Comunitario (FUDECO) did try to use a plastic Waterloo type pump but has discontinued the effort and plans to purchase AID type pumps.

Figure 2.4

Poor practice (excessive solvent) during installation handpump with plastic drop pipe (Dominican Republic)

Failure of solvent weld for cage of plastic foot valve (Dominican Republic)

Question D: The team found that the foundry had sold 25 pumps to the Church World Services and expected to sell 200 more to a PVO (FUDECO).

Question E: Spare parts are still not available locally. The major burden of the handpump installation and maintenance efforts are still borne by the national programs, but plans are being developed for locally based repair and maintenance schemes.

Question F: Due to the rapid turnover of the individuals involved in this effort there is the need for a constant training effort. This had not been developed as of the date of the team's visit.

Question G: No, the second order of 1,000 pumps was purchased at the same price as the first 1,000 pumps.

Question H: The current manufacturer has only made minor efforts to develop a market outside the current one with AID. No other agency has shown any interest in the pump.

Question I: The current manufacturer has sold about 30 pumps to other AID programs and 25 to another agency and expects to sell about 200 more to a PVO.

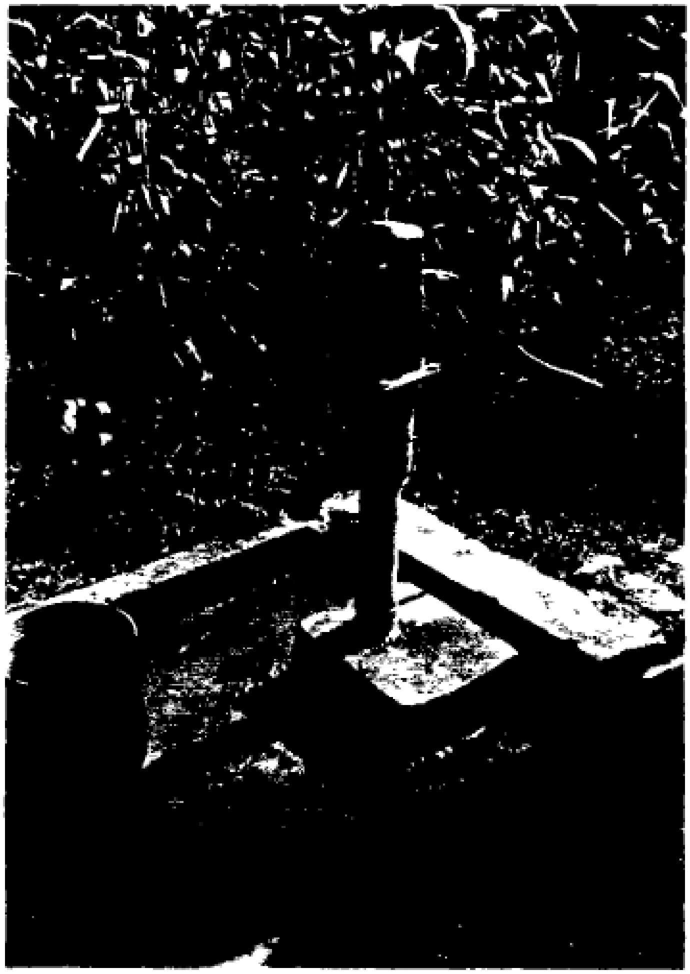
Question J: The current Mission Director and staff are fully aware of this program. They are contemplating including additional pumps in a proposed health sector loan. They are aware of the benefits to be gained as well as the problems of such a program.

Question K: The lessons that have been learned from this effort are: 1) that the purchase of the pumps should be linked to an AID program to ensure the manufacturer a market; 2) top priority should be given to ensuring quality control at the factory and the establishment of user maintenance schemes at the local level; and 3) the management of a handpump effort is a complex and time consuming thing that needs adequate numbers and type of dedicated individuals.

Summary for Dominican Republic

- 63 percent of the pumps visited were operational.
- Lubrication and loose bushings were the two major field problems observed.
- This is the only fully operational program that the author visited.
- The handpump effort is linked to a health sector loan and is part of a national program.
- The manufacturer has sold 25 pumps to a PVO and expects to sell 200 more.
- Spare parts, local maintenance, and factory quality control continue to be major problems.

Figure 2.5



Poor practice of cementing in base. To remove deep-well cylinder one must break the base (Honduras)

Poor Lubrication Resulting in Bushing Falling Out (Dominican Republic)

Figure 2.6

Poorly maintained pump with pins and bushings that have fallen out (Dominican Republic)

Poorly Maintained Pump. No Lubrication and Nails Used as Cotter Pins (Dominican Republic)

- The handpump effort has not advanced to the point where it has organized adequate numbers and types of personnel for its technical, management and user education phases.

## 2.2 General

During the course of this OTD five countries with handpump programs were visited: Sri lanka, Philippines, Honduras, Dominican Republic and Haiti. As a result of these visits the following conclusions are drawn and recommendations for future development of the AID handpump program are made.

### 2.2.1 Critical Juncture

Conclusions: AID's handpump Program started in the late 1960's when the Agency contracted with Batelle Memorial Laboratories to develop a robust, low-cost handpump that could be manufactured in developing countries. Since that time AID has invested over a million dollars in developing the concept and has tested and monitored the manufacture and installation of such pumps in the above-mentioned five countries and others. The original design has undergone many changes and has evolved into what is now called the AID-type handpump.

The program is now at a critical juncture in its development. It has demonstrated to the international community that 1) there is the need for a device to provide safe water to the approximately 25 percent of the world's population which lives in small villages and dispersed areas; 2) that such a device can be made locally; 3) that, while it is not easy, locally based national programs can be developed to manufacture, install, and maintain such devices; and 4) that a great deal more work is needed in order to understand the managerial and user behavior aspects of such programs.

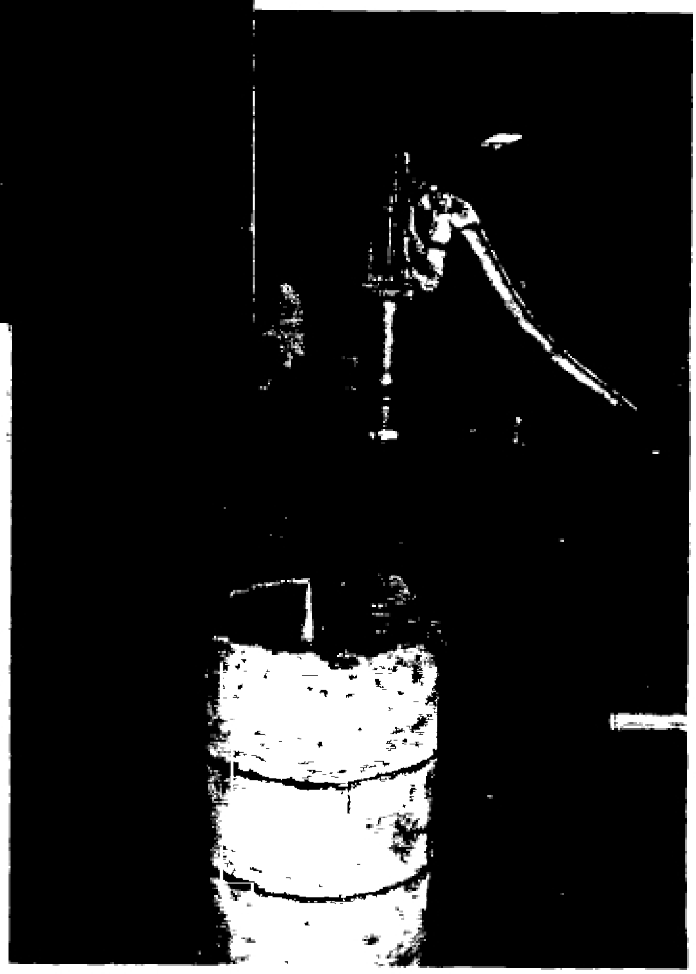
While AID's Program has served as the catalyst for the later efforts of UNICEF and the World Bank by illustrating the need and demonstrating a potential solution, it must now recognized that new technologies make its present design less desirable than other handpumps that are currently available. In recognizing this need it should also recognized that as a result of this Program AID has gained vast and valuable experience in: 1) local manufacture of such devices; 2) the managerial and technical shortfalls of such devices when used in large-scale locally based programs; and 3) the infrastructure needs of such efforts. The recommendations that follow should help AID in modifying its future efforts as it continues to seek ways to improve the health of the millions in the rural and "rurban"* areas.

*Areas characterized by scattered small communities each of which has some sort of administrative structure.

Figure 2.7

Changes in AID Handpump Design

Welded steel version of original design. (Dominican Republic, 1978)



Present design (Dominican Republic, 1983)

Recommendations

A. In order to determine the intensity of its future efforts the AID Office of Health should determine the extent of 1) its influence on the handpump market and 2) its ability to influence trends, directions, and/or types of pumps being used.

B. If AID feels it can have sufficient influence on the market to justify its continued presence, it should reexamine its present program and/or design to determine the costs for modifying the present design vs. that of using an existing non-AID design within the present concept of local manufacture and user maintenance.

C. If AID decides to continue its handpump effort it must recognize that new technologies have made the present design less desirable than others currently available. Therefore, AID should 1) develop a modified design that uses new technologies (i.e. "space age" plastics, roller bearings, pull-through-the-base capability, etc.), 2) incorporate handpumps developed by another agency into its efforts (for example, the UNICEF MKII), or 3) a combination of both.

D. If AID concludes that it has successfully "done" what it set out to do--promote the handpump concept--they must develop a strategy for phasing out assistance in such a way that those countries that have started using the AID pump can shift to a compatable alternative.

2.2.2 Development of Software Data

Conclusion: Because only a few of the programs assisted by AID have reached the operational and/or self-sustaining level (Dominican Republic and Indonesia) there is a lack of information on 1) what are the human, financial, and technical resources needed to operate such programs over the long term; and 2) how they should be institutionalized for different types of handpumps. In spite of this lack of knowledge the AID handpump program could provide a wealth of knowledge in these areas.

Recommendations

A. Despite the few programs in operation AID should tabulate the numbers, types, timing, and organizational patterns for those resources that would be needed for any country-wide handpump program.

Table 2.1 gives the various data that should be considered for the different phases of such a program.

Table 2.1

Handpump Resource Tabulation

| MANPOWER NEEDED | PROMOTION PHASE 100 Handpump/Yr. | START-UP PHASE 100 Handpump/Yr. | IMPLEMENTATION PHASE 100 Handpumps/Yr. |
|---|---|---|---|
| Manufacturers | xx* | xx | xx |
| User Organizers | | | |
| Initial Contact | xx | xx | xx |
| Long-term Contact | -- | xx | xx |
| Installers | (1) | xx | xx |
| Maintenance teams | xx | xx | xx |
| Technical staff | | | |
| Well Drillers | (2) | xx | xx |
| Logistic Experts | -- | xx | xx |
| Program Staff | | | |
| Managers | (1) | xx | xx |
| Financial | (1) | xx | xx |

(1) Use existing wells where possible to reduce costs
(2) Use existing infrastructure where possible.
* Numbers of people to be provided for a particular phase.

2.2.3 Development of Mission Assistance Packages

Conclusion: The current approach to assisting the USAID Missions in establishing handpump programs needs to be improved. The experience to date shows the lack of any coordinated set of documents and devices that could be provided to a mission to guide their promotion, start-up, and long-term efforts. As a result there has been a great deal of costly duplication each time a new program is considered. This approach would allow one country to learn from the mistakes of another. For example, it might have helped prevent the Dominican Republic experience of having at least six contracts to supply the various parts of a single pump.

Recommendations:

A. AID should develop the "packages" of documents and devices indicated in Table 2.2 to assist AID missions to promote, start-up, and implement handpump programs.

Figure 2.8

Typical Field Problem. Difficulty in Filling of
Narrow Mouth Carrying Container

Appropriate Technology Solution for Filling a Narrow
Mouthed Carrying Container. A Coconut Sheel Used as a Funnel.

Table 2.2

Handpump Assistance Packages

| PACKAGE | PROMOTION | STARTUP | IMPLEMENTATION |
|---|---|---|---|
| To identify manufacturers | x | x | - |
| To assist quality control | x | x | x |
| Bid package (See 3.3.2) | | | |
| Sample contract | x | x | x |
| Sample pump | x | x | - |
| Sample jigs | x | x | - |
| Guage kit | x | x | x |
| Program resources | | | |
| Human | (1) | x | x |
| Technical | (1) | x | x |
| Financial | - | x | x |

(1) Use existing resources where possible.

B. Prior to starting any more new programs S&T should develop promotion and start-up packages.

C. Prior to assisting any more Missions the Office of Health should hold a short course on handpumps for the Mission staff that is to be involved in the promotion and start-up phases.

### 2.2.4 Changes In Current Designs

Conclusion: The present technical/managerial review has shown that there are a number of changes that need to be incorporated into the AID handpump concept if the Agency continues to propose it as a way of improving drinking water in the rural and rurban areas. Table 2.3 lists the problems that were observed during the field surveys.

Recommendations

A. To resolve the technical problems noted above the following potential modifications should be investigated for modifying the existing design:

- Replace pin/bushing with roller bearings
- Develop a base that will allow the deep well cylinder to be pulled without removing base bolts.
- Develop a base that will allow a 360 degree orientation of spout.
- Develop a standard foot valve which can be used for both deep and shallow well pumps.

Table 2.3

Handpump Problems Observed During Field Visits

| PROBLEM | LOCATION | | |
|---|---|---|---|
| | Widespread Problems | Common Problems | Minor Problems |
| **Technical** | | | |
| - Poor lubrication of bearings | SL, DR | HON* | -- |
| - Rusty base bolts | SL, DR, HON | -- | -- |
| - Bushing falling out | DR, HA | SL | HON |
| - Leaks at base threads | All | -- | -- |
| - Bushing/pin hardness | DR, HA | | SL, P** |
| - Base cemented in stand (cannot remove base without destroying stand) | -- | All | |
| - Cannot pull deep-well cylinder without removing base | All | -- | -- |
| - Cannot reorient spout because of threaded base | All | -- | -- |
| **Managerial** | | | |
| - Lack of spare parts at site | All | -- | -- |
| - Lack of lubrication at site | All | -- | -- |
| - Lack of operational data for life cycle costing | All | | |
| - Lack of adequate program managers | All | — | — |

Key: SL - Sri Lanka; DR - Dominican Republic; HON - Honduras; P - Philippines; HA - Haiti; All - All Countries

* In Honduras pumps had been installed relatively recently.
** In the Philippines there were only 10 pumps installed.

B. The managerial problems noted above are pump specific. For example, the on-site lubrication needs of a pump that requires yearly greasing are quite different from one that requires weekly oiling. Therefore, they will change as modifictions are introduced into the current design. Thus, all modifications must be examined in the light of the following questions:

- How does the proposed change affect personnel required to operate and/or maintain the pump?
- Will the proposed change increase or decrease the foreign exchange element/cost?

- What are the programatic costs of the proposed changes?
- Does the country have the technical/human resources needed to support the proposed modification and its resulting infrastructure?

### 2.2.5 Better Definition of Targets of Opportunity

Conclusion: Of the five programs visited, and the three additional ones reviewed, only two have resulted in full scale or self supporting programs (see Table 1.3). From this it is concluded that the Office of Health needs to develop better indicators for locating those targets of opportunity that will result in operational programs.

Recommendations

A. AID should provide handpump assistance only in those countries where there is an assured market for them. They should give preference to efforts which are tied to an AID development program such as agriculture or primary health care programs, etc.

### 2.2.6 Develop Standardized Manuals

Conclusion: A review of the documentation developed to date showed that there has been little transfer from one program to another. This has resulted in an unwitting duplication of effort.

Recommendation

A. To help reduce costs AID should develop standardized manuals and job aids that country programs can adapt to local situation and needs.

B. Among the manuals that should be developed are:

- Program promotion
- Pump manufacture
- Pump installation
- Pump maintenance
- User education
- Program management
- Program organization

### 2.2.7 Develop Standardized Design Sheets

Conclusion: In examining the efforts to date it is clear that while AID has developed a standard pump design it has not developed standard program elements that are needed to support the concept.

Recommendation:

A. AID should develop standardized drawings and/or specifications for the following elements:

- Sanitary well
- Drainage pads
- Dry-well
- Well drilling and development

B. All such standard drawings should be developed taking into account those human and managerial resources that are readily available in developing countries.

### 2.2.8 Develop Multiple Resources

Conclusion: In examining the efforts to date it is noteworthy that often resources were focused on a limited number of program elements often with tragic results. For example, in the Philippines only one manufacturer was given technical assistance in pump production. For reasons unrelated to the handpump program this manufacturer is now out of business and AID has lost its investment in handpump transfer. In the same country the Barangay Water Program (BWP) was selected as the agency to field test those pumps that were produced. As it turns out, the BWP is more interested in piped systems than handpump programs. Thus only a very limited number of pumps are being field tested. Although the Government of Philippines is planning on sponsoring large handpump programs it probably will not sponsor a full scale AID handpump program.

Recommendation

A. Future pump programs or activities should consider assisting several manufacturers at the same time. This will allow a country to develop handpump production capability without having to depend upon a sole source.

B. Future pilot efforts should be with all those host country agencies working in rural and rurban programs such as rural development, agriculture, urban development, etc. rather than only one agency.

# Chapter 3

# SRI LANKA HANDPUMP PROGRAM

Typical Handpump Installation
In Sri Lanka

## 3.1 Background

### 3.1.1 History

In October 1979, the Georgia Institute of Technology (GIT) was contracted by USAID/Sri Lanka to: 1) determine "the feasibility of locally manufacturing the AID handpump" and 2) "field test a limited number of locally produced handpumps" (Ref. 3.1).

Between late 1979 and mid-1981, a manufacturer was identified, 90 pumps produced, and 79 were installed at 39 sites (see Map for locations) that were identified from a field of 130 identified by the Government of Sri Lanka (GOSL). This effort was supervised by GIT engineers who traveled from Atlanta to work with staff from:

- USAID (Mr. James Meenan - Capital Development Officer)

- Foundry (Somasiri Huller Manufactory)

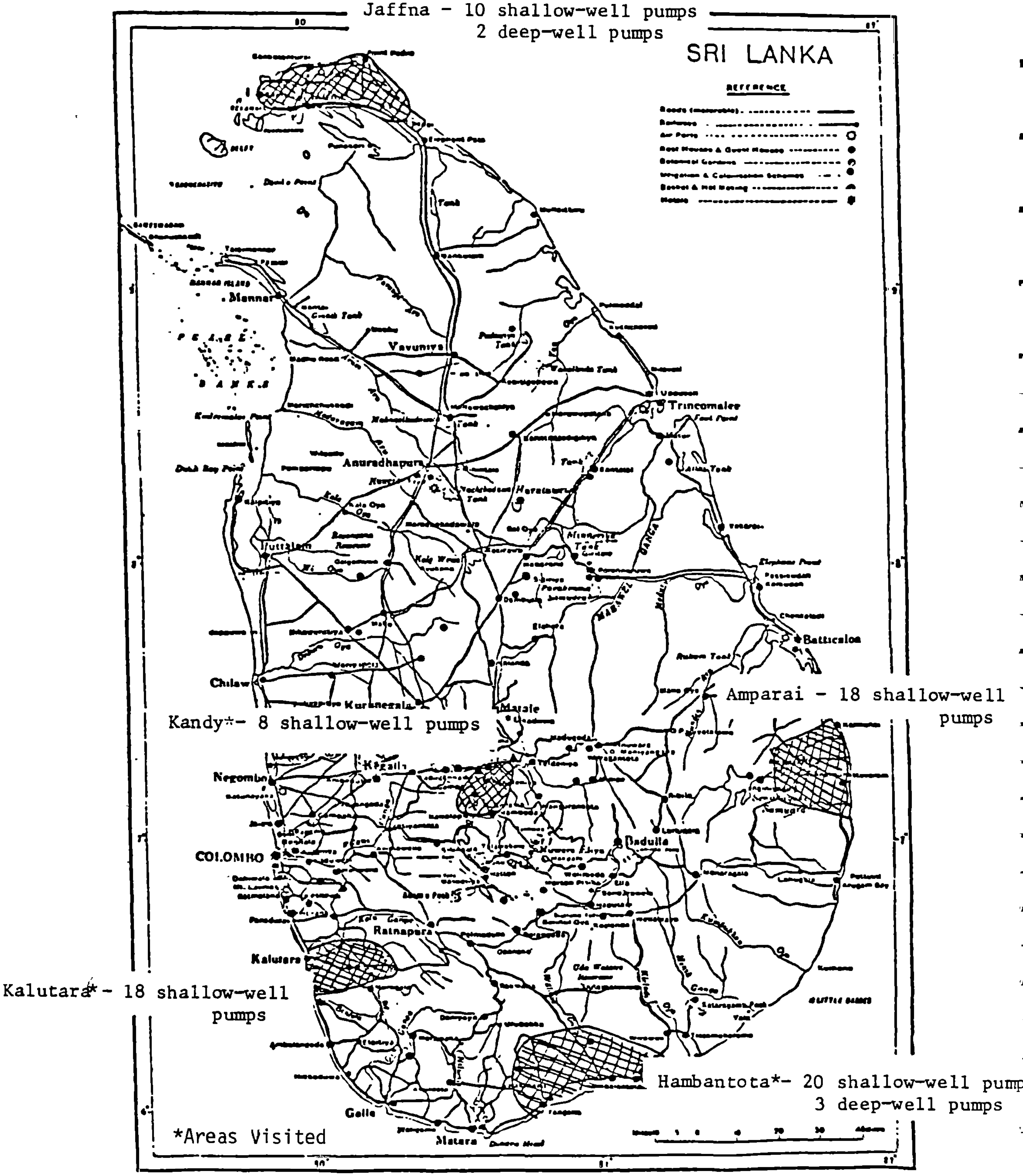
- Sri Lanka Government

  - Ministry of Local Government, Housing and Construction
  - National Water supply and Drainage Board.

During the test period, attempts were made to have the pump maintenance conducted by village caretakers who were appointed by the "Village Development council." These individuals received technical guidance and backstopping from an engineer on the staff of the Commissioner of Local Government for the Region in which the pump was located, as well as through numerous visits by the GIT staff. Spare parts and repairs were to be funded from the budget of the District Development Council (DDC) when requested by the Village Development Council (VDC), but lack of funds often resulted in GIT providing both minor spare parts and technical backup.

Throughout the production and test period, adaptations were introduced to the basic AID handpump concept by both the manufacturer and by GIT staff. Thus, the pump that was field tested was the Sri Lanka version of the AID handpump. This locally manufactured pump is now called the "SOMASIRI" handpump. These modifications ranged from those introduced by the manufacturer to respond to production situations to several design changes to respond to operational problems that were encountered such as, for example leaky foot valves.

The pump manufacturing process was guided by GIT so that by the end of the project the factory had developed patterns (six sets), as well as appropriate jigs and fixtures. At the time of the inspection visit, the local manufacturer was looking forward to receiving orders from the GOSL and German Foreign AID Agency (GTZ) for a limited number of the "SOMASIRI" handpumps.

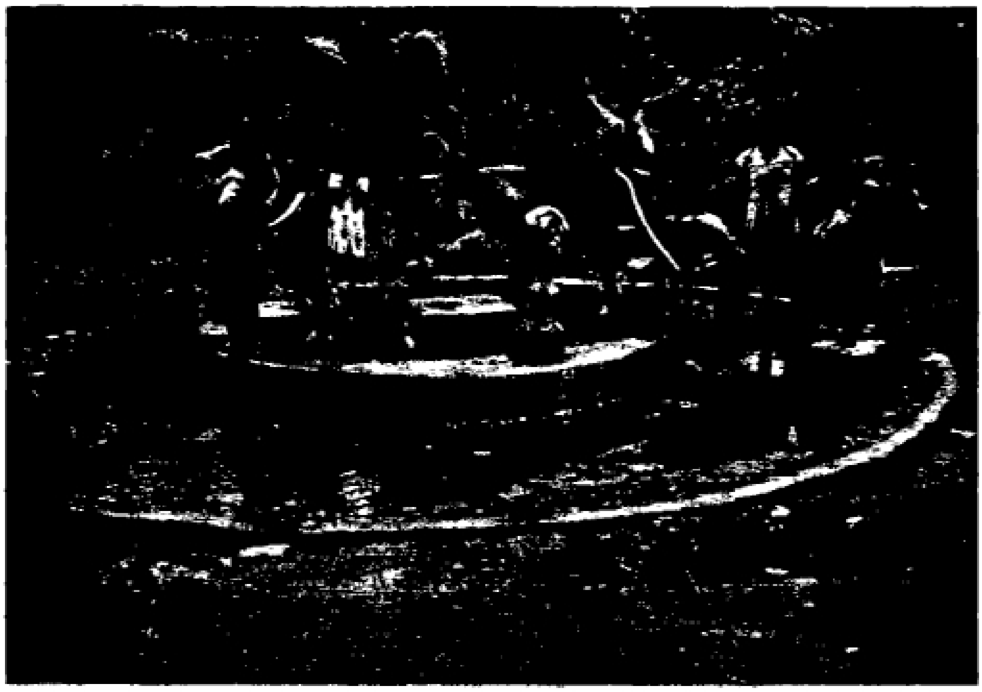



Source: Ref. 3.1

Map of Sri Lanka Showing Areas of Pump Locations and Those Visited

Figure 3.2

Typical Handpump Scenes in Sri Lanka



Scene at high use well site
(One pump out of service)

Wear due to very high usage at above site

The Mission expressed its satisfaction that the work done by GIT (i.e., Phases 3, 4, and 5 of the technical transfer process) had helped it demonstrate to the GOSL that the low-cost, robust, low maintenance handpump could be manufactured, operated, and maintained locally.

### 3.1.2 Efforts to Date

To date only the first five phases of the technology transfer process have been attempted in Sri Lanka. (See Chapter 1 for discussion of the technical transfer process.)

Phases 1 and 2 were conducted by USAID/Washington through visits and cables and by working with the Mission to identify the need to help the GOSC to expand its Drinking Water Program to those living in the small villages and to areas with dispersed populations. Phases 3, 4 and 5 were carried out by GIT in collaboration with the Mission. No decisions have been made on who will finance and carry out the next phases.

The activities of the first two phases were not formally defined but appear to have been:

Phase 1:

To assist USAID/Sri Lanka to identify a low-cost, robust, low-maintenance water pumping device that was conducive to in-country manufacture.

Phase 2:

To provide USAID/Sri Lanka with a working model and drawings of the basic AID handpump.

The activities of Phase 3, 4 and 5 (which were to be carried out during the period 1979 through the end of 1982) were identified by the Mission and GIT as:

Phase 3:

A. "To provide the technical assistance necessary to establish local production of the AID handpump."

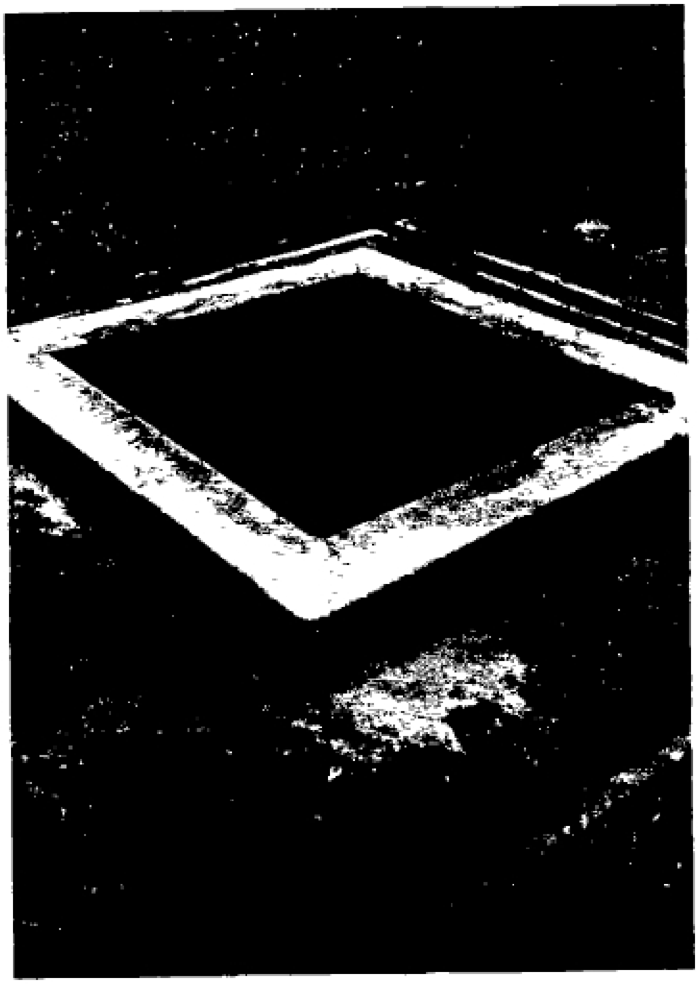
B. "To oversee the manufacture of a production run of 90 AID handpumps." (See Appendix A of Ref. 4.1 for details of the activity.)

Phase 4 and 5:

A. "To implement a field handpump installation program." (See Appendix C of Ref. 4.1 for details of the activity.)

B. "To assess the impact and effectiveness of the handpumps by monitoring and evaluating water quality, handpump performance data, and general user acceptance."

Figure 3.3: Typical Well Sites in Sri Lanka



Open improved well site

Typical background well site at private home

During Phases 4 and 5 to help ensure the successful introduction of the handpump concept in Sri Lanka, GIT undertook the following additional efforts:

- Preparation, printing, and distribution of an illustrated repair/maintenance manual in English, Singhalese and Tamil. (See Appendix E of Ref. 4.1 for this manual.)

- A handpump test program with the Ceylon Institute for Scientific and Industrial Research (CISIR) to determine accelerated wear data under laboratory conditions. (See Appendix F of Ref. 4.1 for the first of two reports. The second has not yet been released.)

- A water quality monitoring program to provide information about the effects of shock disinfection, soil types, and recontamination rates on drinking water quality.

### 3.1.3 Approaches Used by USAID/Sri Lanka

For Phases 1 and 2 USAID/Washington played an active and leading role. They helped the Mission to identify the need for a robust, locally manufacturable, locally maintainable (RLMLM) drinking water delivery device and, in identifying the AID model handpump as the device to be field tested in Sri Lanka.

For Phases 3 through 5, GIT was suggested by S&T/HEA/CWS in Washington and contracted by USAID/Sri Lanka to provide the necessary technical and software assistance to the Mission. To achieve this, in October of 1979 GIT was requested to examine the feasibility of local manufacture of the AID type handpump. After reporting affirmatively on the local manufacturing capability and the potential market for a RLMLM handpump, in March of 1980 GIT was contracted by the Mission to conduct the planning and implementation of the field test program (i.e., Phases 3,4, and 5). To carry out this work, GIT provided the part-time services of five of its staff engineers who traveled to Sri Lanka for periods of up to four weeks. During these periods they :

1) identified a foundry to manufacture the pumps;

2) assisted in developing a contract to produce 90 handpumps (see Appendix B of Reference 3.1 for shop drawings);

3) advised the manufacturer in foundry and production practices (see Appendix A of Reference 3.1);

4) worked with the Ministry of Local Government to select 39 well sites from a list of 130;

5) contracted with and supervised the work of local firms to cover the wells and install the pumps (usually two per well) (see Appendix C of Reference 3.1);

6) worked with the Ministry of Local Government, Housing and Construction (MLGHC) to select, and then train, pump caretakers who were technically backed up by the Technical Officers of the Ministry but who were under the administrative supervision of the District Development Councils (see Appendix D of Reference 3.1);

7) contracted with the CISIR laboratories for an accelerated wear testing of the locally produced handpump (see Appendix F of Reference 3.1);

8) worked with the National Water and Drainage Board laboratories to conduct a water quality program (see Appendix G of Reference 3.1); and,

9) monitored performance of each pump site through frequent visits (every three months or so) by GIT Engineers in the company of MLGHC staff.

USAID/Sri Lanka staff actively participated in all phases of the process.

## 3.2 Discussion of Team Visits

### 3.2.1 To the Factory

The Somasiri Huller factory is a well-run business whose main products are rice milling machines that are sold to the Japanese for re-export to Latin America. Pages 39 to 48 of the GIT final report (Ref. 3.1) describe the foundry, its machine shop and assembly areas. Discussions with the owner/manager showed him to be a knowledgeable businessman who took an active interest in producing a quality product. His workmen demonstrated the use of the patterns, jigs, and fixtures they had developed under the guidance of GIT.

The owner said that he felt the present factory could sustain a production rate of 25 pumps per week at a price of about US $150.00 each.

No other factories were visited. It appears that the Somasiri Huller Factory is capable of meeting the local demand for handpumps in the near future. If the demand grows, there is every reason to believe that others would enter the field if it proves profitable as there are numerous other local manufacturers who produce a wide range of products.

An example of Somasiri Huller's interest in this product is that they have developed a spare parts list catalog at their own expense. This was done to maintain quality after the factory's owner, Mr. M.D.P. Dias, found that in several cases repair parts had been manufactured locally rather than purchased from the factory. Field observations of the numerous bicycle and auto repair shops throughout the areas visited tend to support the expectation that "official" and "unofficial" spare parts would become available in the field once a number of pumps had been installed.

The visit to the Huller factory confirms the Mission and GIT finding that a RLMLM type handpump can be locally manufactured in Sri Lanka at a competitive price (US $150.00 vs. US $360.00 for a UNICEF MKII) and that the pump could be supported with locally produced spare parts.

During the visit to the factory, representatives of the German Foreign Aid Group (GTZ) arrived to discuss the purchase of ten deep well pumps for a field test they were conducting. If successful, this could mean an order of approximately 600 pumps.

### 3.2.2 Field Visits

A total of 15 sites were visited and 32 pumps were observed. Table 1 shows the sites visited and the conditions found.

Field observations confirm that the SOMASIRI pump is locally accepted, reparable on-site, and robust enough to require a minimum of preventative maintenance _if_ kept greased. While frequency-of-repair data were not available, it appears that leaky foot valves are the most troublesome component, and lack of grease is the most common operational problem.

Due to the lack of tools and time, the team was often unable to determine why pumps were not operational at the time of their visit, but, on questioning the local caretaker as to the measures that had been taken to correct non-functioning conditions, it appeared that most of the past repairs had been instigated by and/or conducted as a result of a visit by a GIT staff member rather than any scheduled program.

There seemed to be a serious communication gap between the local caretaker, the MLGHC Technical Officer, and the District Development Council. It was repeatedly noted that the local caretaker, who was a "volunteer" worker who had been appointed by the Village Development Council, had been unable to obtain funds for purchase of minor spare parts. The MLGHC Technical Officer indicated that such funding was the responsibility of the newly established District Development Councils (DDCs) who had not provided for such items in their budgets. The result was that often times GIT staff provided such items as spare parts and grease during their visits.

During the field visits it was noted that the extremely wide spacing of pump sites (many are an hour's drive from each other) resulted in maintenance and repair being done on an ad hoc basis. While it was difficult to judge whether the maintenance scheme used during Phase 5 would be appropriate for a full scale program, the field test did create an awareness in both the MLGCH and the National Water Supply and Drainage Board (NWSDB) of the need for such a support element.

The field visit also found that:

A. The pump is apparently valued by the users. This was concluded after noting the fact that users often have numerous open wells nearby which they bypass to draw water from the pump.

B. The lack of lubrication had not resulted in excessive wear of the hardened pins and bushings even though it does increase the force required to operate the pump.

Table 1

RESULTS OF VISITS TO HANDPUMP SITES

| Sites | | Pumps | | Remarks |
|---|---|---|---|---|
| No.* | Date installed | At site | Operational | |
| 5 | April 1981 | 2 | 2 | (*); Bolts were loose between pump head and body; good drainage at wellsite. |
| 6 | March 1981 | 2 | 2 | (*); poor lubrication as caretaker had no grease; well book indicated water samples had been taken but no results fed-back to caretaker. |
| 1 | April 1981 | 2 | 1 | (**); Foot valve leaked; second pump would not pump water for unknown reasons. |
| 7 | April 1981 | 2 | 2 | (**); caretaker had replaced coller pins with nails; well serves ±300 people. |
| 4 | April 1981 | 2 | 2 | (***) ; well book entry indicated pump had been removed and washers replaced with GIT help. |
| 8 | April 1981 | 2 | 1 | Caretaker not available (2); unable to determine why pump did not work but suspected worn cups. |
| 9 | April 1981 | 2 | 2 | In the yard of Assistant Government Agent at Motugana |
| 3 | April 1981 | 2 | 2 | (*); one pump had grease but the other lacked it; both were noisy to use; pumps had plastic drop pipes. |
| 2 | June 1981 | 2 | 1 | (*); (Book had 47 entries in 1½ years); Foot valve was leaking; good drainage; 8/12/81 entry indicated that well had been chlorinated on 26 Nov. |
| 17 | - | 2 | 1 | (**); cotter pins had been replaced with nails and wire; drainage poor and top slick. Team members fell; this well site is quite isolated from others. |
| 10 | May 1981 | 2 | 2 | (*); well log indicated that foot valve has been replaced about once each six months and cups were replaced each 9 months; one pump misslined to the pedestal of support container; surface slick and team member fell; site isolated from any others. |
| - | ±One year | 1 | 1 | This was a MKII installed by UNICEF; operation smooth; drainage good. |
| 11 | - | 1 (deep well) | 0 | (**); plunger rod on this deepwell pump was disconnected; many nuts missing at base; bolts now badly rusted and were unserviceable; no one had notified DDC pump had been out for 2/3 weeks; villagers had returned to using buckets and wells in their yard. |
| 19 | - | 4 | 3 | Caretaker available but no book; extremely high use by a large population; people bathing during visit with waiting lines; poor drainage; surface slick; maintenance poor (one pump missing a sliding block; two missing bushings; one had stripped threads at plunger rod and rod end that was "fixed" by a home repair; caretaker didn't"know" how to get broken pump fixed. |
| 33 | 1981 | 2 | 1 | Pumps well greased; this is a lone site 1½ hours from repair base over a difficult road and is not near any school or population center; unable to determine why pump didn't work; barrel threads stripped and pump turned around; no caretaker; large crowd but no one knew how to fix it or where to go. |
| 32 | 1981 | 2 | 1 | (**); one pump missing a sliding block; Technical Officer had visited this site within the week and had "removed some parts" but villagers did not know when they would be returned; this pump is a 10 minute walk from site #33; well slab showed evidence of repair by villagers to fix cracks. |
| | Total | 32 | 24 | |

See Table 3 of GIT Final Report for site names and other details.

NOTES: (*) Well book was available and showed multiple visits by Technical Officers and GIT staff.

(**) Lubrication of pump poor or nonexistent.

Figure 3.4

Typical Problem Found in Sri Lanka

Poor Orientation Between Base and Discharge

C. Many of the drainage slabs surrounding the pump installations were very slick. (All four members of the team slid and fell at different sites during the course of visits). Better drainage and increased slopes on the platforms would help to reduce this problem.

### 3.2.3 Government Officials

Meetings with the Ministry of Local Government and the National Water Supply and Drainage Board established that:

A. While the handpump effort to date had been guided by the Ministry, the legal responsibility for the drinking water sector rested with the Board.

B. The Board indicated their willingness to take on the maintenance of the handpump program as soon as "they were given additional budget to do so." They expressed a willingness to work with the Ministry in the maintenance scheme being proposed.

C. The Ministry was concerned about how they would handle the expansion of the handpump program that would result from the arrival of three additional down-the-hole type drill rigs (UNICEF currently has three in the country).

D. The GOSL had decided to modify its Decade Plan. They now proposed to provide potable water to most of its rural population via handpumps, and they will use intermittent supplies to public standpipes for the more concentrated areas.

E. The MLGHC estimates the "market" for handpumps at between 20,000 to 30,000 for the country. Stambo estimates that about 2,000 handpumps per year will be required up to 1983 when the number will rise to 4,000 per year (see Ref. 3.2).

F. UNICEF currently has a handpump program for which they were providing MKII pumps from India. They are also providing three drill rigs and will shortly send two more down-the-hole hammer type, to drill wells for its current program of about 700 deep well and 500 shallow well pumps.

G. As GTZ is planning a test program prior to installing approximately 600 pumps, they have been encouraged to include the SOMASIRI handpump. They had just bought ten SOMASIRI deepwell pumps for testing prior to deciding on a standard design for its upcoming handpump program.

H. The GOSL was concerned about the maintenance and reliability of handpumps in general and felt that failures could adversely affect peoples' willingness to accept this low-cost solution.

I. The World Bank was looking at Sri Lanka as one of the countries in its Village Operated and Local Maintenance Program (VOLMP) test program.

J. A number of donor agencies, Germany (GTZ) and Finland, are interested in providing handpumps. At GOSL insistence, consideration is being given to local manufacture.

K. Denmark and Finland are each sending an additional down-the-hole hammer type, and GOSL will purchase an additional one. This will mean that GOSL will have available to them a total of nine of these types of rigs. They expect to be drilling approximately 600 wells a year for which they will need handpumps.

L. Both the Ministry and the Board expressed concern over the need to develop a strong maintenance structure. This will be a big area of future action as the GOSL has decided to concentrate on Decade infrastructure. In the modified Decade Plan, special emphasis will be given to developing training schemes for local caretakers in approximately 22,000 villages. WASH assistance is contemplated for this effort.

The meetings confirmed that the GOSL is truly interested in providing potable drinking water to the inhabitants of its rural areas. Being aware of the cost of such an effort, they are willing to realistically examine such alternatives to piped supplies as handpumps. Thus, the production, installation, and field testing of the SOMASIRI handpump has helped them to better understand: 1) the variation in pump costs; 2) the maintenance requirements of these devices; and 3) the support schemes (i.e., training of caretakers, spare parts logistics, etc.) that will be required to operate a large-scale handpump program using a locally manufactured pump.

### 3.2.4 USAID/Sri Lanka Officials

Visits with the USAID/Sri Lanka Mission found the Capital Development Officer, Mr. James Meehan, very supportive of and interested in the handpump program.

The program has been guided by Mr. Meehan, been funded by the Mission, and is seen as a successful private enterprise initiative.

## 3.3 Lessons to Be Learned for the Future

### 3.3.1 Was the Program Design Adequate?

Under Phases 1 and 2, S&T/HEA/CWS Washington provided the Mission with the hardware concept and models in such a manner that they were able to understand and act on them, but they were less successful in providing the understanding of the software systems (spare parts, maintenance, etc.) that would be needed if the demonstration effort is to provide an understanding at both the government level and in the field of future problems with both hardware and software.

In Phases 3 through 5, the adequacy question must be answered in three parts: 1) pump production; 2) field testing; and 3) future implementation.

A. Pump production - The program design for Phase 3 resulted in developing one manufacturer who can produce the pump. If, in the near future the GOSL were to purchase the pump in any quantity, it would mean they would have to purchase it from a sole source. It is of concern that the Mission has not been provided with documentation it could use to assist the GOSL to develop other manufacturers if this need should arise.

In addition, while GIT was able to obtain a quality product, neither the Mission nor the GOSL was provided with documentation that they could use to establish procedures for inspecting and accepting future pumps (for example, a sample guage kit or an inspection manual). This lack could lead to serious problems once the SOMASIRI pump was placed into large-scale production.

B. Field test - The manner in which the field test records were kept does not allow the GOSL: 1) to establish frequency of repair records which would be invaluable in designing the maintenance and spare parts logistic system and determining their respective costs; 2) to find out how much users were willing to spend to have this handpump available vs. their current water source or another pump; 3) to develop any comparison of the maintenance required by the SOMASIRI pump to that required by any of the other handpumps that are being used in the country. (For example, the UNICEF MKII). Such an exercise would ensure that USAID could be sure that the life cycle cost (i.e., manufacture, installation and maintenance) of their solution would be the most economical one; 4) to determine the optimum grouping patterns for most effective maintenance schemes. (The density of pumps in many test areas was so low--many times they were at least an hours drive apart--that it did not allow the GOSL to test various maintenance schemes. For example: How many pumps could one mechanic maintain? What tools would he need? How often?); and 5) who should be appointed as the pump caretakers. (For example, should women or men be used? What is the minimum educational level that can be accepted?)

C. Future Implementation - Using the limited cost data available*, it appears that the purchase of the pump, well construction, and installation of the pump would cost the GOSL on the order of US $3.50 per capita served. These limited data indicate that the USAID handpump is a viable solution and one that the GOSL should consider, but the lack of hard data concerning the cost of the various administrative systems (spare parts, maintenance, etc.) precludes developing alternative schemes for implementing future large scale handpump efforts.

### 3.3.2 What Steps Should Be Taken to Increase Number of Bidders to Prevent Sole-Source?

A major potential problem in this area is that if USAID/Sri Lanka or the GOSL decided to use the handpump developed through the GIT effort (i.e., the SOMASIRI), there would be only one supplier. This could be avoided by having GIT summarize its experience into a "package" of documents that would include:

* A pump costs US $150/unit and GIT estimates that it costs an average of US $400 to cover a well and install two pumps for a total of US $700 for a sanitary well with two handpumps on it.

- Guidelines for evaluating the handpump "market" in Sri Lanka. This would assist USAID/Sri Lanka or GOSL to determine the number of pumps that could be reasonably used at any one time. Country installation capacity would be a major factor.

- A "Bidding Package" to assist the GOSL and/or USAID/Sri Lanka to call for bids on a large-scale order (between 2,000 and 3,000) of handpumps. This would include:

  - A set of fabrication drawings that reflect the changes incorporated into the SOMASIRI pump.

  - A sample handpump with all the latest changes.

  - A typical call for bidders.

  - A sample contract for pump production and delivery.

  - A set of pump patterns along with a basic "jigs and fixtures" kit.

  - A set of instructions for the manufacturer on quality control that would include sample specifications for pump acceptance procedures and tests. This should include a basic "guage" kit for measuring pump tolerance and interchangeability.

In using the above-mentioned procedure, it is essential that rigid quality control be stressed as clearly spelled out acceptance procedures and an easily useable "guage" kit are one of the foundation-stones in obtaining a RLMLM handpump.

## 3.4 Conclusions from the Visit

### 3.4.1 What are the Residual Effects at the National Level?

The joint effort by the GOSL, the USAID/Sri Lanka Mission and GIT to demonstrate the local manufacture, installation and use of 90 AID type handpumps (Phases 3, 4 and 5) has resulted in the following residual effects at the program level:

o A clear demonstration that Sri Lanka has the capability to locally manufacture a quality handpump at a reasonable price.

o Establishment of the capability to manufacture the AID handpump by one manufacturer who is interest in and promoting the product as a local item (i.e., the SOMASIRI handpump).

o Awakening of a reasonable degree of awareness among central government officials for the logistics, maintenance, and training requirements needed to support a country-wide handpump program.

- o Establishment among a few technical officers in the regional MLGHC offices of an awareness for the technical, logistical, and managerial difficulties in supporting the local handpump effort and its caretakers.

- o A limited interest by other institutions (Ministry of Housing and Water Supply and Drainage Board) and agencies (GTZ of Germany) to purchase and field test the SOMASIRI pump.

- o While the GIT effort was not designed as a water supply program but rather as a handpump testing program, it has served as a vehicle to help GOSL officials understand the need to modify their Decade Plan by extending it to the middle of the next decade (90's) and by including handpumps as a drinking water solution for dispersed populations.

The above conclusions are based on subjective observations, field visits, and discussions as little hard data have been maintained by GIT or the USAID/Sri Lanka Mission during the monitoring process.

### 3.4.2 What Are the Residual Effects at Official Levels?

One of the desired side effects of the effort was to involve other institutions and agencies in such a manner that they would become interested in the handpump concept and then help to promote it in the country.

In this regard, the various actions have resulted in the involvement of numerous official agencies as follows:

A. CISIR - As the final report by this agency was not available at the time of the visit, little is known about the interest of this organization in the handpump concept, but from the work they did do on improving the rubber for the flapper valve, it appears they could, if approached properly, be a valuable technical resource to help GOSL improve pump performance. (For example, they could examine different lubrication techniques using such locally available things as cooking oil, coconut oil, etc.)

B. Ministry of Local Government, Housing and Construction - It was clearly evident that Mr. Harold Fernando of this Ministry had developed a great interest in finding a robust, locally manufacturable, low cost, low maintenance handpump that would be used to provide safe drinking water to the millions in the rural areas and small villages of Sri Lanka. His deep personal interest in this problem, and particularly in the development of the SOMASIRI pump, is one of the outstanding "residuals" of the effort.

C. National Water Supply and Drainage Board - The awareness and interest of the Board in handpumps as a device for providing water to rural populations and small villages is the result of Mr. H. Fernando's efforts. Unfortunately, the project design did not allow the Board to obtain hard data on the type of maintenance system that would be required for the long-range operation of this type of pump. (The pump density per test area was too low and the technical and logistical back-up tended to be done by GIT staff rather than by the Technical Officer of the District Development Councils.)

D. Other International Agencies - While it is known that UNICEF has had an on-going program for several years, it did not appear that the GIT effort was coordinated with or fully understood by that agency.

E. Other Test Programs - It appears that GTZ (the German Foreign Aid Agency) is planning to provide a substantial number of handpumps to the GOSL. Instead of accepting GIT test results, they are purchasing ten (10) deep well pumps for a 6-9 month field test. Had GIt been able to provide hard data on its tests, this repeat test might have been avoided. A similar situation appears to be developing with the Danish and Finnish handpump efforts. Thus, it appears that the USAID effort had little impact on the decision-making process in the other programs.

### 3.4.3 Should an RLMLM Type Handpump Program Be Considered Further by GOSL or USAID/Sri Lanka?

The key elements in deciding whether a USAID Mission should consider an RLMLM type handpump program, are: 1) by whom and in what numbers are other types of handpumps currently being used in the country? 2) what is the country's ability to fabricate handpumps? and 3) is there a major national program for purchasing handpumps?

In developing a response to this, USAID should not try to introduce the AID pump concept unless they can show it has a clear advantage (price, maintenance, cost, etc.) and unless they are willing to provide loan funds for the purchase and installation of these pumps as well as the development of the needed maintenance schemes.

After examining the conditions in Sri Lanka (few existing handpumps, the limited number of other agencies working in this sector, a strong local manufacturing capability, widespread local repair shops and high level government interest) it appears that Sri Lanka could be a prime candidate for an AID type handpump water supply program. It appears that the conditions are favorable to have USAID/Sri Lanka consider financing such a program.

### 3.4.4 Was the Exercise Cost Effective?

It is estimated that this effort cost about US $236,000 for the GIT input and pump purchase. It was not possible to calculate the cost of the GOSL input. Therefore, the answer to the above question depends on whether any orders are received for additional SOMASIRI pumps. At the present time, there have been several "expressions of interest" but no solid orders, only the GTZ's purchase of 10 deep well pumps for testing.

Therefore, it must be concluded that while the program has many positive spinoffs, it is too early to make a positive statement regarding its cost effectiveness.

### 3.4.5 What Efforts Are Needed for Future Implementation?

As one examines the next steps in the technology transfer process, it is clear that in order for the SOMASIRI handpumps to come into full-scale production either the GOSL or USAID/Sri Lanka will have to purchase and install a substantial number throughout the country. Or, in other words, one or more official agencies will need to serve as the purchaser of these pumps until sufficient numbers are installed to establish their reputation and thus create their own demand.

Unless this step is taken in the near future, two things will happen: 1) the experience and manufacturing capability gained to date will be lost through lack of use; and 2) as the Mission's effort did not demonstrate a clear superiority in the maintenance areas over other handpumps being used in the country (it proved it to be less expensive and locally manufacturable), other agencies will continue to provide pumps with which they have experience (for example, UNICEF and its MKII unit) and the potential opportunity will soon be lost.

### 3.4.6 What Should Be the Next Step for USAID/Sri Lanka?

An immature technology is one which has to have a series of technical adjustments during field testing. In the case of the SOMASIRI pump, the flapper foot valve appears to be a part that is still in evolution. (GIT staff spoke of the desirability of having a poppet valve.) While the reason for field testing a technology is to learn how it will operate in actual practice, one must be careful not to field test too soon or the user gets the impression that one is "tinkering" and that the device is still experimental.

In this regard, one must be aware that any technical transfer concept has two elements: hardware and software. In the case of the USAID handpump concept, the hardware element has been reasonably well developed but the software element has not. The Sri Lanka test program has done little to advance the needed understanding in this area. Therefore, it can be said that the GIT effort demonstrated the manufacturing mechanical aspect of this handpump concept. The managerial (i.e., spare parts, logistics, maintainability, lubrication alternatives, etc.) were less clearly established.

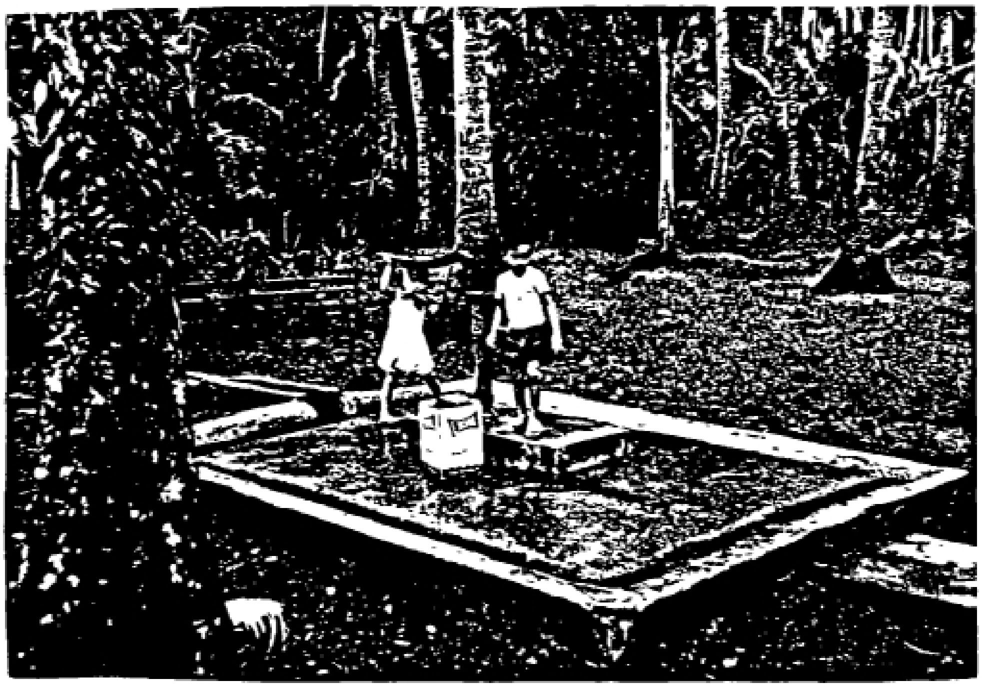
In view of the fact that handpump programs are a relatively simple physical device (the pump) supported by an extensive and often complex management system, more attention will need to be paid to the management requirements of this pump as the GOSL moves to install handpumps on the 20,000 to 30,000 well sites that need to be upgraded from open to covered wells.

Therefore, it must be concluded that in Sri Lanka the USAID handpump concept must be rebalanced (i.e., the software better understood) before the GOSL enters into a large-scale operational program. Such advice should be sought from experts who are knowledgeable in the establishment and operation of program infrastructure (i.e. software). They will need to advise on how to finance and implement the following program elements.

- Maintenance
- Promotion
- Well drilling/site development
- Spare parts
- User education

Chapter 4

# PHILIPPINES HANDPUMP PROGRAM



Typical handpump installation in the rural areas of the Philippines

## 4.1 Background

### 4.1.1 History

In March of 1979, USAID/Philippines had a survey taken of in-country manufacturing capabilities for the production of the AID type handpumps (Ref. 4.1). As a result, three foundries were identifies as being capable of locally producing the AID pump at an acceptable price. In June of 1981, WASH was requested by S&T/H/WS to provide technical assistance to USAID/Philippines in the areas of "handpump development and reproduction" and "well design and construction." The Georgia Institute of Technology (GIT) was subcontracted by WASH to provide the technical staff to assist USAID/Philippines and the Barangay Water Program (BWP) of the Government of the Philippines (GOP) in these areas.

Between July 1981 and August 1982, one manufacturer was identified and 250 AID type handpumps, now called the Barangay Water Program (BWP) handpump, plus 400 deep well cylinders were manufactured and delivered to USAID/ Philippines. Of these, ten shallow well pumps were installed by the BWP and have been monitored by USAID/Philippines staff for the last nine months. The remainder are in a USAID warehouse. GIT staff and a subcontractor developed manuals on handpump maintenance and well related hydrogeology. These documents were then used as the course manual in a one-week short course for BWP local Government Units (LGU) staffs.

### 4.1.2 Efforts To Date

To date only the first five phases of the technical transfer process have been attempted. (See Chapter One for description of technical transfer phases.)

Phases 1 and 2 were carried on by S&T/H/WS by providing USAID/ Philippines with documents and working models and through discussions. While the writer has been unable to find any documentation clearly outlining the activities of these phases, it appears that this effort was directed toward having the USAID financed Barangay Water Program serve as the vehicle for the introduction of the AID handpump concept.

The activities for Phases 3, 4 and 5 are much more specific even though the original scope of work (Order of Technical Direction No. 40) was modified several times as the effort progressed. The work that finally resulted was carried forward as two related but separate components (i.e., handpump work and well design and construction).

The following are the stated activities for Phases 3 through 5 for each of the two components:

Component #1 - Handpump Development and Reproduction[1]

A. Selection of a suitable manufacturer for reproduction of 250 AID handpumps.

B. Selection of suitable manufacturers and suppliers for the reproduction of 400 improved 2-inch diameter cylinders for deep-well handpumps.

C. Provision of technical assistance to both of the above suppliers on the various aspects of handpump and cylinder reproduction, including the provision of drawings and patterns, replication of prototype handpumps, and the provision of continuous technical assistance through final acceptance by the WASH contractor of the 250 AID handpumps and the 400 cylinders.

D. Installation and training of locals in installation of up to 20 of the handpump systems in sites agreeable to and with the approval of AID mission liaison officer (Mr. Charles Brady).

E. Preparation of a section in the BWP Operations Manual entitled "Handpump" covering handpump installation, maintenance and repair.

F. Participation as a principal resource speaker in a four-day training seminar for local government waterworks engineers and technicians, the BWP architectural and engineering firm and the USAID engineering personnel. The seminar would utilize the materials prepared in item "D" of the scope of work as the basis for the curriculum and would cover handpump installation, maintenance, and repair.

Component #2 - Well Design and Construction2

A. Familiarization of Barangay Water Program (BWP) well requirements based on a survey of existing BWP projects. Subcontractor shall prepare a comprehensive survey of Level 1 (handpump activities) programs in the Philippines which are currently being implemented unsatisfactorily by a number of both central and local Government of Philippines (GOP) agencies. Thus, the review should include an investigation of the procedures, approaches, and outputs of each program.

B. Survey of Philippines well driller's capacity (equipment, techniques, personnel, training, etc.). Subcontractor shall prepare a survey which will include a thorough look at both the public and private sectors and will require coordination with various GOP agencies and private companies, field visitation trips, data collection, and data analysis.

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1 Component #1 as it appears here is taken from the Telex MANILA 1775, 22 Jan 81, as amended by OTD 40.

2 "Scope of Work" from Subcontract for Consulting Services Under GIT Project No. A2957-002 Between Georgia Institute of Technology and Bennett and Gass, Inc., Jan.21, 1982, Exhibit A.

C. Provision of technical assistance to various Manila and/or Cebu based suppliers and manufacturers of plastic well casing and well screen. This technical assistance should focus on one particular supplier, Neltex, to evaluate its present production of both casing and screen in comparison with potential quantity and quality of competitors.

D. Preparation of a section for the BWP water operation manual entitled "Well Design and Construction." This will include preparation of criteria for site selection and well development standards and specifications based on knowledge gained while doing items 1, 2, and 3, and in consultation with BWP hydrogeologists. A step-by-step manual will be prepared by subcontractor for site selection and source development taking into account existing data bases as well as driller capabilities, agency financial capabilities, and local support industries, and will provide procedures for such items as well perforation, casing, screening, disinfecting, well recharging and rehabilitation, water quality testing, and water quality control.

E. Preparation for classroom and field practicum presentations of a seminar for local government waterworks technicians and engineers, to include printing of well development manuals and guides, curriculum, and training materials.

F. Participation as a principal resource speaker in a seminar for waterworks technicians, local engineers, and USAID technical personnel on well design and construction. This aspect will include training in well site selection, materials, design standards, drilling, casing, gravel packing, grouting, testing and disinfecting wells. The seminar will be one week in duration and will be held jointly with a member of the research faculty of the Georgia Institute of Technology who will cover handpump nomenclature, installation, maintenance and repair.

### 4.1.3 Modifications of the Original Scope of Work

Component #1, Paragraph B

Due to the unexpectedly large amount of research and design that went into producing the improved two-inch cylinders and to the fact that the manufacturer was heavily involved in the design process, it was expedient to produce the deep-well cylinders at the same factory as the pumps.

Component #1, Paragraph B and C

The number of cylinders to be produced was changed from 300 two-inch deep well cylinders at the request of USAID/Manila because the majority of existing well casings are less than the four-inch diameter required for three-inch cylinders.

Component #1, Paragraph F

The five-day seminar was reduced to four based on the anticipated amount of time required to effectively present the seminar material.

Component #2, Paragraph F

The seminar participants included waterworks engineers because they site, design, and supervise the construction of the wells. It would not have been necessary to invite the engineers had the seminar concerned handpumps only.

### 4.1.4 Approach Used by GIT and USAID/Philippines

A detailed description of what was done for each task, and the results obtained, can be obtained from WASH Field Report No. 54 entitled "Philippine Handpump Program (Barangay Water Program)" dated August 1982 (pages 7 through 35).

From this one can see that the "hardware" elements were given the greatest attention. The software elements tended to be postponed for Phase 5 (field testing) which really never was fully implemented (only 10 of 250 pumps were installed in the field). It should be noted that the OTD never called for a full scale field testing program.

## 4.2 Discussion of Visits

### 4.2.1 To the Factory

It was found that the foundry which had made the 250 pumps and the 400 deep-well cylinder (Tri-Star) was no longer in business. They had closed their doors because of business reverses.

Contact was made with the Tri-Star engineer who had been responsible for the pump production (Engineer Gabra). It was found that he was now Vice President for Technical Operations at the Philippine Valve Mfg. Co. which was a subsidiary of Luzon Foundries.

The Philippines Valve Co. was visited and found to be a modern, well-equipped plant for producing cast iron (C.I.) gate valves, fittings, saddle clamps and other castings. It was quickly determined that using the knowledge of Engineer Gabra, these factories could, if the financial incentives were right, produce a handpump equal to (or better than) that produced by Tri-Star. The General Manager stated that he would be interested in making handpumps if the price were in the range of US $100.

Inquiries into foundry and machining capacity of other factories in Manila show that pump production should not be a major problem in the Philippines for any program that USAID/ Philippines would care to fund. This is confirmed by Yniquez in his paper entitled "Handpumps in the Philippines Rural Water Supply Program (see Reference 4.2) in which he identifies the nine Philippines handpump manufacturers (see Table 4.1) from previous Rural Water Development Corporation (RWDC) invitations for bids. He also indicates that there are "other manufacturers that can provide the requirements of government's handpump program that are not in the list" (Reference 4.2).

Table 4.1

List of Philippine Handpump Manufacturers
(Based on Previous RWDC Sanitations for Bids)

## CAST IRON PUMPS

1. Metals Engineering Resources Corporation (METERCOR)
   E. Magalona Sr. St., Mandaluyong, MM, Philippines

2. Philippine Iron Manufacturing Co., Inc. (PHILIMCO)
   249 J. Teodoro St., Grace park, Calcocan City, Philippines

3. Seacom Industrial Corporation
   30 Scout Tuason St., Diliman, Quezon City, Philippines

4. Yamakikai Manufacturing
   131 Atlas Road, Bo. San Bartolane, Novaliches, Quezon City, Philippines

## DEEPWELL HANDPUMP ASSEMBLY

1. Malanday Machinery and Manufacturing Corporation
   15 Gen. MacArthur Highway, Sumilang Subdivision, Dalandanan, Valenzuela, MM, Philippines

2. Metals Engineering Resources Corporation (METERCOR)
   E. Magalona Sr. St., Mandaluyong, MM, Philippines

3. Unno Steel Products Co.
   139 Joy St., Grace Village, Quezon City, Philippines

4. Atlantic Industrial Sales Corporation
   97 9th Avenue, Caloocan City, Philippines

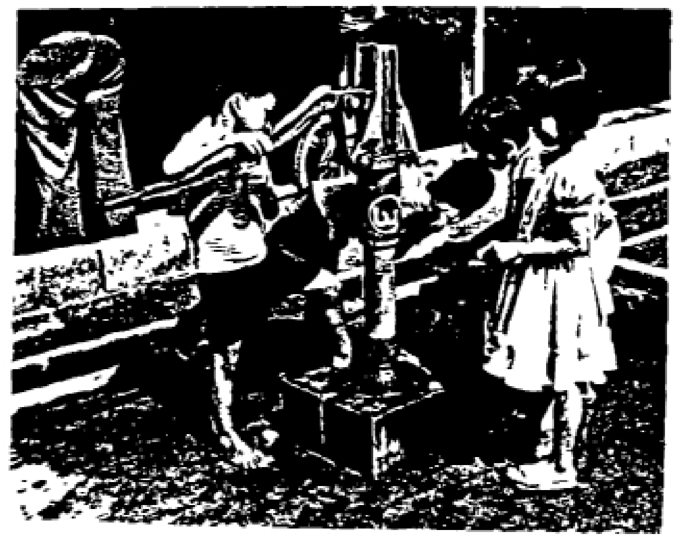
5. Makati Machinery and Equipment Co., Inc.
   1142 Pres. E. Quirino Avenue, Paco, Manila, Philippines

Source: Reference 4.2

Figure 4.1

Photos of Different Pumps Being Used
in the Rural Areas of the Philippines

Typical BWP type installation



Typical "Traditional" type installation

Typical "Jetomatic" type installation

It was confirmed that several local manufacturers were currently producing a "jetomatic" type pump which sell for about US $50 and is widely distributed throughout the country. Although the handpump is much less robust than the BWP handpump, spare parts are inexpensive and are reported to be readily available throughout the rural areas.

### 4.2.2 Field Visits

It was found that of the 250 pumps produced, only ten had been installed. The others were currently being distributed to various provinces which had requested them and were to be installed sometime in the future in a series of different GOP programs. Other than the ten reported above, none had been installed. The deep well cylinders were also in storage.

The pumps visited had been installed about nine months. They had been visited quarterly by Mr. O. Basa of USAID staff. His reports and the field visits show that the handpumps were robust, accepted by the users, and could be easily maintained with only minor assistance and input by the community.

In addition, observation visits were made to several sites where "jetomatic" and "traditional" pumps had been installed. The findings are reported in Table 4.2 (also see Figure 4.1).

The fact that each of the BWP pumps provided water after only one or two strokes, coupled with a lack of foot valve failures, bears testimony to the soundness of the design modifications introduced. (A poppet valve was used vs. a flapper for the foot valve.)

While the ten pumps are a very limited sample, the field test did show the following:

a) That the pump was accepted and well thought of by the users. In several cases this was evidently visible in the caretaken attitude and knowledge of the site (see Figure 4.2).

b) The pump could be lubricated with material other than grease. The coconut oil used to lubricate the only deepwell pump was the best lubricant observed. Being locally available, it was applied generously and regularly. Being of a thin viscosity, it penetrated the bearing surface between the pin and the bushing whereas the grease did not. Thus, the pump receiving coconut oil was lubricated throughout all bearing surfaces whereas, very often when grease was used, only external bearing surfaces were found to be lubricated.

c) That when the well covering had adequate slope to a drain that ensured that no water stood on the slab, the surface did not become slick even when heavily used for laundry purposes.

Table 4.2

| Site | | No. of Pumps | | Remarks |
|---|---|---|---|---|
| Name | Date Installed | At the Site | Operational | |
| San Carlos/San Luis | 11/81 | 1(SW) | 1 | Pump well lubed, serves approx. 200 people, foot poppet valve works well, 16 strokes to fill 5 gal. can, maintenance done by Provencial staff. |
| Lanary/Candaba | 11/81 | 1(SW) | 1 | Well lubed, base very slick, replaced a Liberty pump (#664 dated J-1-11 '54), pumps sand and handle has a backlash, pump has heavy usage, well nearby river and was drilled by hand, maintenance by Provencial staff. |
| Santa Monica/ Santa Rita | 11/81 | 1(SW) | 1 (had parts missing) | Located in courtyard of an elementary school, was missing both sliding blocks, pin had been replaced with a bolt, four pitcher pumps and elevated task on school ground, neighbors use well for water, pump much used and "appreciated" but not maintained by users. |
| Lubas/Santa Catalina | 11/81 | 1(SW) | 1 | Well lubed and maintained by a neighbor who was very proud of "his" pump, very heavily used as it is in a cluster of 40/50 houses, slab well sloped and drains well, slab not slick. |
| Well at school | 11/81 | 1(SW) | 1 (damage by vandal) | This pump is no longer in service and will be moved. |
| Ilayang-Tamin | 11/81 | 1(DW) left is ± 70' | 1 | This is excellent example of a well lubed pump (they use coconut oil), serves ±20 families and an elementary school, in excellent condition, maintained by user, pumps sand. |
| Traditional pump (See photos in Figure 4.1) | ± 5 yrs* | - | - | Has roller bearings at the pivot point which have been exposed to weathering approx. 1 year and no sign of wear. Program has 3 to 5 years successful experience with roller bearing exposed to the weather. Uses wooden handle and concrete support post, no lube required, cylinder replacement very easy. |
| Wilson Jetomatic Pump (See photo in Figure 4.1) | * | | | Hard to pump, poor quality, poor installation (needs apedestal), low lift, has been installed by the 1000s in the Philippines by Rural Water Program free of cost to users, parts readily available in local stores. |

SW = Shallow Well model
* Typical of many installed throughout the Philippines

In the course of the field visits, several "traditional" and jetamatic handpumps (see photos in Figure 4.1) site were observed for comparison purposes. It became clear that the "traditional" pump was robust and widely distributed and had a proven design that used locally available parts and which could be constructed for a price near to the BWP pump. Whereas, while the jetomatic pump was hard to use and of poor quality, it was about half the cost of the BWP pump, was in widespread use, and parts were readily available on the local market.

The field test points up the fact that in order for the BWP handpump to become a competitor of the jetamatic and/or the traditional, it would have to have strong government support to overcome the widespread distribution of the lesser quality, though cheaper, jetomatic. It appears that in order for the BWP pump to overcome this price/spare parts availability USAID would have to support any effort to enter the market. This could be done by providing funding for a rural water program which would require the installation of several thousand handpumps of the BWP type, along with assistance to develop the necessary operation and maintenance infrastructures.

#### 4.2.3 Government Officials and Documents

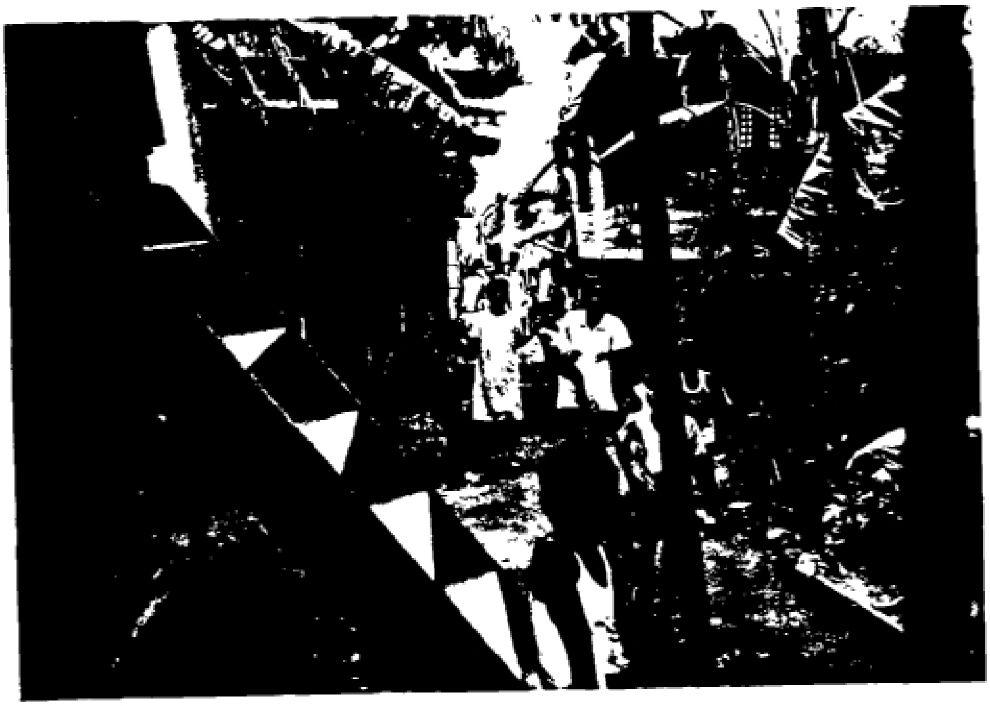
A review of a draft of the "Rural Water Supply and Sanitation Master Plan", developed by the Ministry of Public Works and Highways, Ministry of Health and Ministry of Human Settlements, shows that there will be about 55,000 shallow wells and 25,000 deep wells for which handpumps will be needed by 1990. The Plan established the policies and strategies to be followed by the:

- National Water Resources Council (NWRC)
- Ministry of Public Works and Highways (MPWH)
- Rural Water Development Corporation (RWDC)
- Metropolitan Waterworks and Sewerage Systems (MWSS)
- Local Water Utilities Administration (LWDC)

Under this Plan to RWDC, "with the MPWH as its principal implementing arm for engineering and construction, will be responsible for the rural sector and other areas not covered by MWSS and the LWUA." It goes on to indicate that "since the MWSS and the LWUA... are at present, and will still be in the next few years, heavily preoccupied with the water supply needs of the (concentrated) population and other urbanized areas in their jurisdictions, it is proposed that as an interim arrangement over the coming five years or so, the RWDC and the MPWH will handle the larger parts of the water supply program for the urban fringes and rural areas within the MWSS and LWUA territories..." It goes on to indicate that "the involvement of the RWDC and the MPWH in these areas will gradually diminish over time as the MWSS and the LWUA expand their developmental activities towards the rural areas under their responsibility." While the Barangay Water Program (BWP) of the Ministry of Local Government (MLG) is mentioned in the Plan, its role is not clarified, even though the MLG was a member of the Planning and Implementation Inter-Agency Committee along with MPWH, RWDC, LWUA, MON and NWRC.

Figure 4.2

Typical High Use Pumpsite in Philippines



During visits to the BWP offices, it was determined that while program officials were "interested" in the handpump, they saw their program as basically one to provide piped systems to villages of approximately 10,000 (see Figure 4.3 for typical system) because it was "national policy" not to charge for handpump use, but allowed operating costs from piped systems to be recovered. Thus the handpump program was seen as a potential financial drain on BWP. Therefore, one could say that while there was BWP "interest" in a handpump program, there was no firm commitment to the BWP pump. A similar attitude was found at the provincial level of the Ministry of Local Government even though some individual engineers were committed to the current field testing program.

In reviewing the above mentioned Master Plan, one finds that 57 percent of the proposed Level I (Point sources) systems will be 1 1/2 to 2" shallow well handpumps, 6 percent will be 4" shallow well (these will eventually be upgraded to Level II system), 14 percent will be 1 1/2 to 2" deepwell, 17 percent will be 2" deepwell (these will be eventually upgraded to Level II), 3 percent of the improvements will be by spring development, 1 percent will be by infiltration galleries and 3 percent by others. A summary of the Level I targets for 1982-2000 can be seen in Table 4.3.

The cost of this effort is shown in Table 4.4. It is interesting to note that although about 60 percent of the pumps will be of the shallow well type, about seven times as much will be spent on the higher cost deep well units.

The above data indicate that the GOP plans a substantial handpump effort in the coming years. It is estimated that at US $100 per pump, the handpump "market" could be on the order of five to six million dollars during the next three to five years.

Other than the RWDC program to distribute approximately 16,000 jetomatic type pumps and that of using an unspecified number of traditional pumps for deep well sites, no mention was made in the above mentioned plan of how the pumps called for in Table 4.2 would be provided. USAID contacts with other agencies such as UNICEF did not reveal any large scale handpump programs being sponsored by them.

## 4.3 Lessons to Be Learned for the Future

### 4.3.1 Was the Program Design Adequate?

Under Phases 1 and 2, the AID Office of Health served as the catalyst for having USAID/Philippines Mission incorporate the handpump into the Barangay Water Program. It appears they were most successful in transfering the hardware components of the program. They were much less successful in developing the understanding required for developing the software systems for spare parts logistics, local maintenance schemes, etc.

Figure 4.3

Barangay Type Water Systems

Pump station and office for local piped water system

Typical standpipe on a Barangay system

Table 4.3

Targets for Rural Water Supply Projects

| Level of Service | Stage I (1982-85) | Stage II (1986-1990) | Stage III (1991-2000) | Total (1982-2000) |
|---|---|---|---|---|
| Level I (Point Supply) | | | | |
| - Construction | | | | |
| Shallow wells | 29,500 | 34,000 | 45,100 | 108,600 |
| Deep wells | 14,300 | 10,700 | 18,000 | 43,000 |
| Spring box | 1,315 | 470 | 2,700 | 4,485 |
| Infiltration/ Rain collection | 175 | 465 | 2,085 | 2,725 |
| | | | | 158,810 |
| - Rehabilitation | | | | |
| Wells | 10,200 | 4,500 | 3,000 | 17,700 |

Table 4.4

Investment Requirements for Level I (Rural Water)
(Millions of Pesos)

| Category | Shallow Well | Deep Well | Spring Development | Others | Total |
|---|---|---|---|---|---|
| 1. Drilling/development/ construction of point sources | 77.6 | 35.18 | 188.5 | 35.3 | 653.2 |
| 2. Level I | | | | | |
| Construction | 52.7 | 223.4 | 56.3 | 8.8 | 341.2 |
| Replacement | 8.3 | 22.3 | 2.9 | - | 33.5 |
| Repair/rehabilitation | 14.0 | 26.0 | 0.8 | - | 40.8 |
| | 75.0 | 271.7 | 60.0 | 8.8 | 415.3 |
| | | | | | 1,068.5 |

In Phase 3 (production) only one manufacturer was developed. In view of the fact they are now out of business, it appears that while this phase met its objectives, it must be considered a limited success as no long-term capability was developed. While the goals of Phase 4 (development of software) were never clearly defined, it must be concluded that the intent of this Phase (to provide a clear understanding of the needed administrative, social, and technical subsystems) was never properly attempted.

Because of the flaws in Phases 1, 3, 4 and the limited scale of Phase 5 (ten pumps), few conclusions can be drawn to assist in designing future actions. In summary, it must be concluded that the overall program design was not adequate for the desired results.

Examining the major elements of this effort, the following comments can be developed:

Pump Production

The design of this phase could be considered adequate as it resulted in the production of 250 quality pumps and deep well cylinders. But it lacked follow-through to see that the pumps and cylinders were installed in the field for testing and program promotion. The documentation of the Phase into instructions sheets and guidelines, is lacking.

In the future, more time should be allotted to document what should be done in order to allow the Mission to develop new pump manufacturers in the event the GOP decided to go to a large scale program.

Field Test

The field test called for by the Mission was too small in number of pumps and types of conditions to be of any value. While the records maintained by USAID/Philippines are good, they are very limited. They allowed a good appreciation of the problems encountered but contain no data on frequency of repair and/or cost.

As no comparison testing was done, no comparisons could be made between different locally produced handpumps. (For example, do they need different maintenance systems? What are the life cycle costs for the total system, etc.?)

Future Implementation

The extremely limited field test reduced chances for using the GIT effort to promote the future use of the BWP handpump.

4.3.2 Can the Philippines Effort Be Considered Cost Effective?

Until one of more agencies place orders for BWP pumps, the GIT effort should not be considered as cost-effective. To be in a position to do this when the GOP is ready, the program must summarize its experience into the following set of documents:

- Guidelines for evaluating a handpump manufacturer

- A "bidding package" that would contain:

    - Typical call for bids
    - Sample contracts for production and delivery
    - Lastest technical specifications
    - Fabrication drawings
    - A simple pump

- Guidelines on how to assess bids

- Procedures for inspection and acceptance of locally manufactured pump

- Recommendations for quality control procedures at the factory and at the well site

- Guidelines for technical and organizational schemes needed to provide long-term operation and maintenance of this pump.

## 4.4 Conclusions From the Visit

### 4.4.1 What Are the Residual Effect at the National Level?

The following were found to be the residual effects of the USAID/GIT effort:

a) The Mission is now at the point where it has demonstrated that there are a number of foundries in the Philippines that are capable of producing the USAID type (BWP) handpump. Even though the original manufacturer (Tristar) was no longer in business, it was found that the knowledge of pump manufacture remained in the Philippines through the people trained at the Tristar plant.

b) Because of the small number of pumps installed (i.e. ten), only a limited awareness of the possibilities of the BWP pump was developed among the various government agencies and/or officials.

c) Little awareness regarding program needs for long-term operation and maintenance, spare parts logistics and/or training was developed because of the small field testing program.

### 4.4.2 What Are the Residual Effect at the Official Level?

Involving the various agencies, institutions and officials, is one of the ways in which knowledge of the needs for any handpump effort is spread. To determine the effectiveness of the GIT effort, the following agencies were contacted:

Barangay Water Program (BWP)

This USAID approved agency sees its principal role as that of providing drinking water to the small villages through public fountains (Level II). While the program officials were aware of the handpump effort (they indicated they found it "useful), they were unwilling to put much in the way of staff time or resources into the monitoring of the field testing.

USAID/Philippines

The monitoring of the field test was being supervised by a USAID/Philippines staff officer (Mr. Oscar Basa) who was very knowledgeable about and interested in the handpump effort as one of the several phases of the Barangay Water Project. The second stage of BWP which is to be funded in 1984 does not include any large scale handpump effort.

Rural Water Development Corporation (RWDC)

While this agency carries on a major handpump distribution program, it was not visited due to limitations of time. But, in previous visits by GIT the RWDC had indicated that they plan to continue distributing jetomatic pumps for point source supplies. While this agency seems to be a major potential market, GIT and USAID/Philippines seem to have done little to develop an awareness of the BWP handpump in this agency.

Manila Waterworks and Sewerage system (MWSS)

This agency is responsible for the drinking water and sewerage systems of Manila. Conversations with this agency uncovered the fact that they had need of a limited number of handpumps to provide water to rural populations along several of their major transmission mains. These would be high-visibility low-use pumps.

Local Water Utility Administration

While this agency seeks to provide medium sized cities with piped water supplies on a commercial basis in the future it could be interested in the BWP handpump. At the present they only had a vague knowledge of the USAID/BWP effort.

### 4.4.3 Should a BWP Type Handpump Program Be Considered further by GOP or USAID/Philippines?

In attempting to address this question, one finds that because Phase 1, 2 and 3 efforts concentrated on only one manufacturer, there is currently no in-place manufacturing capacity. Further, the lack of documentation on how to go about developing this capability will greatly handicap future efforts to produce the BWP handpump.

The lack of hard data concerning frequency of repair, types of maintenance schemes and cost of repairs eliminate any life-cycle casting exercises that might be used to show the BWP's superiority to the jetomatic.

Without the above data it does not appear to be a very productive exercise for USAID/Philippines to continue trying to manufacture the BWP handpump in the Philippines. Further, the efforts in the Philippines clearly show the need for an adequate sized field test in order to establish the required "track record" in the local market. It is clear that if the pump is to be accepted by the Philippines it must be "sponsored" by one or more agencies until there are sufficient numbers of pumps in the field to encourage local manufacture of spare parts and replacement pumps. Having the BWP handpumps adopted as the standard for a series of major programs (i.e. PUSH, BICOL and/or BWP) will do much to ensure the final success of the effort.

### 4.4.4 Was the Exercise Cost Effective?

It is estimated that the GIT input cost about US $ 86,000. No estimate for Phase 1 and 2 inputs could be developed. While there is considerable market for handpumps in the Philippines, no agency has expressed interest in purchasing large quantities of the BWP handpump.

Therefore, while there are many positive spin-offs of the program no positive statement can be made regarding its cost effectiveness at this time.

### 4.4.5 What Efforts Are Needed for Future Implementation?

In order to assist the Mission to capitalize on the investment they have already made, the documentation called for in Item 4.3.2 should be developed. Consideration should also be given to having meetings and/or workshops with GOP agencies to: 1) assist them in understanding the concept behind the BWP handpump (i.e. local manufacture low maintenance, low-cost, robust, etc.), and 2) to develop a joint strategy for using the BWP handpump in the upcoming rural water supply program.

### 4.4.6 What Should the Next Steps Be for USAID/Philippines?

In order to preserve the experience gained by the efforts to date, the Mission should have the documentation indicated in Section 4.3.2 developed as quickly as possible. This material will serve as the basis for identifying and assisting future manufacturers if it is decided to proceed further with the BWP concept.

In support of the documentation described above it is suggested that the Mission request advice in the software (i.e. management, administration schemes) needed to support a large-scale handpump effort. To gather data for this the Mission should consider installing and monitoring BWP pumps for about a year. During this time special attention should be given to establishing life-cycle data for the various management schemes needed for the major handpump programs (i.e. BWP, jetomatic, and traditional). At the end of the period the Mission should sponsor a workshop for disseminating the results.

# Chapter 5

# HONDURAS

## 5.1 Background

### 5.1.1 History

The Government of Honduras (GOH) included in its 1979 to 1983 Five Year Plan a series of activities to improve the drinking water supplies and sanitation facilities of those living in the rural areas. To extend this to as many people as possible, on 31 March 1980 USAID/Honduras and the GOH signed a loan agreement to undertake the Rural Water and Sanitation Project (PRASAR).

The project sought to improve the health status and practices of the rural inhabitants in five northwest departments of Honduras. Financing for the project was from three sources: (1) a $10,000,000 loan from USAID/Honduras plus a $500,000 grant, (2) $3,778,000 in counterpart funds from the GOH, and (3) $3,916,000 in cash and kind from those to be benefitted. The project was originally scheduled to be completed by September 1983.

The project called for the construction of 180 water supply systems, 21 sewerage systems, and 3,000 wells with handpumps, rehabilitation of 50 water supply systems and 800 wells, and the installation of 18,000 pit privies and 14,000 Colombia-type water seal latrines as well as 25 experimental windmills. The project also included strong programs of health education, training, and promotion to ensure user participation in the installation, operation and maintenance of the systems.

The Project Paper (PP) envisioned that PRASAR would install 3,000 handpumps on existing and newly dug, drilled, or driven wells. While the project paper had called for the purchase of US-made Dempster handpumps, USAID/Honduras decided that locally-manufactured pumps should also be considered for the project. Thus, the signed loan agreement included a provision under which USAID/Honduras would try to develop the in-country capability to manufacture a reliable, low-cost, low-maintenance handpump such as the AID-type handpump.

In order not to cause any delays, PRASAR used loan funds to order 1,000 Dempster handpumps to be used while waiting for the local pump to be developed. At the same time PRASAR requested technical assistance from USAID/Honduras to develop a local handpump manufacturing capability and conduct a testing program to compare the Dempster, the AID-type, a local type (SANPAR), and, later, the Moyno handpump. The testing would allow the GOH to have objective criteria on which to base future orders for handpumps. WASH, through the AID Office of Health, was requested to carry out this technical assistance effort. They in turn contracted Georgia Institute of Technology to do the field work.

The work was done in two phases. The scope of work for the first phase was as follows:

A. Identify a suitable manufacturer in Honduras and provide technical assistance for producing 150 AID-type handpumps and 200 feet of roboscreen (a plastic well screen).

B. Purchase the 150 AID-type pumps and 200 feet of roboscreen produced in Item A as well as 35 Dempster model 210 pumps, 50 SANPAR pumps and 10 Moyno deep well pumps, all pumps to have plunger rods, drop pipes, and expendable supplies.

C. Assist the GOH (PRASAR) identify test sites that are accessible year-round and clustered to facilitate monitoring.

D. Inspect, test, and accept the AID-type pumps and roboscreen produced in Item B.

The second phase was to provide technical assistance to MOH technicians and engineers in the properly installation of the various pumps and screen. This included training Ministry of Health (MOH) technicians that PRASAR was using as water technicians in proper water sanitation techniques including pump installation, testing and disinfection. The second stage was also to provide a monitoring and evaluation program of the comparative test effort so that information could be fed back to the MOH in such a manner that they could use it in the ultimate determination of which handpump would be used in the PRASAR project.

The second phase (OTD-85) was started in February of 1982 and was still going on at the time of the visit. Figure 5.1 shows the pump test sites.

By early 1983 the field work on these two phases had been conducted by Georgia Institute of Technology so that at the time of the visit the basic purposes of the effort had been achieved. It was found that WASH had assisted the Mission and the GOH to:

- Develop an in-country capacity to produce AID-type handpumps and roboscreens.

- Conduct a comparative testing program so that GOH would have the information they needed to select the most appropriate handpump when they place their second order for the PRASAR Project.

### 5.1.2 Efforts to Date

To date only the first five phases of the technology transfer process have been attempted in Honduras. For discussion of the process see Chapter One.

Phases One and Two were conducted by S&T/H/WS Washington through consultant visits, the provision of materials, and working with the Mission to identify the needs of the GOH as they attempted to provide adequate quantities of safe water and sanitation to those living in the small villages and depressed areas. Phases Three, Four and Five carried out by WASH and Georgia Tech in close coordination with the Mission. Because Phase Five is not yet complete, no decisions have been made regarding how or if the other phases will be continued.

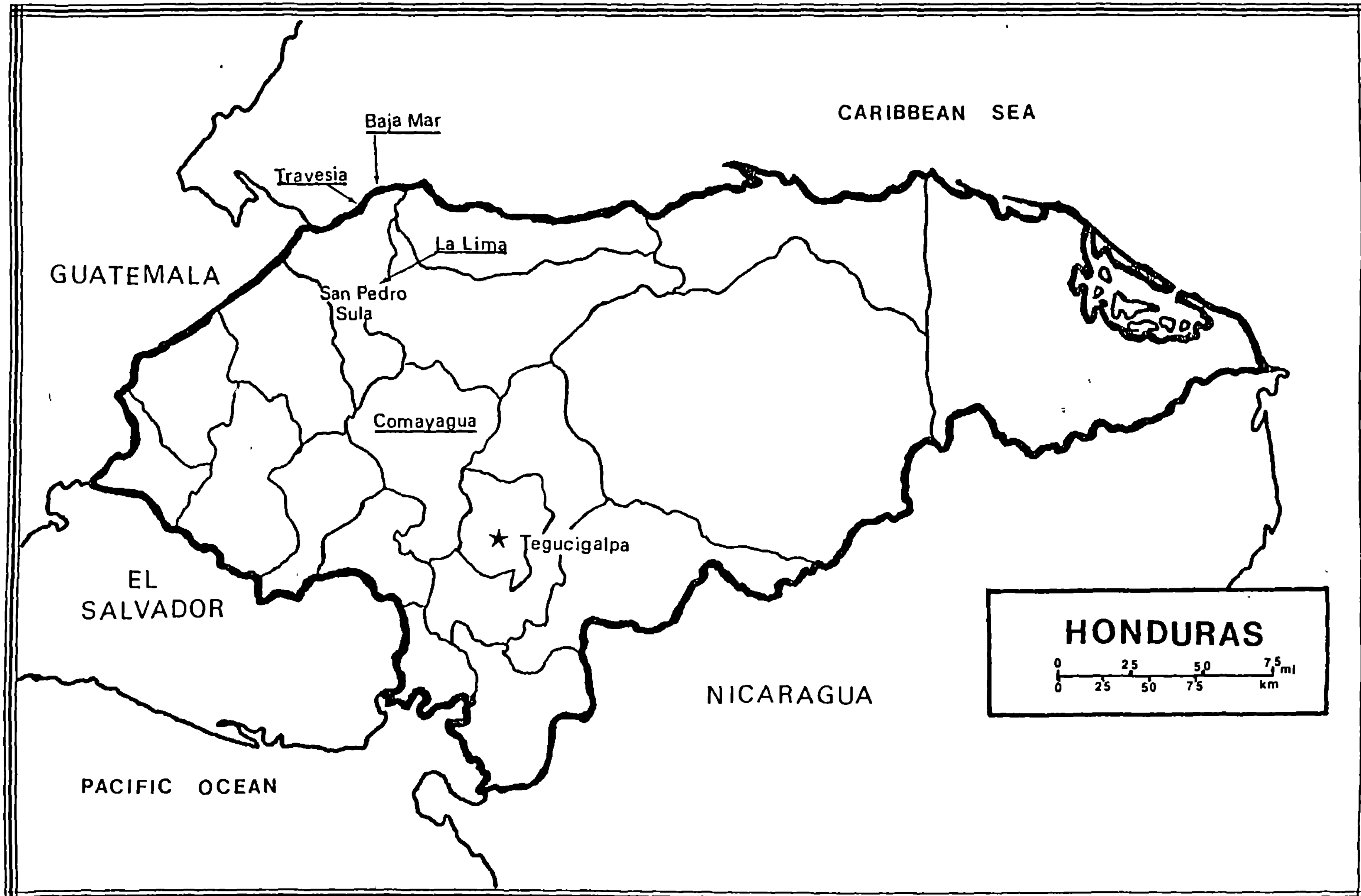



Figure 5.1: Map of Honduras Showing Pump Test Sites

The activities of Phases One through Five were basically the same as those carried out in Sri Lanka (See Section 3.1.2 above). Chapter 3 of the final report for OTD-29 describes the activities of these phases.

During Phases Four and Five Georgia Tech documented the criteria to be followed in judging pump acceptance and casting porosity. In addition, special attention was given to develop jigs and fixtures to ensure interchangeability of parts. The documents, jigs, and fixtures are such that they can be used in programs in other countries.

### 5.1.3 Approaches Used by USAID/Honduras

The approaches that were followed were similar to those used in Sri Lanka (see Chapter 3 Item 3.1.3 of this report and Section 3.2 of Chapter 3 in the final report of OTD-29). The results obtained during the manufacturing effort are described in Chapter 3 of the final report of OTD 29. The problems encountered and the results obtained in the field testing up to late 1982 are summarized in WASH Field Report No. 69.

## 5.2 Discussion of Team Visits

### 5.2.1 The Factory

The present manufacturer (Fundicion y Maquinado--FUNYMAQ) is located in San Pedro Sula and is a combination foundry and machine shop. This firm makes products on request and keeps little or no inventory of its product line. The owner/manager is a knowledgeable businessman but not very aggressive in pushing his products.

FUNYMAQ is a well run foundry and a good machine shop (see Appendix A of the final report of OTD 29 for details of equipment). The owners were willing to make pumps on a mass scale if the market could be demonstrated. The owner, Mr. Ricardo Mata, did not show much interest in expending any funds or efforts to promote and/or develop the handpump market in Honduras.

The visit to the FUNYMAQ foundry of machine shop confirms the Missions and Georgia Tech's finding that a RLMLM handpump can be manufactured in Honduras at a price (approximately US$100) that is competitive with other local and/or imported pumps. The same manufacturer had the capability of providing all of the needed spare parts.

### 5.2.2 Field Visits

A total of 18 sites were visited and 21 pumps, 13 shallow well and eight deep well (see table 5.1).

Field observations showed that the FUNYMAQ pump was well made and locally accepted. Of the AID-type pumps that were observed all but one were operational (89 percent). In the case of the one that did not function, the cylinder was found to be out of the water. This apparently was due to a

TABLE 5.1

Results of Visits to Handpump Sites

| Name | When Installed | Pump Installed | Pump Operational | Remarks |
|---|---|---|---|---|
| La Lima #22* | approximately 6 months ago | 1 (shallow) | 1 | Base bolts covered by concrete. |
| La Lima #9 | approximately 9 months ago | 1 (shallow) | 0 | Base bolts covered by concrete; pump was loose on its base. |
| La Lima #3 | 6 to 9 months ago | 1 (shallow) | 1 | Base bolts cemented over; foot value leaks. |
| La Lima #6 | 6 to 9 months ago | 1 (shallow) | 1 | Well greased but poor drainage. |
| La Lima #14 | March '82 | 1 (shallow) | 1 | Base bolts cemented over, poor lubrication, poor drainage. |
| La Lima | Oct. '82 | 1 (shallow) | 1 | Dempster pump works well poor drainage. |
| La Lima #21 | 6 to 9 months ago | 1 (shallow) | 1 | Well lubricated. |
| Puerto Cortes #15 | 9 months ago | 1 (shallow) | 1 | Needs lubrication, or private property, owner has tried to make several adaptations to make it pump to a tank. |
| Puerto Cortes #2 | May '82 | 1 (shallow) | 1 | Drain used to irrigate a crop. |
| Puerto Cortes D-88 | May '82 | 1 (shallow) | 1 | Well lubricated, good drainage and good installation. |

* At La Lima site handpump water is mostly used for laundry and bathing. Drinking water is carried from a water system approximately three blocks away.

TABLE 5.1 (continued)

Results of Visits to Handpump Sites

| Name | When Installed | Pump Installed | Pump Operational | Remarks |
|---|---|---|---|---|
| Puerto Cortes D-16 | April '82 | 1 (shallow) | 1 | Needs lubrication, good drain, used by promoters as demonstration and user education site. |
| Travecia #23 | May '82 | 1 (shallow) | 1 | Good lubrication, good drainage, poor design of support. |
| Travecia | approximately 3 years ago | 1 (shallow) | 1 | Balser Monitor (Model HD) in good condition. |
| Comayagua #6 | approximately 1 month ago | 1 (deep well) | 1 | Model site used to train installers, 5/10 houses use this site, large step up to pump platform |
| Comayagua #12 | 3 to 4 months ago | 1 (deep well) | 1 | Well lubricated, handle poorly placed, no steps up to platform, good drainage. |
| Comayagua #8 | approximately 6 months ago | 2 (1 AID and 1 Dempster, both deep well) | 1 (Dempster) | AID cylinder was out of the water, both well lubricated, Dempster pumps hand. Approximately 8 meters to water. |
| Comayagua #5 | approximately 6 months ago | 2 (1 AID and 1 SANIPAR (Both deep well) | 2 | Both well lubricated. |
| Comayagua #3 | approximately 6 months ago | 2 (Same as above) | 2 | Both well lubricated. |

lowering of the water level because of a second pump whose cylinder was set lower and the well's very low recharge rate. The people at the well claimed the pump worked when the water level was up. It should be noted that all of the pumps were visited periodically and often maintained by Georgia Tech staff.

Twenty-seven percent of the AID-type pumps that were visited needed lubrication in spite of the fact that program personnel had been advised of the visit two weeks ahead of time.

In evaluating this information it should be noted that the pumps that were visited had been installed only between six to nine months ago and some as recently as three months.

Most sites were well constructed and maintained. Very few cases of poor drainage were observed except in the La Lima area which is very flat and has a very high water table. In a few of the deep well sites it was observed that the stairs leading up to the pump platform were narrow and steep.

In the La Lima, Puerto Cortes and Comayagua languages area it was determined that there had been Ministry of Health promoters who worked with PRASAR and the communities in the promotion, installation, and maintenance phase of the program (see Chapter 3 of WASH Field Report No. 69).

### 5.2.3 Government Officials

Discussions with the PRASAR Director, Eng. Efrain Giron, established that:

A. PRASAR is behind schedule (see Item 3.2 of WASH Field Report No. 69).

B. That the installation and monitoring phase of the project was delayed because of financial problems among the GOH and the MOH promoters.

C. Due to delays by the MOH in providing materials and assistance some of the platforms had just been finished at the time of the visit.

D. PRASAR's understanding of the human, technical, and financial resources that will be needed to carry out the full scale program is limited.

E. The comparative data regarding the three pumps being tested (i.e., AID, Dempster, and SANPAR) had not yet been made available to PRASAR as it was too early to draw conclusions.

### 5.2.4 USAID/Honduras Officials

In meetings with the USAID/Honduras officials it was clear they were aware of the various delays and problems in the handpump effort. The Mission had been supportive of the contractor's efforts and had provided guidance for overcoming most of the more difficult problems. The GOH officials indicated that they were awaiting the result of the comparative test before deciding on any future pump purchases. Their attitude was one of general support but "wait-to- see" final results.

## 5.3 Lessons to be Learned for the Future

### 5.3.1 Was the Program Design Adequate?

As in all of the programs, Phase one and two were conducted by S&T/H/WS in Washington. This served as the catalyst for having the GOH incorporate the AID-type handpump in the PRASAR program. While it is too early to be absolutely sure, it appears that S&T/H/WS was successful in transferring the concepts of the hardware components of the handpump system. It appears they were less successful in transferring the understanding required for developing the software systems.

The Phases Three through Five GIT provided the supervision for, and acted as the technical advisor for, the local production and installation of a limited number of AID-type handpump. The monitoring of these field installations will be carried out by PRASAR.

The results obtained to date tend to indicate that more time should have been spent in designing the software elements and in explaining them to the GOH staff. Future programs should have more software orientation.

Examining the major elements of this program, the following comments can be made:

A. Pump Production - The Design of this segment of the program can be considered adequate as it resulted in the production of 150 high quality handpumps by a local manufacturer. To prevent the problems of a sole source purchase it is suggested that future programs assist several manufacturers.

   It should be noted that this effort developed several jigs and fixtures that will prove very useful for future production and for use in other countries. In future programs gauge kits for inspection should also be developed to help insure quality control and interchangeability of points.

B. Field Testing - As the field testing phase had only been recently started only a few comment can be made: 1) Record keeping for frequency of repair should be incorporated into the testing protocol in as detailed a manner as possible to assist in designing future maintenance and spare parts systems; 2) Realistic cost data should be maintained in such a manner that they can be used for designing program elements in the future; 3) Data on all pumps in the test program should be kept in such a way that comparisons can be made between different makes; and 4) the test program should be used to obtain data on the various management and community participation systems that will be needed to support a full fledged handpump program.

C. Future Implementation - Using the limited cost data that are available it appears that the AID-type handpump is a viable element in the GOH effort to bring water to its dispersed population. in developing any full scale program more attention should be given to insuring that administrative, logistical, maintenance, and user education components are more clearly understood and made a viable part of the program as quickly as possible.

5.3.2 Can the Effort be Considered Cost-Effective?

Until one or more agencies place orders for the handpump, this effort cannot be considered cost-effective.

In order to make the maximum use of this experience GIT should be requested to summarize its experience into the following set of documents:

- A guideline for evaluating handpump manufacturers.
- A "bidders" package that would contain:
  - typical call for bids
  - sample contracts for production and delivery
  - technical specifications reflecting the Honduras experience
  - fabrication drawings
- Guidelines on how to assess bids.
- Procedures for inspection and acceptance of handpumps.
- Guidelines for quality control at the factory and at the well site.
- Guidelines for the technical and managerial systems needed to ensure long-term operation and maintenance of the Honduras handpump.

## 5.4 Conclusions From the Visit

5.4.1 What are the Residual Effects at the National Level?

As the field testing phase of the program has only recently been started it is hard to tell what might be the long-term residual effects of this effort.

5.4.2 What Are the Residual Effects at the Official Level?

While it is still early to tell, conversations held with government officials during the visit indicate a growing awareness of the human and organization needs of a large-scale handpump program. Other than among PRASAR and a few Ministry of Health officials, it appears that there is a limited understanding of the current handpump effort.

5.4.3 Was the Exercise Cost Effective?

It is estimated that the cost of the efforts to data is about U.S. $120,000 without including the S&T/H/WS costs for their Phase One and Two efforts.

While there seems to be a considerable market for handpumps in Honduras, no agency has expressed interest in purchasing the AID-type model. Therefore, while there may be many positive spin-offs of the program, any evaluation of the cost effectiveness of the effort is still to be determined.

5.4.4 What Should be the Next Step for USAID/Honduras?

In order to benefit from the experience to date the Mission should have the documentation indicated in Section 5.3.2 developed as quickly as possible.

The Mission should also ensure that the comparative field test that has just been started is carried to completion. The data from this test will be invaluable in assisting the Mission to advise the GOH in future handpump purchases. It is suggested that, once the field test is completed, the Mission seek assistance to design and carry out a national workshop to disseminate test results.

Finally, the Mission should seek advice on how to use the field test experience to demonstrate to GOH officials the need to coordinate the management, administrative, and training schemes with the technical aspects of a handpump program.

Chapter 6

# DOMINICAN REPUBLIC

Typical handpump installations in the Dominican Republic - 1983

## 6.1 Background

### 6.1.1 History

In 1978 the U.S. Agency for International Development's Mission in Santo Domingo, initiated a rural water supply project as part of a wider public health effort in the Dominican Republic. One component of this effort was the local manufacture, installation and maintenance of an AID type handpump in the rural areas of that country.

To promote the local manufacture of handpumps, two companies were awarded contracts by USAID/DR to produce a total of 46 AID type handpumps. One company (Industroquel, C. por A.) made a welded steel body (see Figure 6.1), the other (Astilleras Navalis Dominicanoas, C. por A.) cast the body and machined it in their well equipped foundry and machine shop. The pumps were delivered between August 1978 and September 1979. By January of 1979, 21 of the pumps had been installed in the Cibao Valley region of the country and were being monitored by Georgia Institute of Technology (GIT) who had provided technical assistance to the manufacturers and supervised the pump installations. After the initial test period, which ended in 1980, the remaining 25 pumps were installed in the same area.

By November of 1978, USAID/DR had concluded Health Sector Loan II with the Government of the Dominican Republic (GODR). Under this loan USAID provided US$8 millions which were matched with 3 million DMR Pesos to assist that government to improve rural health conditions in three of the country's seven health regions. The Secretariat of Health and Public Assistance (SESPAS) was to be the executing agency of the loan.

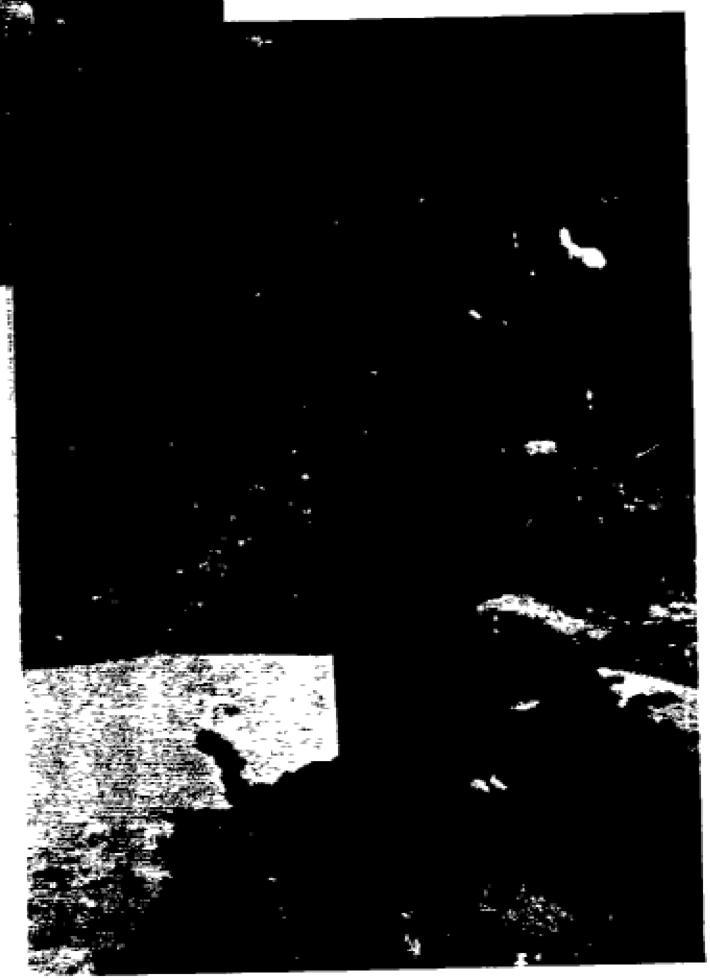
Health Sector Loan II consisted of two major elements. The first was an expansion of the Basic Health Service program. (This was an expansion of an element of Health Sector Loan I to include extending services to additional communities and to upgrade rural health clinics and small hospitals.) The second element of Health Sector Loan II called for: 1) the provision of safe water through a limited number of gravity feed aqueducts and a large number of handpumps; 2) sanitation facilities; and 3) a health education program. All these efforts were to be focused on people living in small communities (800 people or fewer) or in dispersed rural population.

As the loan agreement was executed after the 1979 GODR budget was completed, there were no counterpart funds available to start the project in that year. In addition, Hurricane David (August 1979) delayed the start and progress of activities.

As part of the loan agreement in 1980 SESPAS started actions to purchase, install, and maintain 1,000 AID type handpumps using funds from USAID/GODR Health Sector Loan II. Manufacturers were invited to submit bids. After

Figure 6.1

Welded steel AID type handpump made by Industroquel in 1978



Cast-iron AID type handpump made by Astilleras Navalis Dominicanoas in 1978 evaluating the bids it was found that neither of the two manufacturers mentioned above had won the competitive bid. A third firm (Equipo Tecnico Industrial) was finally awarded the contract for 1,000 pumps. Later they received a second order for 1,050 more (see Figure 6.2).

As Equipo Tecnico Industrial (ETINCO) had not received any technical assistance during the above-mentioned demonstration effort, WASH was requested to provide the services of Mr. Robert Knight from the Rural Water Laboratory of the University of Maryland to assist USAID/DR in ensuring the manufacture and installation of a quality handpump. In his field and trip reports (Ref. 6.1) Mr. Knight reviews his visits to some of the demonstration pumps, his work with the foundry, his visits with SESPAS, and his resulting recommendations to USAID/DR.

By July 1982 several critical elements of the water supply effort had begun to fall behind schedule, and WASH was requested to provide technical assistance in the areas of: 1) well drilling; 2) measures to accelerate handpumps manufacture, installation, use and maintenance; and, 3) measures to ensure community participation. The results of this work are covered in WASH Field Report No. 50 (Ref. 6.2) and Interim Report No. 3 (Ref. 6.3). These efforts were followed up in November of 1982 by Mr. Knight during one of his trips to assist USAID/DR and SESPAS resolve a series of manufacturing and installation problems that had occurred as the program moved forward (Ref. 6.4).

By January of 1983 the technology transfer effort (see above Chapter 1) had moved through Phase 8 (first stage production and marketing), and the handpump effort had became part of an operational program. In Phases 1, 2, 3 USAID/DR had been assisted by GIT. Phase 4 (Development of Software) had been conceptualized by USAID/DR and SESPAS with WASH assistance. Phase 5 and 6 had been assisted in the early stages by GIT and in their later stages by Mr. R. Knight of the University of Maryland. Phases 7 and 8 (first stage production and marketing) were basically national efforts guided by USAID/DR health officials with advice from WASH consultants. In the course of Phases 1 through 8 many modifications were made in the handpump concept. The majority of these are summarized in Mr. Knights report of June 1981 (Ref. 6.5). The major modification was the decision by the Mission to modify the design of the last 1,050 handpumps to have a two inch plastic drop pipe and a plastic foot valve.

### 6.1.2 Efforts to Date

As a result of the efforts to date, a number of problems have been identified which are closely related to the pump design as it relates to those human/technical resources which were locally available in the Dominican Republic. Among these were: 1) the inability of the contractor to produce pins and bushings of the specified hardness; 2) the lack of adequate quality control at the factory; and 3) the lack of appropriate personnel and measures for ensuring quality control in SESPAS's acceptance and installation efforts. Additional problems have been identified at the technical-software interface. For example, SESPAS has been unable to ensure 1) local maintenance and lubrication and 2) local long-range user education and maintenance backed up by a national program.

Figure 6.2

AID handpump being produced in Dominican Republic by Equipo Technico Industrial (1983)

Typical field installation in the Dominican Republic (1983)

### 6.1.3 Approaches Used by USAID/DR

To move the handpump effort from a pilot manufacturing/installation/monitoring effort into an operational program, USAID/DR has used GIT to carry out Phases 1 through 5. For Phases 6 through 8 WASH has assisted USAID/DR and SESPAS to: 1) modify the handpump to fit Dominican Republic human and technical resources; and, 2) develop such infrastructure mechanisms as were required to operationalize the handpump effort (i.e. well drilling, local maintenance schemes, user education schemes, etc.).

## 6.2 Discussion Team Visits

### 6.2.1 Visits to Factories

The team visited two of the three factories that have been receiving assistance in producing handpumps in the Dominican Republic.

The first visit was to Equipo Tecnico Industrial (ETINCO) where the team found a foundry/machine shop combination (see Ref. 6.1 for details of equipment). The foundry appeared to be adequate for producing from 50 to 100 handpumps per week. The machinery in the machine shop was old though it appeared to be adequate in numbers and types to produce the desired number of handpumps per week. The jigs and fixtures appeared to be well used and appropriate for the task. The main problem at the foundry/machine shop was one of quality control in the various manufacturing steps. (For example, an examination of the castings of the shop floor showed a significant number of units having blowholes.) The need for this was reinforced by a visit to the SESPAS warehouse where pumps were being given the final inspection prior to acceptance. The rejection rate was running at about 38 percent in spite of the claim by the factory that they had "tested" all pumps before sending them out. Rejection was because of loose bearings, binding handles, and missing parts. An examination of the situation found that the ETINCO was not following WASH recommended procedures. The sudden rise in the rejection rate was due to the fact that within the last two months, SESPAS had instituted a strict quality control procedure for pump acceptance along the lines of WASH recommendations.

During the ETINCO visit, the administrator, Mr. Tobias Fernandez Dotel, indicated that he had sold 25 AID type pumps to Church World Services and that they were asking for 25 more. He also expected to sell 200 to Fundacion Para El Desarrollo Comunitario (FUDECO). He indicated he had sold four to private individuals, 20 to USAID/Haiti, and six to Guatemala and that he was preparing to ship six more to USAID/Haiti. Mr. Fernandez indicated they had displayed the handpump at one local trade fair. While they had not done any other promotion of the product, ETINCO was "planning" to contact Gulf and Western Corp. who has a substancial community participation program.

It was indicated that the factory had delivered 1,356 pumps of the 2,050 being ordered and, that had they had 50 to 100 more on the floor in various stages of production.

ETINCO indicated that the hardness of the pins and bushings that had been provided by TORNICA, had been a major problem and it continued to be so. It was indicated that while they did not test the bushing for hardness as they were supplied by SESPAS to ETINCA (see page 13 of Ref. 6.3 for further details) they did check them for straightness and roundness. This is a serious gap in the quality control chain.

Mr. Fernandez indicated that there had been several "significant" design changes in the pump since the contract had been written which included:

- Changing cylinders from 2-3/4" to 2"
- Changing base opening from 1-1/4" to 2"

After examining all the evidence, it appears that at the time of the visit the manufacturer was probably having a cash flow problem and previously adequate quality control had slipped in the face of this.

The second factory visit was to Cedeno Industrial, S.A. (CEDINSA). This was one of the two foundry/machine shops aided by GIT during the pilot phase. It was similar in nature to ETINCO in that it was a small owner/operator business. On the day of the visit there were about 10 workers in evidence. Mr. Jose Feo Cedeno (President/Director Tecnico) showed the team the molds, jigs, and plans for the AID type pump that he had stored in anticipation of further orders. He indicated that they had made and sold a "small" number (125) since 1979. He indicated that he would be interested in making additional pumps for approximately US$275 each. While it appears that an acceptable pump has been made and could again be made by this manufacturer, quality control would probably be a problem in future contracts.

Conclusion

As a result of the visit to both foundries, it appears that there is adequate foundry/machine shop interest and capacity in the Dominican Republic to meet current and future demand for the AID handpumps. However, the manufacturers and SESPAS would need extensive assistance in quality control procedures.

### 6.2.2. Field Visits

A total of 19 sites were visited. Table 6.1 shows the sites visited and the conditions found. The installed age of the pump ranged from approximately two weeks to about three and a half years, the older pumps being those installed under the GIT operated demonstration phase.

While SESPAS has drilled about 900 wells (they plan for approximagely 2,000) only about 700 handpumps had been installed. It was found that SESPAS had plans to increase the production rate and quality of the well by contracting with the National Institute for Potable Water and Sewerage (INAPA). This measure, which had been recommended by WASH (Ref. 6.2) should increase the well drilling rate as well as decrease the number of wells that pump sand and/or have low yields.

Table 6.1

| LOCATION | DATE INSTALLED | PUMP INSTALLED | PUMP OPERATIONAL | REMARKS |
|---|---|---|---|---|
| Hannia | 1980 | 1 (Deep) | No | Deep well with plastic drop. No lube, had been repaired twice (Worked 3 days and 5 days). |
| Near Boni on Road to San Jose | 1982 (See Fig. 6.3) | 1 (Shallow | Yes | Water very salty - people do not use. No lube, bushings falling out. |
| Near Boni on Road to San Jose | 1982 | 1 (Shallow) | Yes | Water salty - people use ditch. No lube, lost two bearings, base loose, no maintenance. |
| Near Boni on Road to San Jose | Feb. 1982 | 1 (Deep) | Yes (100' to water | High salt content, people do not use, pump lubed, base bolts loose. |
| Los Ranchitos #1 | Early 1980 | 1 (Shallow) | Yes (oldest pump in project) | Well lubed, used by 10/15 families. Shows use but in in good condition. |
| Los Ranchitos #2 | Early 1980 | 1 (Shallow) | Yes | Well lubed, good water, shallow, leaking a lower thread, base bolts loose, potential foot valve problem. |
| Near Los Ranchitos on Raod to San Jose | 1981 | 1 (Shallow) | Yes | Poorly lubed, poor quality manufacturing, low usage (3/4 families), base bolts rusted. |
| Above Los Ranchitos | 1981 | 1 (Deep-120') | Yes (But well can be easily overpumped because of low yield) | Well lubed, pumps hard. Needed 10 strokes to start, low usage. |
| Above Los Ranchitos | ±June 1982 | 1 (Deep) | Yes (Well easily over-pumped re-charge slow | Bushing badly worn from no lube and high bearing load, low usage ±5 houses, foot valve appears to be bad. |
| Above Los Ranchitos | ±June 1982 | 1 (Deep) | No (Foot valve problem | Water level 120'. Well plat-form cracked. |

| LOCATION | DATE INSTALLED | PUMP INSTALLED | PUMP OPERATIONAL | REMARKS |
|---|---|---|---|---|
| Above Los Ranchitos | ±June 1982 | 1 (Deep) | No (Foot valve problem | Original installation lacked a bushing in lower pin. |
| Above Los Ranchitos | Early 1982 | 1 (Deep) | No | No lubrication. Unable to tell if dry well or no foot valve. Missing parts, nails as cotter pins. |
| Las Tablas | Jan. 1983 (See Fig. 6.4) | 1 (Deep with plastic drop) | No | Cage of plastic footvalve came loose. Well pumps sand. |
| El Pennito Sabente* | June 1978 | 1 (Shallow) | Yes | Pump from pilot project. Well lubed, low usage, changed leather one in 4 years, missing bushings. Worked 4-1/2 years with little maintenance. |
| Canto Cerro* | June 1978 | 1 (Deep - ±45 ft.) | Yes (Low usage) | Bushings badly worn, well lubed, had several adaptions: steel slide blocks, bolt for pin, bushing replaced by pipe. |
| Guaco* | Nov. 1978 | 1 (Deep) | No. (Pump rod disconnected) | Pump out of service for six months and people "didn't know how to fix it". Handle welded in two places. |
| Las Frometa | 9/27/78 | 1 (Deep ±20') | Yes | Single family usage, well lubed, pins and bushings worn but useable, base bolts rusted on, good footvalve. |
| Near Sanitago | 1978 (See Fig. 6.5) | 1 (Deep ±50') | Yes | Low usage, well lubed, had several user repairs and adaptations, was operational but in poor condition, cups worn thus low mechanical eficinecy. Welded steel model. |
| San Francisco Aoneba | 1978 | 1 (Deep) | No | Welded steel model used only by several families, cups badly worn, footvalve broken, rod end loose. Repairs were simple but users had no idea how to do them. Pump has brass or bronze bushings that were in good condition. Anchor bolts rusted on. Screws for footvalve rusted on. Obviously had been heavily used for many years. |

The field observations confirm that an acceptable AID type handpump could be manufactured locally if adequate quality control measures were exercised. It was also determined that when the pump is used on shallow wells and its use is limited to one to five families it can be kept in operation by the users. The deep-well pumps tended to be in the poorest condition because of the more complex problems of pulling the drop pipes, increased wear due to high bearing loads, the lack of locally available spare parts, and the lack of a maintenance scheme to back up the local user.

The most common field problems found were the lack of a system to provide lubricant to the user, the lack of locally available spare parts, the lack of any system to help users conduct repairs and maintenance on an as-needed basis, and the lack of any preventive maintenance program for the wells and/or pumps.

In most cases the pump sites were well constructed and maintained. Site drainage was found to be a widespread and continuous problem. Little user education was being done to correct this problem area.

SESPAS field crews were observed removing and reinstalling modified deep-well pumps (i.e. having plastic drop pipes, plastic foot valves, and roboscreens) which had failed after about two to three weeks of service. From field observations it was obvious that they needed to improve their techniques for removing the drop pipe, making solvent welds, and reporting on the failure. It was also obvious that the crew was overloaded with work and spread too thinly.

The field visit showed that SESPAS did not have a "field" structure in place and that such lubrication and/or repairs that had been made were often initiated and carried out by the user at their own expense. This lack of local infrastructure had been pointed out by WASH previously (Ref. 6.3) but due to Presidential elections and shifts of personnel there was insufficient manpower to solve the problem. Because of recent personnel shifts and additional staff for user education there should be substantial progress in the near future.

In visiting this operational program it was interesting to note that many adaptations had been made by the local users to both the original welded steel and newer cast iron pump bodies. For example, pipes had been used to replace bushings. Bronze (or brass) bearings had been installed to replace steel bushings. Roller bearings had been installed to replace slide blocks. Nails had often been used to replace cotter pins, and old shoe leather had been used to make replacement flapper valves (see Figures 6.5 and 6.6).

While it was readily apparent that both the shallow and deep well pumps were valued by the user, their concern for the pumps was usually a function of the distance to the alternate source (i.e. people who would have had to walk five or ten kilometers to an alternate source showed more willingness to collaborate with the authorities than those who could draw from a nearby drainage ditch even if it was contaminated). A major user problem was that even though he/she was "concerned" about pump operation (they didn't want the inconvenience of hauling water X kms.) they often didn't know what to do to maintain or repair the pump. They usually didn't even know where to go to get help.

Figure 6.3

Handpump on the road to
to San Jose - Installed
1982. Note lack of
lubrication and poor
maintenance

Handpump near Santiago -
Installed 1982. Well
maintained and lubricated

In addition to observing handpumps, the team visited two gravity fed piped water systems in the San Jose area. Both had operational problems that indicated a lack of adequate national and/or regional maintenance schemes to assist local committees in making simple repairs.

Conclusions

While the AID type handpump was accepted by the users in Dominican Republic, SEPAS had not established an adequate long-term maintenance scheme to back-up local efforts. As a result many of the pumps were found to be in need of repair. In addition it appears that the modified pump (i.e. those using plastic drop pipes and foot valves) need more investigation prior to full-scale field installation.

### 6.2.3 Meetings with Government Officials

The team was accompanied in their discussions and field visits by the head of the SESPAS/USAID-DR program (Dr. Herrera) and by Dr. O. Rivera of USAID-DR.

The above mentioned meetings and visits established that:

A. The GODR is committed to the handpump and aqueduct program but they have not been able to organize an effective user education program to support local operation and maintenance efforts.

B. The GODR perceives a "market" for "several" thousand handpumps per year over the next five to ten years. No assessment has been made as to the share of this market that the AID type pump could (or should) capture.

C. The World Bank was interested in having the Dominican Republic as one of its sites in in its Village Operated and Local Maintenance (VOLMP) test program.

D. Not many other types of pumps had been installed in the Dominican Republic.

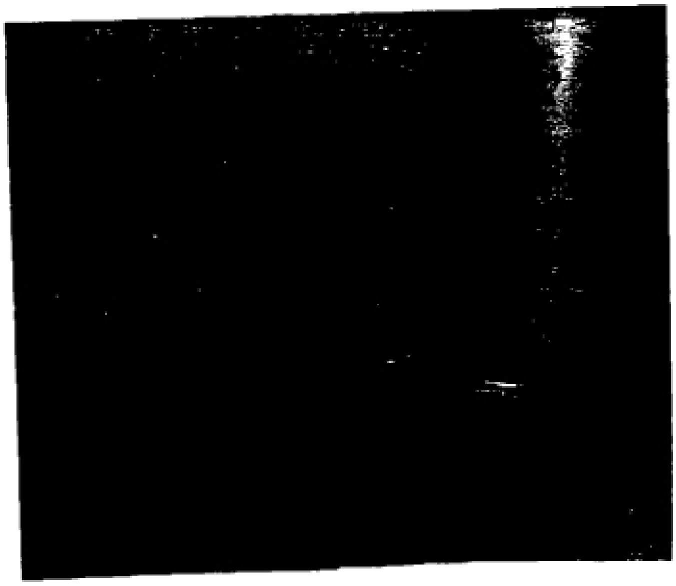
E. A plastic Waterloo type pump had been provided by Canadian CIDA and had been given such a poor performance rating that the Fundacion Para el Desarrollo Comunitario (FUDECO) had removed them and was considering the purchase of AID type pumps from ETINCO.

F. While steps were being taken to correct "software" problems (infrastructure training schemes, additional personnel etc.), the procedures for accepting/rejecting handpumps needed a lot more of SESPAS's attention.

Conclusions

The handpump effort is a priority area of SESPAS's water supply effort but they need to give more attention to 1) linkage to the other elements of primary health care; 2) development of program infrastructures for

Figure 6.4



Plastic foot valve and roboscreen being used on "modified" Dominican Republic handpump

Field crew removing modified Dominican Republic handpump. Note that plastic drop pipe has come loose and fallen into the well community participation and local maintenance of the handpumps, 3) establishing long-term maintenance schemes; and 4) gathering information on program progress and problems.

### 6.2.4 Meetings with USAID Officials in the Dominican Republic

Visits with Dr. O. Rivera and his staff found them to be very knowledgeable about the project, its problems, and potential solutions.

In spite of the many problems that the project has brought to his office, Dr. Rivera has been very supportive of the effort and highly cooperative in seeking and implementing solutions.

## 6.3 Lessons to Be Learned for the Future

### 6.3.1 Was the Program Design Adequate?

For Phases 1 and 2 S&T/H/WSS Washington served as the catalyst for having USAID/DR and SESPAS include the handpumps concept as part of Health Sector Loan II. For Phases 3 through 5 GIT provided the supervision for and acted as the technical advisor for the local production, installation, and monitoring of a limited numbers of AID type handpumps. For the operational phases (6 through 8) WASH has served as the technical advisor to SESPAS and USAID/DR for the manufacture, installation, and modification of over 700 handpumps as well as the program infrastructure to support them.

As this was the only country visited by the team which had a full-scale program in operation, it is difficult to make comparisons among the programs. Nevertheless, several general comments can be made concerning the process that led to the present status of the program in the Dominican Republic.

A. The efforts to date have resulted in a full scale operational program under which approximately 2,000 AID type handpumps have been ordered, 900 wells drilled, and approximately 700 pumps installed.

B. The efforts to date have resulted in a concentration on hardware and not enough on the development of support mechanisms (i.e. administrative, logistical, training of staff, spare parts, user education).

C. While each phase was well done, the overall coordination of the different phases was left to USAID/DR. As they were inexperienced in this area, progress has been slower than planned.

In general, it appears that more time and effort should have been expended in the software area once the hardware concept was understood, i.e. at the end of phase 5.

Figure 6.5

Welded steel 1978 model showing user maintenance and local adaptation to handle and slide blocks

Welded steel body handpump installed in 1978

Examining the major elements of the effort, the following comments can be made:

### Pump Production

The process of field testing by GIT did not result in sufficient feedback to the designers and purchasers. For example, in order to change the foot valve of the deepwell pump, the bolts of the pump base must be removed. But, once the pump has been in the field for a year, the base bolts are almost impossible to remove because they are often rusted on. More feedback from the field to the designer could have resulted in the manufacturer's incorporating several design changes that would have reduced operational problems. Another example is that in spite of obvious manufacturing and field problems with the steel pin and bushing concept, little has been done to find a solution more in tune with the commercial and technical resources of the Dominican Republic (for example, use of ball bearings). Also, it is felt that not enough was done to develop, establish, and monitor a strong and efficient quality control system that could operate under the administrative and legal climate of the Dominican Republic. This failure might have allowed some less than highest quality products to be installed in the field. Coupled with the lack of adequate lubrication and maintenance schemes the handpumps and wells have often deteriorated at a faster rate than expected.

### Field Testing

Field testing appears to have been well done. But there was little feedback between the work done by GIT and later phases. The reason for this appears to lie in 1) the use of different consultants for the different phases, 2) the inexperience of USAID/DR in the handpump field, and 3) the inexperience of SESPAS. All these combined into a situation where no one knew exactly what feedback should be given to whom.

### Implementation

More attention should have been given to ensuring that the administrative, logistical, maintenance, and user education components were in place prior to proceeding with the manufacture of the pumps. Earlier attention should have been given to the well drilling problems.

## 6.3.2 Can the Effort Be Considered Cost-Effective?

In spite of slippage in various elements and phases, the overall effort should be considered a success. The pilot effort has resulted in a full scale operational program. While a great deal more effort will be required, it does appear that on the order of approximately 50,000 to 100,000 people can be provided safe water from the approximately 2,000 handpumps that will eventually be installed. The developmental and technical adviser costs appear to be on the order of US $100,000 for the original 2,000 pumps. This unit cost will drop as the number of pumps increases. This cost was borne by the AID Office of Health through the GIT and WASH.

Figure 6.6

Typical shallow well installation being repaired

Shoe leather used to repair shallow well foot valve

## 6.4 Conclusions from the Visit

### 6.4.1 What Are the Residual Effects at the National Level?

The main residual effect of this effort is that SESPAS has been successfully assisted to establish a potentially viable program for delivering safe water to those living in the dispersed areas of the Dominican Republic (i.e. population concentrations of fewer than 800 people) that is incorporated with other primary health care programs such as sanitation.

Another residual effect is the development of a national awareness of the limitations of technological "fixes". It has become very clear that if these types of programs are to be successful, technical solutions must be mated with managerial, maintenance, and user education schemes that realistically reflect the skills and technology currently available in the Dominican Republic.

This project has also opened the door for other efforts to produce low-cost locally manufactured water and sanitation devices.

### 6.4.2 What Are the Residual Effects at the Official Level?

The fact that SESPAS has been able to work with INAPA on the well drilling problem shows that the two agencies have realized the need for mutual cooperation and support. Additional cooperative efforts can now be started using this one as a model.

### 6.4.3 Should the AID Type Handpump Program Be Considered Further by GODR or USAID/DR?

The answer to this is two-fold. First, it is clear that the following technical modifications must be resolved before the AID type handpumps should be recommended for use in the Dominican Republic:

- Either a mechanism must be established for producing large numbers of pins and bushings that meet hardness specifications or a substitute must be found for the bearing support problem (sealed ball bearings for example).

- A way must be found to replace the foot valve on a deep well pump without removing the base bolts (for example, pull it through the base).

- A better scheme for ensuring the lubricating of above-ground moving parts must be developed so that field lubrication is less critical.

- Better methods of drilling and testing wells must be developed.

In addition, the following software elements must be implemented before this, or any, handpump program should be considered further:

- A logistics system that will result in having the most common spare parts available in the local store.

- A multi-tiered maintenance system that will call for the user to do such basic maintenance such as lubrication, while regional teams provide preventive maintenance and back-up for heavier maintenance such as pulling the pump to repair a foot valve.

- A user education system which addresses the use of such techniques as radio, audiovisual, etc.

The recommendation to obtain additional handpumps over those currently on order is highly dependent on the degree to which the current program can resolve the above mentioned questions.

### 6.4.4 Was the Exercise Cost Effective?

In view of the low unit cost of the developmental effort (approximately $50 per pump) and the fact that it resulted in an operational program, it can be said that this is the most cost effective of all the programs examined to date.

### 6.4.5 What Efforts Are Needed for Future Implementation?

The Mission and SESPAS need to do more work on institutionalizing and staffing the following schemes into a long-term program elements:

- Quality control
- Acceptance procedures
- Well drilling
- User education
- Preventive and maintenance repair
- Training of staff and users

### 6.4.6 What Should the Next Steps Be for USAID/DR?

The Mission should: 1) call for an in-depth up-date of the July 1982 WASH Interim Report No. 3 under OTD No. 48 (Ref. 6.3), 2) assist SESPAS to collect hard data on frequency of repair and life-cycle costing of various pumps and schemes, and 3) turn their attention to implementing the software schemes mentioned in Item 6.4.5.

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Chapter 4

4.1 Pashkevich, P. Alan, and Tyler E. Gass, Philippine Handpump Program, Water and Sanitation for Health, Field Report No. 54, Arlington, VA, August 1982.

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Chapter 6

6.1 WASH Field Report No. 20

6.2 WASH Field Report No. 50

6.3 WASH Interim Report No. 3 (DMR - July 1982)

6.4 Knight sheet

6.5 Knight report

APPENDIX A

Camp, Dresser & McKee, Inc. WASH PROJECT 1982

WATER AND SANITATION FOR HEALTH (WASH) PROJECT
ORDER OF TECHNICAL DIRECTION (OTD) NUMBER 113
September 8, 1982

Camp, Dresser & McKee, Inc.
WASH PROJECT

SEP 09 1982

To: Dr. Dennis Warner, Ph.D., P.E.
WASH Contract Project Director

FROM Mr. Victor W. R. Wehman Jr., P.E., R.S. VWW
AID WASH Project Manager

SUBJECT: Provision of Technical Assistance Under WASH Project Scope of Work for S&T/H to Conduct Technical/Managerial Review of AID Handpump Program in Sri Lanka, Philippines, Indonesia, Honduras and Dominican Republic

REFERENCES: A) S&T/H Scope of Work

1. WASH contractor requested to provide technical assistance to S&T/H as per Ref A.

2. WASH contractor/subcontractor/consultants authorized to expend up to 58 person days of effort over a five (5) month period to accomplish this technical assistance effort.

3. Contractor authorized up to 46 person days of international/domestic per diem to accomplish this effort.

4. Contractor to coordinate with S&T/H (V.Wehman) and Georgia Tech (P. Potts) regarding coordination of travel and incountry logistics and coordination of lodging and ETAs.

5. Contractor authorized to provide one international round trip from consultants home-base through Washington D.C.(for briefing) to Colombo, Sri Lanka to Manila, Philippines to Jakarta/Bandung, Indonesia and return to Washington D.C. for debriefing and report preparation. Contractor authorized one international round trip from consultants home-base through Washington D.C. to Tegucigalpa/San Pedro Sula, Honduras to Miami to Santo Domingo, Dominican Republic and return to Washington D.C. for debriefing and report preparation. Contractor authorized one international round trip from Washington D.C. to Santo Domingo, Dominican Republic and return to Washington D.C. for purpose of debriefing and report preparation.

6. Contractor authorized local travel within Sri Lanka, Philippines, Indonesia, Honduras, and Dominican Republic NTE $ 1500 for all 5 countries without the prior written approval of AID WASH Project Manager.

7. Contractor authorized to obtain secretarial, graphics or reproduction services in WASH CIC for purposes of developing draft final and final reports. These support services overseas at country sites will be provided by the Georgia Tech representative who will be providing these services to all members of the AID Handpump program technical/managerial review team.

8. Contractor authorized to provide for car rental if necessary to facilitate effort of team. Missions will be encouraged to provide mission vehicles if available and appropriate.

9. WASH contractor will adhere to normal established administrative and financial controls as established for WASH mechanism in WASH contract.

10. WASH contractor should definitely be prepared to administratively or technically backstop field consultants and subcontractors.

11. Contractor to provide S&T/H/WS with draft final report on 5 country review by 8 Jan 83. Final report due to S&T/H/WS by 15 Jan 83.

12. Contractor should coordinate WASH consultants travel very closely with Georgia Tech IQC contractor (Contact Mr. P. Potts) as Georgia Tech is responsible for coordinating incountry travel, lodging and developing meeting agendas in the various countries.

13. S&T/H/WS should be contacted as soon as consultants identified and technical assistance initiated as soon as possible but before 20 Sept 82.

14. New procedures concerning subcontractor cost estimates and consultant justifications remain in effect.

15. Appreciate your prompt attention to this matter. Good luck.

September 8, 1982

## S&T/H SCOPE OF WORK

1. S&T/H requests the presence and participation of WASH Project Coordination and Information Center principal engineering staff on a technical/mangerial review team involved with a 5 country review of the AID handpump technology transfer program. The country programs to be reviewed include in order of review the following: Sri Lanka, Philippines, Indonesia, Honduras, and the Dominican Republic. The WASH consultant(s) on the team will need to take into consideration the following aspects (minimum) when accomplishing the technical/managerial review which will lead to an independently written report to S&T/H/WS:

   (A) Are handpumps still functioning at test sites?
   (B) Is the manufacturer that was assisted in each country still producing AID design handpumps according to the original specifications provided or are there changes and if so what changes?
   (C) Are other donors or host country organizations using the AID handpump design and manufacturer sponsored by AID in tech assistance?
   (D) Is the manufacturer selling handpumps to private sector individuals and too what extent is the marketing program developed?
   (E) Are communities involved with field installation pilots able to maintain the handpumps and obtain locally manufactured spare parts?
   (F) Are the organizations or individuals trained in installation/operation/maintenance of the AID handpump still operationally involved?
   (G) Has pricing of the AID handpump changed much since initial orders under AID pilot manufacturing programs?
   (H) What roles have USAID/WHO/UNDP/host country government/private sector/local manufacturer taken in the overall tech transfer effort? Has there been a sustained effort or a discontinuous one and what have been the perceived impacts by the various parties?
   (I) What numbers of AID handpumps have been sold or are being contemplated to be sold since the initial tech transfer tech assistance to the local manufacturer?
   (J) Are the current AID mission staff and Mission Director aware of the technology transfer and private sector initiative aspects of these pilots; and what are their perceptions of the worth of these types of activities within the context of overall development assistance and/or more specifically within the context of health or human resources development?
   (K) What are lessons learned for future AID handpump or technology transfer programs?

2. Other team members of technical/managerial review team include:
   (A) Mr. F.E. McJunkin, S&T/H/WS in Sri Lanka and Philippines
   (B) Mr. Phillip Potts, Georgia Tech, in Sri Lanka, Phillipines Indonesia, Honduras, and Dominican Republic
   (C) A senior international expert on handpump programs provided under IQC from the Pragma Corp for all 5 country reviews
   (D) Mr. Victor Wehman, S&T/H/WS for Honduras and Dom. Rep.

3. REQUIRED REPORTS:

Country report required on each country visited by WASH team representative describing contacts/perceptions obtained as a result of visit. Report to be formal, single spaced, not to exceed 120 pages total for the 5 countries visited. Contractor to produce 30 copies of report. Draft report of final report due to S&T/H/WS Project Manager by 8 Jan 83. Final report due to S&T/H/WS by 15 Jan 83.

4. Sequence of Events to be relayed to contractor by S&T/H/WS (V. Wehman). Contractor to coordinate with Mr. Wehman to insure proper timing of consultant selected.

## APPENDIX B

## PERSONS VISITED

Sri Lanka

Mr. Harold Fernando
Senior Assistant Secretary
Ministry of Local Government, Housing and Construction

Mr. M.O.P. Dias
Managing Director
SOMASIRI Huller Manufactory (Pump Manufacturer)

Mr. James Meenon
USAID Capital Development Officer
USAID Sri Lanka

Mr. N.D. Peiris
Chairman
National Water Supply and Drainage Board

Mr. T.B. Modugalle
General Manager
National Water Supply and Drainage Board

Mr. D.E.F. Joyasooriya
Deputy General Manager
National Water Supply and Drainage Board

Mr. M.S. Issadeen
Superintendent of Construction Works
Department of Local government in Hamkontota

Mr. Marcos Fernando
Technical Officer
Ministry of Local Government

Mr. Oswin Silva
Special Assistant to USAID Mission Director
USAID Mission/Sri Lanka

Philippines

Carlos Crowe
USAID/Philippines

Oscar Basa, Mechanical/Waterworks Engr.
Capital Development Unit
USAID/Philippines

Gaspar E. Nepomoceno, Project Manager
Barangay Water Project

Noel L. Viaje, BWP Engineer
Barangay Water Project

Ricardo L. Cruz, Assistant Province Engineer
Pampanga Province
Pampanga Provence

Engr. Virgilio D. Delin, Water Works Engr.
Lucina City
Quezon Province

Mr. Gary W. Cook, Health Development Officer
U.S. Agency for International Development
Ramon Magsaysay Center
1680 Roxas Blvd.
Manila

Mr. S.W. Singwing, Chief Office of Populations
Health and Nutrition
Ramon Magsaysay Center
1680 Roxas Blvd.
Manila

Honduras

Ing. Efrin Givon, Director PROSABA
c/o Ministry of Health
Tegucigalpa, Honduras

Ing. Angel Ronfinio Sanchez, Delegado de ICAITI en Honduras
Blvd Los Proceves y 4th Ave. Col. Lana
A.P. 20-C
Tegucigalpa, Honduras

Mr. Richard Dudley, Chief Engineer
c/o USAID/Honduras
Tegucigalpa, Honduras

FUNYMAQ
San Pedro Sula, Honduras

Mr. Alejandro Castro, Sanitary Engineer
Pan American Health Organization
c/o Ministry of Health
Tegucigalpa, Honduras