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USAID HANDPUMP PROGRAM IN HAITI

WASH FIELD REPORT NO. 128

SEPTEMBER 1984

Prepared for:
USAID Mission to the Republic of Haiti
Order of of Technical Direction No. 46

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WASH

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T-46

13 September 1984

Mr. Harlin H. Hobgood
Director
USAID Mission
Port-au-Prince, Haiti

ATTENTION: Mr. James Gardner

Dear Mr. Hobgood:

On behalf of the WASH Project I am pleased to provide you with ten (10) copies of a report covering the handpump installation, maintenance and training project in Haiti.

This is the final report by WASH and is based on the activities carried out by our subcontractor, Georgia Institute of Technology, during the period of July 1981 to May 1984.

This work was undertaken by the WASH Project under the Order of Technical Direction No. 46 issued by AID's Office of Health on 7 July 1981.

If you have any questions or comments regarding the findings or recommendations contained in this report we would be happy to discuss them.

Sincerely,

David Donaldson

David Donaldson, P.E.
Acting Director
WASH Project

cc: Dr. John H. Austin, S&T/H/WS

DD/gh

WASH Field Report No. 128

USAID HANDPUMP PROGRAM IN HAITI

Prepared for the USAID Mission to the Republic of Haiti
under Order of Technical Direction No. 46

Prepared by

Ben E. James, Jr.

September 1984

Water and Sanitation for Health Project
Contract No. AID/DSPE-C-0080, Project No. 931-1176
is sponsored by the Office of Health, Bureau for Science and Technology
U.S. Agency for International Development
Washington, DC 20523

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LIST OF ACRONYMS

USAID	-	United States Agency for International Development
OTD	-	Order of Technical Direction
S&T/H	-	Office of Health, Bureau for Science and Technology, USAID
WASH	-	Water and Sanitation for Health Project
UNDP	-	United Nations Development Program
CARE	-	Cooperative for American Relief Everywhere
UNICEF	-	United Nations International Children's Education Fund
GAO	-	(U.S.) General Accounting Office
PVO	-	Private Volunteer Organization
GIT	-	Georgia Institute of Technology

ACKNOWLEDGEMENTS

WASH personnel extend their appreciation to Messrs. James Gardner and Frank Temmel of the AID Mission in Haiti for their assistance in carrying out the work of this project. Appreciation is also extended to Messrs. Jean Sprumone and Jean Bernard Sugier of the Atelier of Camp Perrin for their involvement. Also, without the invaluable assistance of Mr. Sean Finnigan of Camp Perrin, much of the work could not have been completed. The assistance of the workers of the Atelier Ecole de Camp Perrin, who exhibited much patience with the project staff as they tried to speak the language of Haiti and comply with Haitian customs, is also gratefully acknowledged.

EXECUTIVE SUMMARY

Haiti is a desperately poor country where, according to a recent World Bank Study, 75 percent of the population lives at or below the "absolute poverty level." Only 4 percent of all dwellings in Haiti have running water. The remainder depend on streams, wells, springs, cisterns, and so forth. Among the many water delivery systems now used in Haiti are handpumps.

In July 1981 AID directed WASH to institute a demonstration handpump program in Haiti to determine whether or not a major handpump program in Haiti was warranted.

Experience has shown that the following four conditions must be met to ensure successful technology transfer:

- There must be a demonstrated need and a local awareness of the need for the technology to be transferred.
- The technology must be technically, socially, and economically matched to the local culture.
- Local institutions must have the capacity to implement this new technology and to sustain it after expatriates are no longer involved and must be willing to commit the necessary manpower, money, and leadership.
- International organizations must have the capacity to carry a technology transfer project to a successful conclusion and must commit the necessary funds, manpower, and managers.

A brief assessment of manufacturing capability in Haiti, made concurrent with the site identification task, revealed that without extensive technical assistance the only foundry/machine shop identified could not manufacture an acceptable AID handpump. Therefore, for this program, 20 AID handpumps were secured from a manufacturer in the Dominican Republic.

Thirteen test wells were identified and 16 AID handpumps were installed. The Atelier Ecole de Camp Perrin, a workshop school for agricultural mechanics, was selected to provide continuous local support for a long-term, handpump maintenance system.

To conduct comparison tests of other handpumps, Mono, Moyno, and Malawi handpumps were installed on test wells and their performance tested. A user survey was finally completed on two test well sites after several unsuccessful attempts to obtain user data from local sources. It was found that one test well served approximately 1,500 people, while another furnished water for approximately 400 people. (The AID pump is designed to serve approximately 150 people.)

Among the many problems encountered during this project were:

- Insufficient local community leadership
- Poor AID handpump quality

- Poor performance of the local maintenance and monitoring program
- Difficult lines of communication and supply
- Transportation difficulties
- An unusually high number of beneficiaries per pump
- Project shutdown difficulties.

The conclusions drawn from this project were:

- The AID handpump design is suitable only where user rates are not extremely high and where there is a suitable community and governmental structure for assuring proper maintenance.

- The quality of the AID-type handpumps manufactured in the Dominican Republic was poor and they had to be upgraded before they could be used in the field test. This lack of quality contributed to excessive numbers of failures throughout the field testing.

- The number of beneficiaries per pump was initially grossly underestimated.

- An inadequate commitment was made on the part of the counterpart organization.

- No existing in-country capability to manufacture AID handpumps was identified in Haiti.

- The logistics were unsuitable for effective project execution.

It is recommended that future AID handpump programs:

- Include a statement of project purpose as part of each OTD and conduct pre-project briefings, which should be attended by representatives of S&T/H, WASH (including the subcontractors or consultants who will conduct the field work), and the AID Mission.

- Use only handpumps of acceptable quality.

- Acquire timely information on potential problems concerning cultural, governmental, and geographical peculiarities of the host country. If insufficient host country involvement is indicated, AID should be advised to discontinue the project.

Chapter 1

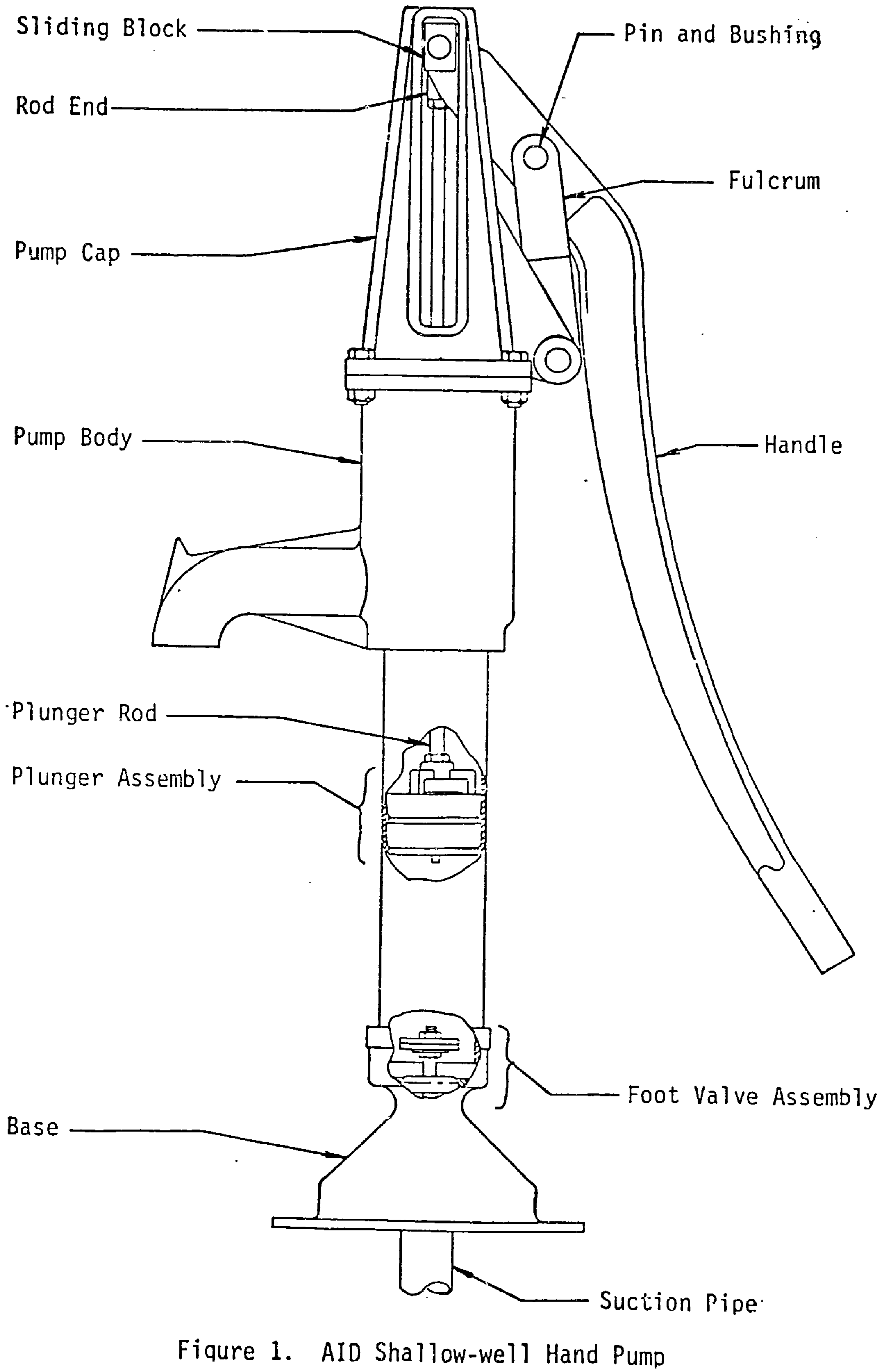
INTRODUCTION

Haiti is a desperately poor country where 75 percent of the population lives at or below what the World Bank calls the "absolute poverty level." The country is densely populated, yet only 4 percent of all dwellings have running water. The remaining dwellings depend on community water sources, including streams, wells, springs, cisterns, and so forth. USAID has investigated several systems which might meet the need in Haiti, including photovoltaic pumps, capped-spring/gravity-flow systems, and handpumps. Because of the wide variation in water sources in Haiti, there is no one system that can be applied throughout the country. For example, the handpump can be used only where the number of users per pump is relatively low, where the static water levels are less than 200 feet, and where local maintenance infrastructures exist. Many Private Volunteer Organizations (PVOs) now have handpump programs in Haiti. These programs are being conducted using new and existing wells.

The AID handpump is a single-action, reciprocating, positive displacement pump designed by Battelle-Columbus Laboratories for USAID. Specifications for the design included long life under severe operating conditions, easy maintenance using simple tools and unskilled labor, potential for manufacture in developing countries, and easy operation by women and children. The shallow-well version, with the piston and cylinder assembly incorporated into the above-ground pump stand, is suitable for wells where ground water is located at depths of less than 26 feet (see Figure 1). For the deep-well version, the piston and cylinder are positioned below the water level, thereby allowing pump operation at depths in excess of 100 feet (see Figure 2).

In 1976, AID contracted with the Georgia Institute of Technology (GIT) to carry out field-testing activities in developing countries. Under the initial contract, the AID handpump was manufactured and field-tested in Nicaragua and Costa Rica. After some design changes, it was introduced in the Dominican Republic, Indonesia, the Philippines, Honduras, and Sri Lanka through a series of contractual mechanisms which included WASH.

The AID handpump programs normally feature the local manufacture of pumps and spare parts, involve local technicians for installation and maintenance of the pumps, and sometimes include users as pump monitors. Because the programs depend heavily upon the expertise and resources of the nation involved, they have met with varying degrees of success. The program being reported on in this document was initiated to determine whether the AID design handpump was a suitable technology for Haiti.



Fiqure 1. AID Shallow-well Hand Pump

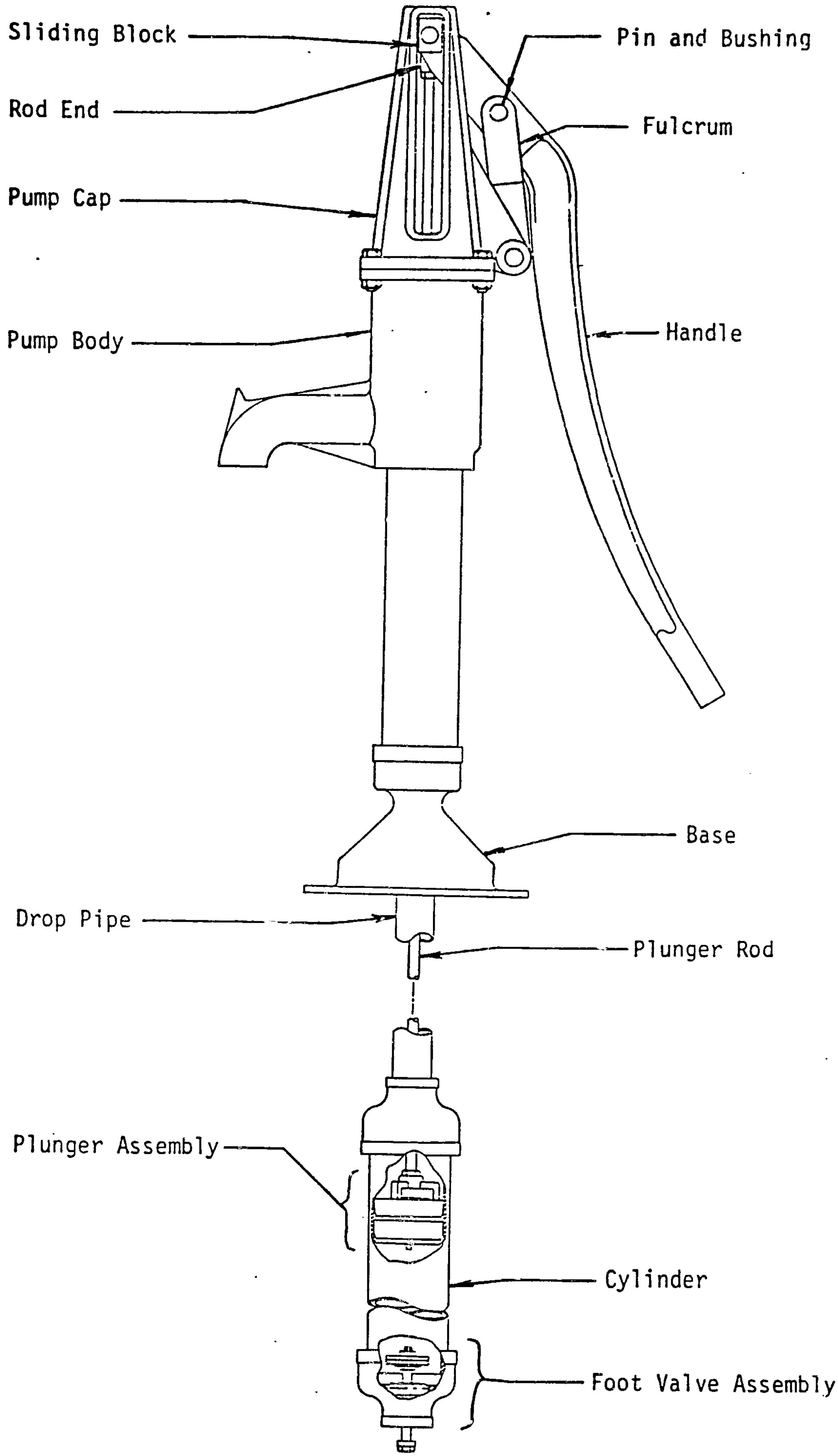


Figure 2. AID Deep-Well Hand Pump

Chapter 2

PROJECT BACKGROUND

2.1 Chronology

In March 1980, the USAID Mission in Haiti made a brief survey of possible sites for the AID-Battelle handpump. This survey was presented to the Chief Engineer of the AID Mission. Later, as a result of telephone conversations among AID's Office of Health in the Bureau for Science and Technology (S&T/H), the WASH Project, and the Mission, Order of Technical Direction (OTD) Number 46 was issued July 7, 1981. To conduct the field work of this task WASH contracted the services of the Georgia Institute of Technology (GIT). Ben James of that institution, assigned as the liaison officer with WASH, was to lead the field missions that received, installed, and monitored the various handpumps being tested. He was assisted in the field by George Murdoch and F. Pareja of the same institution.

2.2 Statement of Work

The original OTD was modified several times as project conditions changed. The resulting statement of work included:

- Secure 16 AID-design handpumps from Santo Domingo, Dominican Republic, along with appropriate quantities of spare parts.
- Secure sufficent quantities of drop pipe and drop rod to install 16 handpumps on 13 wells.
- Identify 13 easily monitored and clustered well sites, construct appropriate upper structures, and install 16 AID handpumps.
- Identify and develop a long-term maintenance system with an organization that will make a long-term commitment to maintain, repair, and replace the pumps, to ensure financial support, and to retain appropriate staff.
- Train USAID, Haitian Government, local personnel and PVOs in the installation, maintenance, and repair of handpumps.
- Conduct a rapid assessment of the feasibility of local manufacture of AID handpumps in Haiti.
- Install one Moyno and one Mono handpump donated by their respective manufacturers. In addition, install one Malawi handpump purchased from the manufacturer.
- Remove one Moyno handpump and replace with one Mono handpump.
- Obtain a user count on at least two wells indicating the number of people using the pumps over a 15-hour period in one day.

2.3 Organization of Report

Chapter 3 covers the general approach, field and laboratory activities, and significant problems and events involved in carrying out this task. Most of the major details are included in Chapter 3, while others are either presented or illustrated in the appendices. Chapter 4 presents the outcomes and conclusions, and Chapter 5 presents recommendations for improving technology transfer programs of this type in other countries.

Chapter 3

METHODS AND PROCEDURES

3.1 General Approach

Experience has shown that the following four major conditions must be met for a technology transfer project to be successful:

1. There must be a demonstrated need and a local awareness of the need for the technology to be transferred.

2. The technology must be technically, socially, and economically matched to the local culture.

3. Local institutions must have the capacity to implement this new technology and to sustain it after expatriates are no longer involved and must be willing to commit the necessary manpower, money, and leadership.

4. International organizations must have the capacity to carry a technology transfer project to a successful conclusion and must commit the necessary funds, manpower, and managers.

This project was essentially a demonstration project designed to see if these four conditions were met adequately enough for a large-scale technology transfer project with handpumps to be carried out in Haiti.

From the beginning of this project, it was obvious to all parties involved (USAID Haiti, USAID S&T/H and WASH and its subcontractor) that there was a definite need for some type of technology to provide abundant supplies of clean water to the rural areas of Haiti. It was also obvious to USAID Haiti, and later to the other parties, that there was a strong local awareness of this need.

After preliminary visits, it was felt that there were strong commitments by local institutions (missionary groups, PVOs, international organizations, outposts, and so forth) to implement and sustain a handpump program if it proved feasible. Because this was a demonstration project, the two remaining elements could not be immediately quantified. It was not known at the onset of the project whether or not handpump technology was appropriate for Haiti, and, therefore, it was unknown whether there would be strong commitments by international organizations for such an effort.

With this information in mind, project personnel selected an area in the vicinity of Haiti's Camp Perrin to install 16 pumps on 13 wells and to monitor their performance. This area was chosen over others for several reasons. Two of the primary considerations, however, were:

- All of the wells were clustered within a ten-mile radius of Camp Perrin.

- Camp Perrin was the site of the Atelier Ecole de Mecanique Agricole

(Workshop School for Agricultural Mechanics), which not only agreed to cooperate fully with this project but which also had the tools and equipment necessary for installing, maintaining, and repairing the handpumps. This Atelier was in the process of establishing a modern cast iron foundry that could eventually produce the AID handpump if it were proven suitable for Haiti. The Atelier was operated by two competent Europeans who encouraged USAID Haiti and GIT to use this area for the demonstration project.

3.2 Field and Laboratory Activities

3.2.1 Secure Handpumps and Spare Parts

Through a separate project, six AID handpumps had been purchased in April 1981 from Equipo Technico in Santo Domingo, Dominican Republic, and shipped to the AID Mission in Port au Prince, Haiti. In September 1981, 14 more AID handpumps were purchased from Equipo Technico and shipped to Haiti under OTD 46. All 20 pumps were found to be of unacceptable quality. The manufacturer in tne Dominican Republic was contacted, and he agreed to ship 20 new pumps to replace the pumps previously shipped.

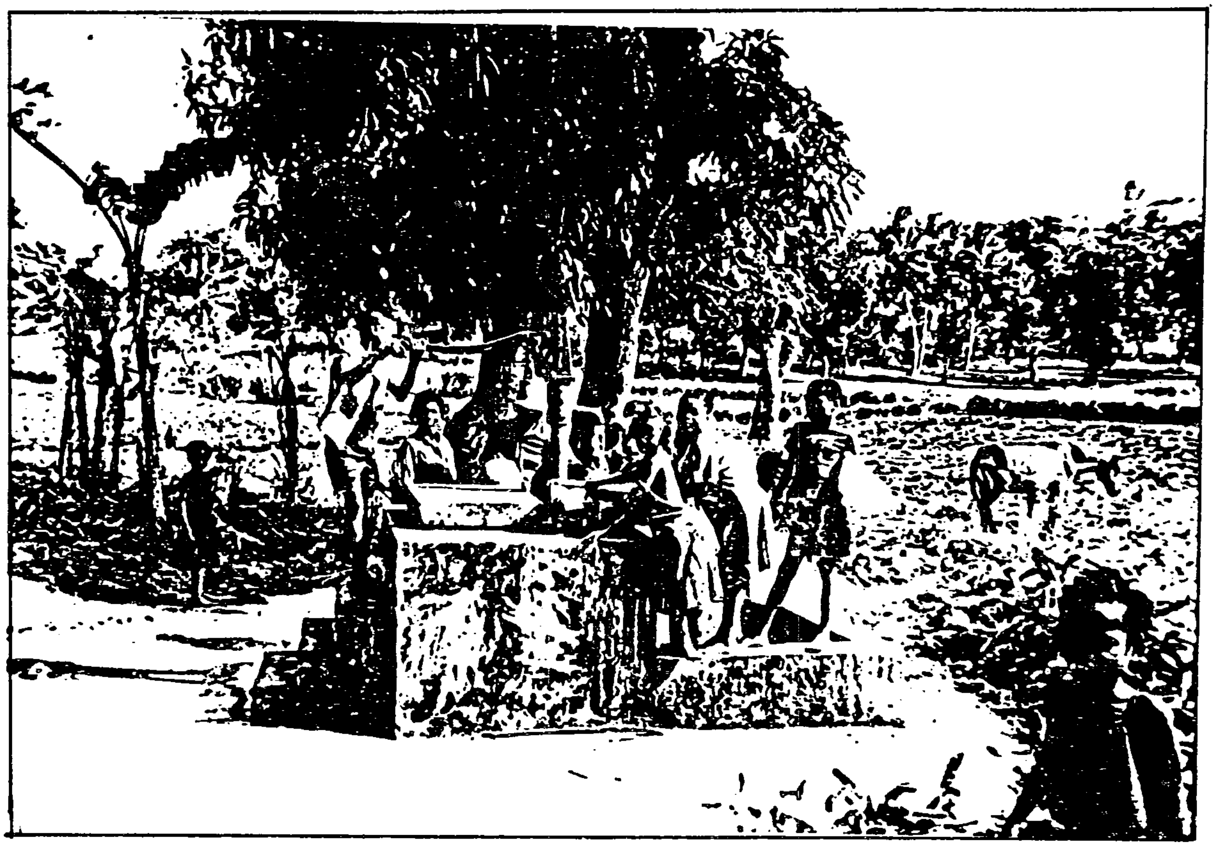
3.2.2 Secure Drop Pipe and Drop Rod

The initial plan was to purchase galvanized drop pipe and galvanized drop rod in the Dominican Republic and ship it to Haiti for this project. Following unsuccessful attempts to ship handpumps to Haiti overland from the Dominican Republic, however, it was decided to purchase these supplies in Haiti. A galvanized drop pipe was purchased in Les Cayes, approximately 25 miles from the test area of Camp Perrin. Attempts to purchase a galvanized drop rod were unsuccessful; therefore, a hot-rolled steel rod was purchased from the same company that supplied the drop pipe.

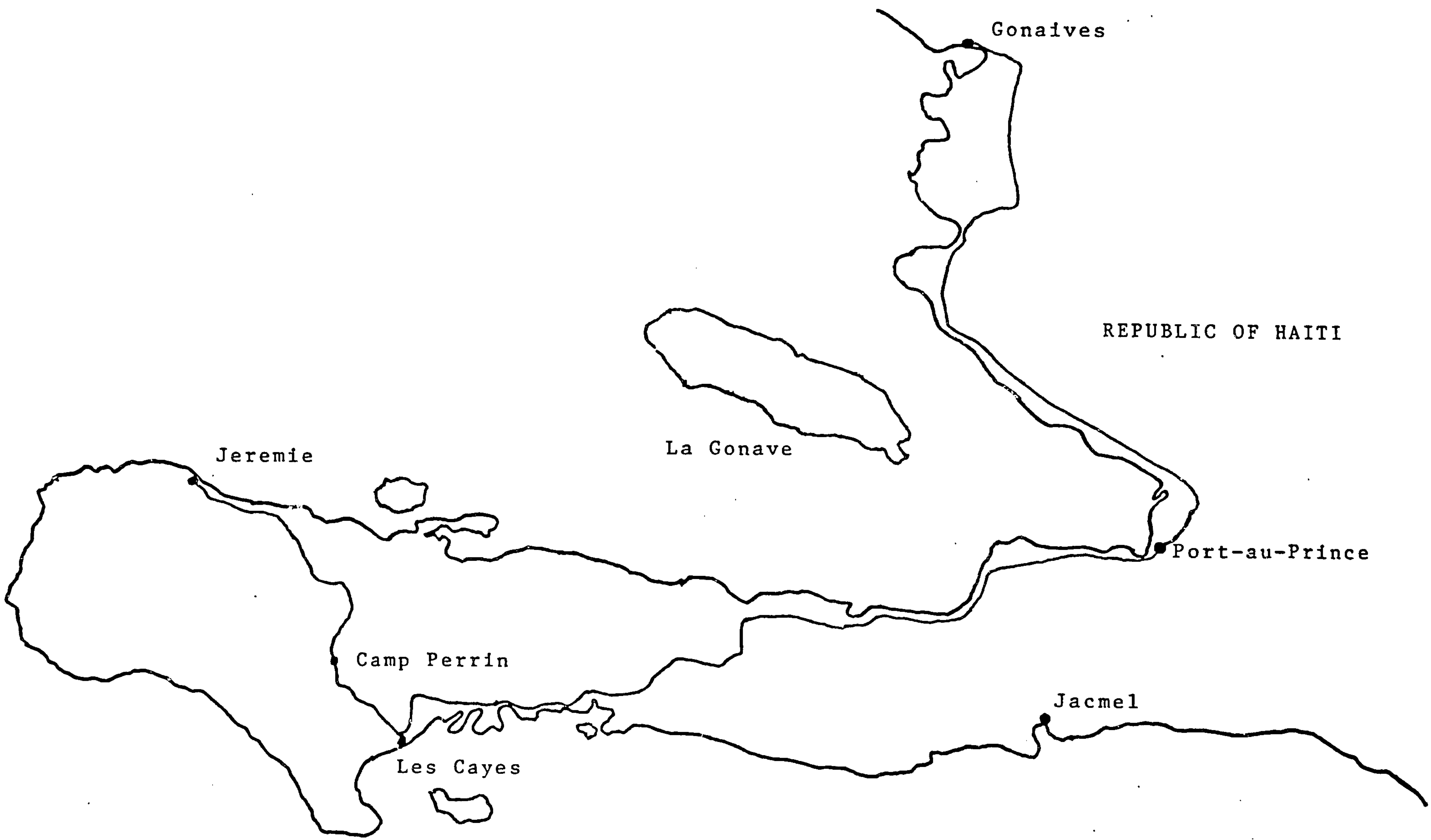
3.2.3 Identify Test Well Sites, Construct Upper Structures, and Install Handpumps

Beginning in September 1981, several areas of Haiti were investigated as possible test well sites. These included the areas near Cap Haitian, around Gonaives, in the vicinity of Camp Perrin, and on the island of La Gonave (see Map 1). Ultimately, Camp Perrin was selected because there were more than 20 well sites within a ten-mile radius of this village. These wells included both deep and shallow wells, tube wells, and dug wells. The compelling attraction, however, was the presence in Camp Perrin of the Atelier Ecole de Camp Perrin, which was a general machine shop/fabrication shop operated by United Nations Development Program (UNDP) volunteers. In addition to having manpower and shop tools available, these UNDP volunteers were involved in a well-digging program and were interested in manufacturing some type of handpump. With the assistance of the UNDP volunteers and personnel from the AID Mission in Port au Prince, 13 well sites were selected (see Map 2). A work order was then issued to the Atelier Ecole for construction work necessary to construct suitable masonry upperstructures to accommodate the AID handpumps. Sixteen AID handpumps were then installed (see Maps 1 and 2).

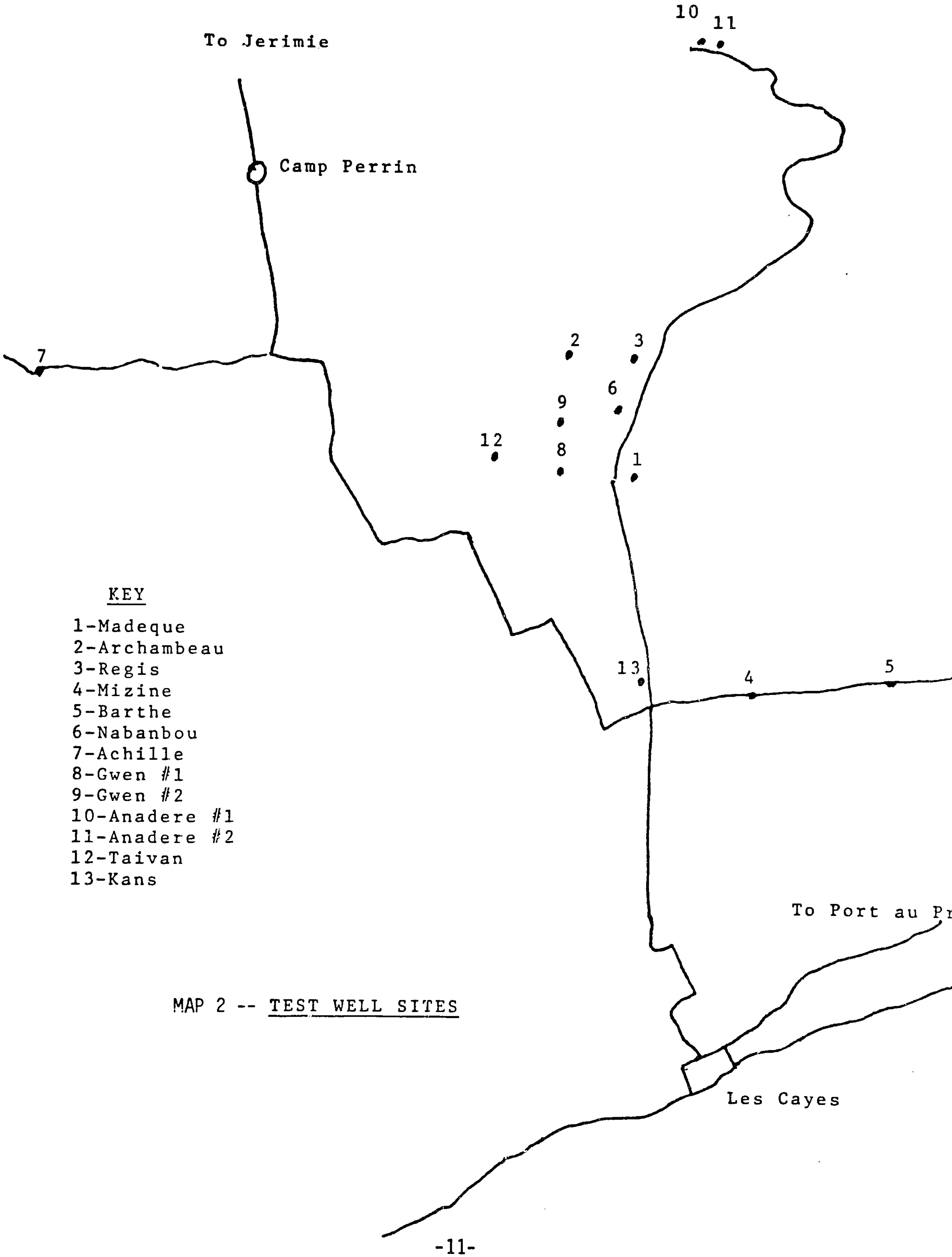
ILLUSTRATION 1



AID HANDPUMP INSTALLATION AT MADEQUE



MAP 1 -- SOUTHWEST PENINSULA OF HAITI



KEY

1-Madeque
2-Archambeau
3-Regis
4-Mizine
5-Barthe
6-Nabanbou
7-Achille
8-Gwen #1
9-Gwen #2
10-Anadere #1
11-Anadere #2
12-Taivan
13-Kans

MAP 2 -- <u>TEST WELL SITES</u>

3.2.4 Identify and Develop a Long-Term Maintenance System

Beginning in late 1981, efforts were begun to identify an organization that would be capable of providing long-term maintenance for a handpump program in Haiti. The following organizations were contacted to determine their interest in and ability to become involved with the AID handpump program:

- CARE
- Compassion International
- Baptist Convention of Haiti
- Atelier Ecole de Camp Perrin
- World Hunger Relief, Inc.
- UNICEF
- Organization de Development de Nord (ODN)
- World Team Mission.

Although many of these organizations had the commitment and the ability to become involved in the effort, each seemed to have territorial limitations within Haiti.

Because of the continuing involvement of these organizations in their own well-digging programs and because of the mechanical facilities and trained workers available, it was decided to concentrate the efforts to develop a long-term maintenance system on the Atelier Ecole de Camp Perrin. At the time, it appeared that this organization had all of the essential elements necessary to support a local handpump program. As a result, project engineers spent more than 26 weeks during the two and one-half year period in the Camp Perrin area training both Atelier Ecole workers and residents of the communities to develop a long-term maintenance system for the AID handpumps. Unfortunately, such a system was never successfully launched.

3.2.5 Train Personnel in the Installation, Operation, and Maintenance of Handpumps

The only people trained in installation and maintenance of handpumps were workers from the Atelier Ecole. Eight young Haitian workers were trained and became proficient in AID handpump installation and maintenance to the point that they are now capable of operating independently as a team with little, if any, expatriate involvement. Other workers in the Atelier were trained in heat treating procedures and leather pump cup manufacturing procedures.

3.2.6 Conduct a Rapid Feasibilty Assessment of Local AID Handpump Manufacture

In late 1981, a survey was conducted, with the assistance of local AID personnel, of foundry/machine shops capable of producing the AID handpump. Only one such machine shop was identified, the Fonderie National in Port au Prince. While this company was somewhat marginal regarding its machine shop capability, the foundry appeared to be above average in both equipment and technique. This company was subsequently given $500 with which to purchase wood patterns to make sample AID handpumps.

Later the company manufactured several handpumps, however, they were found to be of inferior quality. Because the project was not authorized to provide technical assistance to this company, the poor quality was simply noted. One of the pumps manufactured by this company was tested at a handpump facility in Atlanta. It broke down quickly and could not be repaired.

3.2.7 Install Mono, Moyno, and Malawi Handpumps

Three Mono handpumps and three Moyno handpumps were donated by their respective manufacturers for field testing in Haiti and for laboratory testing at GIT under a separate WASH contract (the results are covered in a separate report). In addition, two Malawi pump superstructures were purchased from the manufacturer for field testing in Haiti and for laboratory testing (these results are also covered in a separate report). In late 1983, a Mono, a Moyno, and a Malawi handpump were installed at field test sites near Camp Perrin (see Illustrations 2, 3, and 4).

3.2.8 Replace the Moyno Handpump with a Mono Handpump

In early 1984, an inoperable Moyno handpump was removed from a field test site and replaced with a Mono handpump. (See Appendix H for details of failures.)

3.2.9 Obtain a User Count on Two Test Wells

Beginning with the first contract with the Atelier Ecole for pump performance monitoring and repair, attempts were made to obtain reliable data on the number of users of each pump on the test wells. Unfortunately, there were many delays. When the user survey was finally carried out by Atelier Ecole personnel, the resulting data were suspect and, therefore, considered invalid. In April 1984, a 14-hour user survey was conducted on two representative test wells (see Appendix A).

3.3 Significant Problems or Events

The following statement from a February 1982 U.S. General Accounting Office (GAO) report, Assistance to Haiti: Barriers, Recent Program Changes, and Future Options, sums up the kinds of difficulties the demonstration project experienced:

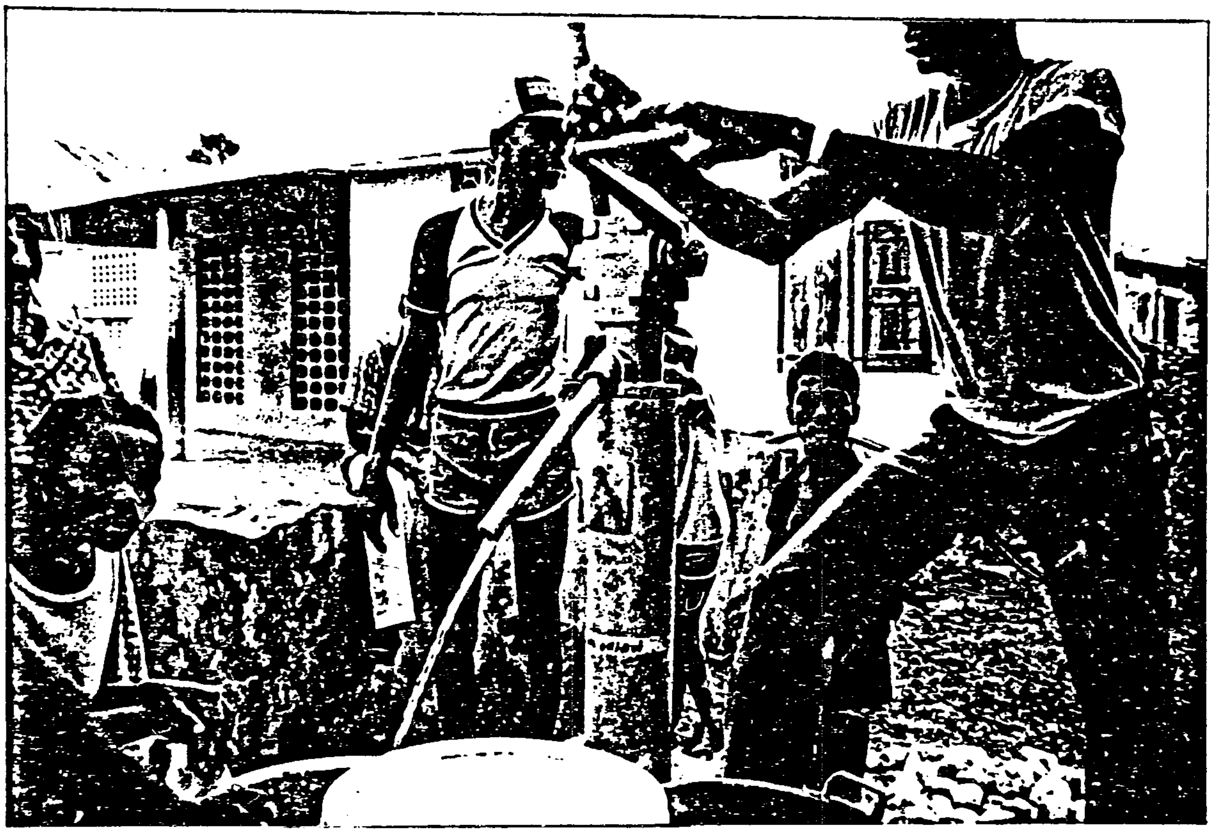
> "Since 1973, the United States has provided Haiti approximately $218 million in food, aid, and economic assistance. After eight years of operating in Haiti, AID is still having difficulty implementing its projects. Past projects, designed to improve Haitian Government institutions, have had only limited impact, and many projects have suffered serious delays."

It is difficult to conduct technical projects in Haiti. Proper tools and materials are not readily available, adequate skills are scarce, and the Haitian work ethic is often difficult for outsiders to understand. This project was not immune to such problems including:

ILLUSTRATION 2

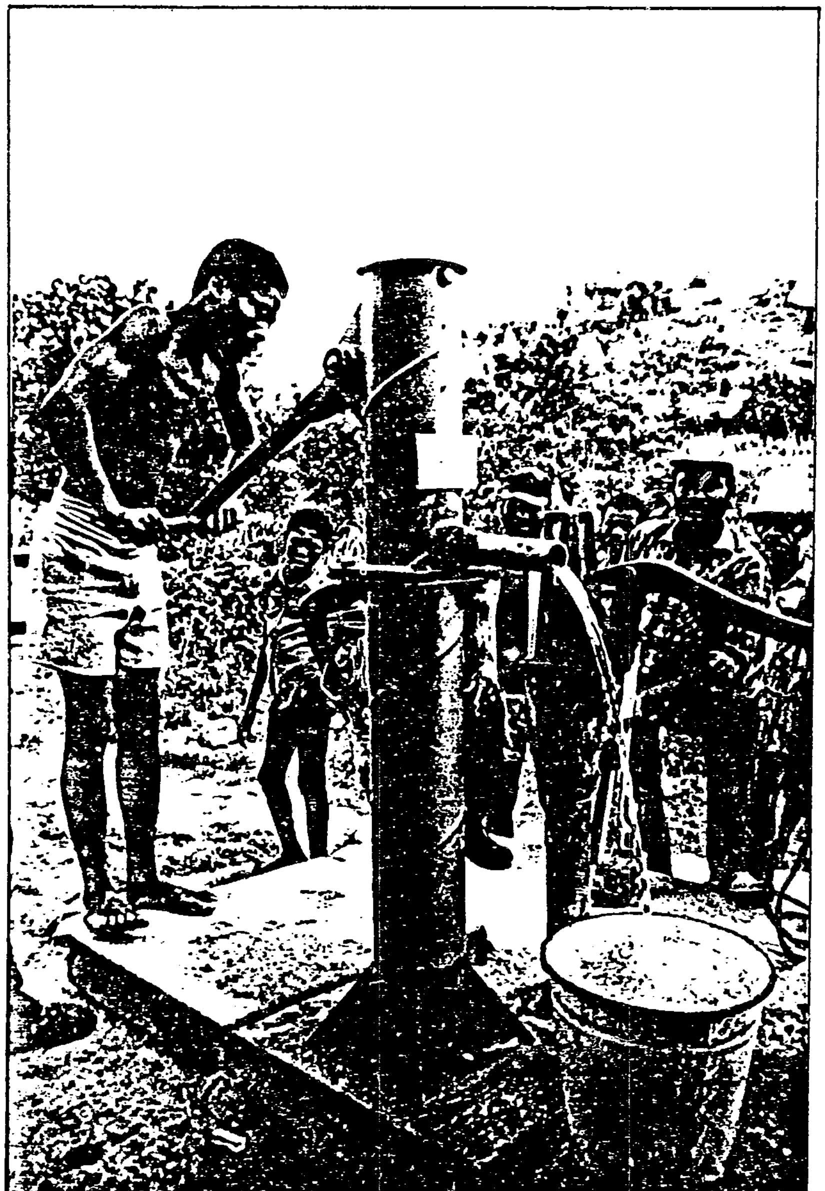
MONO HANDPUMP INSTALLATION AT MIZINE

ILLUSTRATION 3



MOYNO HANDPUMP INSTALLATION AT KANS

ILLUSTRATION 4



MALAWI HANDPUMP INSTALLATION AT TAIVAN

- The limited interest of the government
- The lack of strong local community involvement
- Poor pump quality
- Difficulty in obtaining spare parts
- The poor performance of the local handpump maintenance and monitoring program
- Poor lines of communication and supply
- Transportation problems
- Unforeseen occurrences
- The high number of beneficiaries per pump
- Project shutdown difficulties.

3.3.1 Limited Interest of Government

Unlike other AID handpump projects, this project had no government involvement in this project. This fact hampered the ability to plan for or think in long-range terms about handpump maintenence, repair, and installation programs conducted by Haitians and for Haitians.

3.3.2 Lack of Strong Local Community Involvement

As noted the GAO report mentioned above, the Haitian level of poverty limits the peasant's concern to anything more than short-term economic survival. Moreover, projects which depend upon community cooperative actions do not parallel the local traditions of "every man for himself." This reality makes a traditional handpump project with village caretaker involvement and community pride of pump ownership difficult to implement in Haiti. It was noted during this project that only in those few communities with a strong local leader (that is, a pastor of a church, a local witch doctor, and so forth) was there any semblance of communal concern for the care and maintenance of a handpump.

3.3.3 Poor Pump Quality

Because of the proximity of the Dominican Republic to Haiti, AID handpumps manufactured in the Dominican Republic were chosen for this project. It was soon discovered, however, that those handpumps were of extremely poor quality (see Appendix B). All of the pumps had to have their steel pins and bushings replaced to ensure proper hardness. Also, because of extensive porosity in the cast iron pump components, much breakage occurred, especially when attempts were made to press fit the steel bushings. The quality of the threaded components was poor, thereby causing many leaks and necessitating several retightenings after the pumps were installed. Poor quality in the threaded rod ends contributed to pump-rod breakage at the threads, the most prevalent field failure. The piston leather cups were nonuniform in thickness and overall quality. These cups were coated with a hard tar-like substance which had to be removed prior to installation. Finally, many of the PVC cylinder liners in the shallow-well version of the handpumps were loose in the steel pump stand and required the use of a sealant to prevent their being displaced.

3.3.4 Difficulty in Obtaining Spare Parts

Because many of the Dominican Republic handpumps varied dimensionally from one another and from those manufactured in other countries, the component parts were not interchangeable. This situation necessitated using spare parts only from the manufacturer in the Dominican Republic. Unfortunately, these spare parts were also of extremely low quality and had to be modified at the Atelier Ecole in Haiti to accommodate hardened pins and bushings produced in the United States. Producing spare parts at the Fonderie National in Port au Prince was considered, but the quality levels from that manufacturer were even lower than those of the Dominican Republic. Ultimately, technical personnel at the Atelier Ecole were trained to produce hardened pins and bushings as well as leather cups. Orders were then placed with the Atelier Ecole for these spare parts, but they were never produced.

3.3.5 Poor Performance of the Handpump Maintenance and Monitoring Program

A service agreement (see Appendix C) with the Atelier Ecole de Camp Perrin was initiated in December of 1982 and was scheduled to be in effect for 11 months. This agreement contained four major work elements:

- <u>Pump Monitoring</u>, including periodic visits to each test site to determine the pump's condition and the water output. It also included a two-day user survey of each test well site.

- <u>Pump Maintenance</u>, including periodic lubrication of the pumps and minor on-site repairs.

- <u>Pump Repairs</u>, including stocking repair parts (supplied by the project) and replacing broken or worn out pump components, such as cylinder components, drop pipe and drop rod, pump superstructure components, and concrete well-cap structures.

- <u>Reporting</u>, including the provision of data on pump breakdowns, routine maintenance, unusual events, community acceptance, and information on number of users (see Appendix D).

For various reasons, this work program was never effectively carried out by the Atelier Ecole. Some pumps remained broken for long periods before they were repaired. Monthly reports were not received on a regular basis and were of questionable quality. No monthly invoices or requests for additional spare parts were ever sent to WASH. It appeared that the only real interest shown by the Atelier Ecole in this monitoring and maintenance program was during the periodic visits by the project's field engineers.

It was anticipated that the service agreement would be extended in October 1983 until April 1984. In October 1983, the Atelier Ecole submitted a proposal for a service agreement to provide handpump maintenance through April 1984 (see Appendix E). Even though the cost of this proposed six-month effort was considerably higher than the cost of the previous eleven-month program, it was considered reasonable. Following discussions with the WASH office, the Atelier Ecole was informed that it should continue the monitoring and maintenance in anticipation of a new agreement which would be prepared by the project. In January 1984, when the new agreement was returned to the Atelier Ecole, it was found that only half of the handpumps were working and that no monitoring records had been maintained and probably no visits had been made to the well sites during the previous two and one-half months. Consequently, the field engineer telephoned the WASH office and recommended that the service agreement not be renewed. This recommendation was ultimately accepted.

3.3.6 Poor Lines of Communication and Supply

When the area for field testing the handpumps was selected, several factors were considered. Among those factors were:

- Accessibility of wells
- Availability of deep wells and shallow wells
- Well cluster (wells to be within ten miles of a central location)
- Mechanical shop facilities at the central location
- Trained machinists available
- Availability of a PVO to assist in managing the handpump program
- Availability of vehicles.

The Atelier Ecole de Camp Perrin, a PVO-sponsored mechanical facility, seemed to meet all the requirements. Also the Camp Perrin area offered many wells which met the requirements of clustering, depth, and accessibility. Thus, Camp Perrin was an obvious choice as a test area. Soon after initiating the field work on this project, however, it became apparent that because of the remoteness of the area (150 miles from Port au Prince and 25 miles from the nearest small city, Les Cayes), communications and transportation would be a problem. As a result of transportation difficulties, supply was also a problem. Critical supplies were unavailable in Les Cayes and had to come from Port au Prince. Camp Perrin had no telephones; any calls, therefore, had to be made from Les Cayes. It was impossible to make telephone calls to the Atelier Ecole from the United States. The only lines of communication from the United States to Camp Perrin were by mail (three to four weeks) and by asking the AID Mission personnel in Port au Prince to relay messages or to obtain information during their infrequent visits to the Camp Perrin area. Had there been a more direct method of communication, many of the problems and misunderstandings might have been resolved or limited.

3.3.7 Transportation Problems

The AID Mission in Port au Prince had a limited number of vehicles and could not furnish the field crews with a four-wheel drive vehicle during their visits. Rental four-wheel drive vehicles could only be obtained from agencies in Port au Prince, were exorbitantly expensive ($150 to $200 per day), and were in poor repair. At the beginning of this project, field crews would rent sub-compact autos in Port au Prince, drive to Camp Perrin, and then depend upon the truck of the Atelier Ecole for field transportation. Unfortunately, in early 1982, this truck was wrecked and from then on an expatriate from England, who operated a weaving shop in Camp Perrin, was persuaded to rent his four-wheel drive truck to the project as his business operations permitted. His condition for renting was that he drive. This arrangement turned out to be extremely valuable for the project. The owner of the vehicle spoke fluent

Creole (the patois of the rural area) and was able to provide invaluable translating assistance. Unfortunately, this individual was not always available, and much time was spent waiting to obtain suitable transportation.

3.3.8 Unforeseen Occurrences

The handpump project in Haiti suffered numerous problems as a result of unusual or unforeseen occurrences. A combination of unusually heavy rains during the rainy seasons and severe drought in the dry seasons affected not only the ability of the crew to install and maintain the pumps but also the pumps' performance. During the drought, wells that had not previously gone dry did so. Villagers, not understanding the use and function of pumps, would attempt to operate them when the wells were dry. Frustrated at not getting any water, villagers would sometimes try to pump harder and faster and would ultimately break the pump.

The only truck of the Atelier Ecole was wrecked in a near fatal accident that put the primary handpump program manager in a hospital in France for approximately six months. After returning to duty, this man contracted hepatitis and was further incapacitated for more than three months.

Serious personal problems experienced by other members of the Atelier Ecole also affected the handpump program to some degree.

One of the unforeseen occurrences that affected the handpump maintenance service program was that the Atelier Ecole began manufacturing a handpump of its own design which, in the opinion of the head of field activities, made them less than objective about the AID handpump testing activities.

3.3.9 High Number of Beneficiaries Per Pump

The AID handpump was designed to serve approximately 150 people. Prior to initiating this handpump program in the Camp Perrin area, it was known that the number of people using each well might exceed that figure, although no valid well-user data were available. It became apparent during the pump installation that the number of beneficiaries per pump would far exceed the 150 that the pump was designed for. Several unsuccessful attempts were made to obtain accurate user data using the Atelier Ecole. Finally, at the termination of field activities of this project, a user survey conducted by GIT field engineers indicated that some of the handpumps served more than 1,500 people (see Appendix A).

3.3.10 Project Shutdown Difficulties

At the termination of this project, only 5 of the 13 remaining AID handpumps were working. The two Mono pumps and the Malawi handpump were also working. Because there were to be no additional funds provided by AID for handpump maintenance and repair and because it was unlikely that any local organization would undertake such a task, consideration was given to removing all of the handpumps, thereby leaving the wells in their original condition. This action would have caused a substantial hardship for the people served by the three tube wells because pumps of some type are required to remove the water. Removing the inoperable pumps would have had a minimal effect because the people served by those wells had been drawing water with buckets and ropes through the well hatches.

After much deliberation, S&T/H, WASH, and the AID Mission in Port au Prince decided to remove the broken pumps and restore the well sites to their "original conditions or better." It was also decided to leave pumps still operating in place but to provide funds to the Atelier Ecole to remove the pumps at some later date (if the community made that request), and to restore the wells to their original condition. In addition, provision was made to transfer ownership of the pumps and all responsibility for repairing or paying for repairs to the communities (see Appendix F).

Two of the inoperable AID handpumps required only simple repairs. These repairs were made, and the ownership of seven AID handpumps, one Malawi handpump, and two Mono handpumps was transferred to the communities. Six AID handpumps were then removed (one from a dual-pump installation) and five wells were converted to installations that allowed the villagers to withdraw water with buckets and ropes safely and conveniently.

Chapter 4

OUTCOMES AND CONCLUSIONS

4.1 Summary of Data

Test data were obtained on the following four types of handpumps during the demonstration project in Haiti:

- USAID-design handpump manufactured in the Dominican Republic
- Moyno rotary handpump
- Mono rotary handpump
- Malawi handpump superstructure with AID handpump cylinder and piston assembly.

These pumps were monitored to determine the suitability and reliability of various types of handpumps under conditions of high use and minimal maintenance. Initially, 13 well sites were used and 16 AID handpumps installed, with three wells having dual-pump installations. Of the 13 wells, 10 were dug wells and 3 were tube wells, ranging in total depth from 18 feet to 200 feet and in static water level from 10 feet to 90 feet. Original user estimates could not be verified; therefore, user surveys were conducted on two well sites. There were just under 1,500 beneficiaries for one of these sites.

4.1.1 Pump Failures

Even though the monitoring and maintenance data provided by local organizations was incomplete, the following modes of failure were noted most frequently:

- Failure of the leather flapper foot valve
- Breakage of the drop rod in the topmost threaded position
- Destruction of the cotter pins which retain the handle and fulcrum pins, thereby causing the loss of pins, slider blocks, and sometimes fulcrums
- Leakage in the threaded sections of the pump body and pump base
- Failure of the leather piston cups
- Destruction of pins and bushings caused by wear brought on by a lack of lubrication.

4.1.2 Pump-User Data

It was difficult to obtain reliable user data on the 13 test well sites. Four were made to obtain this information:

- During test well site selection in 1981 the Atelier Ecole staff estimated that there were up to 350 beneficiaries per well.

- According to information provided by villagers during pump installations in 1982 there were up to 3,500 beneficiaries per well.

- A user survey was conducted on nine wells by the Atelier Ecole in 1983; however, the data from this survey appeared to be inconsistent and were not used.

- A user survey conducted on two representative wells by WASH field crews in 1984 indicated that one of the test well sites had nearly 1,500 beneficiaries.

4.2 Outcomes

4.2.1 Secure Design Handpumps and Spare Parts

In 1981, 20 USAID handpumps were purchased from Equipo Technico in Santo Domingo, Dominican Republic, and shipped overland to Port au Prince, Haiti. Equipo Technico was the supplier of all of the AID handpumps used in the Dominican Republic handpump program.

After arriving in Port au Prince, these pumps were inspected and found to be of unacceptable quality. When informed of the inferior quality, the manufacturer agreed to replace these pumps. After many long delays in attempting to ship the replacement pumps to Port au Prince overland, it was decided to ship them by air freight. (Overland shipments between Haiti and the Dominican Republic are subject to many bureaucratic delays and sometimes serious irregularities at the border.) Within one week of this decision, the pumps arrived in Port au Prince.

It was decided to keep the first 20 handpumps to be used for spare parts, where possible.

4.2.2 Secure Drop Pipe and Drop Rod

Galvanized drop pipe and hot-rolled steel rod were secured in Les Cayes, a small city approximately 25 miles from Camp Perrin. The OTD originally directed that galvanized pipe and rod be purchased in the Dominican Republic and shipped to Haiti. However, because of problems and delays in shipping, sources of supply in Haiti for the pipe and rod were investigated. It was found that galvanized pipe was readily available, but not galvanized rod. Only hot-rolled steel rod was available. The galvanized pipe was of acceptable quality, but the steel rod was of inferior quality because it was not uniform in size. This caused many problems with threading and contributed to numerous pump failures in the field. Most of these failures were caused by a rod breaking in the threaded section as it entered the pump rod end. The axis of the threaded hole in the rod end was not perpendicular to the axis of the unthreaded hole that accommodated the pin. This angularity caused a slight flexure in the drop rod as the pump was operated. In time, this flexure caused fatigue failure in the thread roots of the drop rod and also contributed to pump failure.

4.2.3 Identify Test Well Sites, Construct Upper Structures, and Install Handpumps

Many areas of Haiti were considered and investigated for test-well sites. Plans initially called for test sites to be scattered in various areas of Haiti. Because of the added expense of travel and logistical problems, however, it was decided to concentrate all of the sites in the Camp Perrin area (see Map 2). These sites included three recently drilled tube wells with six-inch diameter casings. The other ten sites were all dug wells (see Appendix G). The dug wells all required modifications to the slab to accommodate the handpumps. All of these wells had had only rectangular openings in the slab so that buckets and ropes could be used to draw the water. The three tube wells had never been used. After these tube wells had been drilled, the six-inch casings had been cut off approximately two feet above the ground and plates welded over the openings. Concrete block structures one meter square and one meter high were built around the well heads, filled with rocks, and covered with a concrete slab. After these structures were completed, 13 AID handpumps were installed.

Three of the dug wells were later modified to accommodate two AID pumps each. Adding these pumps did little to provide additional water because the villagers and the maintenance and repair group would usually allow one of the two pumps to remain out of commission most of the time. The reason for this was never determined.

4.2.4 Identify and Develop a Long-Term Maintenance System

After several organizations in Haiti had been contacted to determine their interest in handpump programs, the Atelier Ecole de Camp Perrin was selected as having the best combination of apparent commitment and ability in this field. In addition, there were many wells in the vicinity which could serve as test sites. The project contracted with the Atelier Ecole to modify the 13 test sites so that the AID handpumps could be installed. Ten of these 13 sites were open wells, and the other three sites were unused and unimproved tube wells. There were many delays in modifying the test wells. These delays were caused, in part, when some members of the Atelier Ecole's management team involved with the handpump program would not clearly communicate their intended plans and schedule to other members of the management team.

After the 16 AID handpumps were installed on the 13 wells, the project engineers trained a team of workers from the Atelier Ecole in AID handpump installation, maintenance, and repair. The Atelier Ecole was then contracted to maintain, repair, and monitor the performance of the handpumps for an 11-month period. Special forms for recording performance and repair data were supposed to be filled out monthly (or after major repairs) and mailed to the project. However, monitoring data was insufficient, and reports were not received regularly.

In late 1983, while a renewal handpump monitoring contract with the Atelier Ecole was being written, an oral agreement was made with the Atelier Ecole to continue the monitoring program. During this period, however, no reports were written, and, according to WASH field crews, little maintenance was performed.

As a result, the renewal contract was not offered to the Atelier Ecole. In April 1984, workers from the Atelier assisted field crews in removing six handpumps from test wells and converting the wells so that water could be drawn with buckets and ropes.

4.2.5 Train Local Personnel in the Installation, Operation, and Maintenance of Handpumps

Eight workers from the Atelier Ecole were trained in the installation, maintenance, and repair of handpumps. Attempts to train villagers in simple handpump maintenance were not successful, because they were not interested and also because few had sufficient mechanical aptitude.

4.2.6 Conduct a Rapid Feasibility Assessment of Local AID Handpump Manufacture

After a brief survey, one foundry/machine shop that had the potential capability to manufacture AID handpumps was found. This shop was given funds with which to purchase wood patterns for the cast components of the handpump. AID-design handpumps were subsequently produced by this company. One of these pumps was shipped to AID's handpump testing facility in Atlanta and others were purchased and installed by the Baptist Convention of Haiti. Performance data from laboratory tests and field installations indicated that the pumps produced by this manufacturer were not of acceptable quality. No technical assistance was given to this company.

4.2.7 Install Mono, Moyno, and Malawi Handpumps

To obtain comparative handpump performance data, AID handpumps were removed from three well sites and were replaced by a Mono, a Moyno, and a Malawi handpump.

4.2.7.1 Mono Handpump

Manufactured in England, the Mono handpump is a rotary progressive cavity-type pump driven by a hand-operated gearing mechanism. It was installed in December 1983 on a six-inch diameter tube well with a total depth of 71 feet and a static water level of 41 feet (see Illustration 2). After approximately two months of use, this pump failed (see Appendix H). It failed because moisture entered the gear box, and caused the shaft to rust and freeze inside the ring gear. This caused the ring gear to turn in reverse and thereby to unscrew the rotor rod joints connecting the gear box to the pump cylinder. This pump was repaired by removing all of the components in the gear box and refinishing the shaft in a lathe. After reassembly, grease was applied on the shaft to prevent further rusting. Four months after these repairs, the Mono handpump was still operating satisfactorily.

4.2.7.2 Moyno Handpump

This handpump, manufactured in the United States and Canada, is also a rotary progressive cavity-type pump driven by a hand-operated gearing mechanism. The Moyno handpump was installed in October 1983 on a six-inch diameter tube well with a total depth of 200 feet and a static water level of 121 feet (see Illustration 3). The pump operated for three hours and then failed. The rotor rod broke in the threaded section, that is screwed into the gear head.

The gear head was removed, the rotor rod rethreaded, and the gear head reinstalled. The pump operated for three days and failed again. The failure was again caused by rotor rod breakage at the same location. The entire handpump assembly (gear head, drop pipe, rotor rod, and rotor/stator assembly) was removed and all of the components inspected. The only anomaly found was that a standard "off-the-shelf" 2-inch to 1-1/4 inch bushing used to adapt 1-1/4 inch drop pipe to the 2-inch pipe threads in the gear head was faulty. The fault was that the central axis of the 1-1/4 inch threads instead of being coaxial with the 2-inch thread axis had an angular deviation of approximately five degrees. This faulty reducing bushing was replaced, the rotor rod rethreaded, and the handpump assembly reinstalled.

The handpump operated satisfactorily for three more days and failed again. This time the cause of failure was found to be rotor rod breakage in the threaded section that is screwed into the pump rotor. The rotor rod was removed, the gear head was reinstalled and the handpump was left inoperable until it was replaced in January 1984 with a Mono handpump.

4.2.7.3 Malawi Handpump

This handpump, manufactured in Africa, consisted of the above-ground structure only. This mechanism was designed without an articulated fulcrum. This causes the point of attachment to the drop rod to be translated laterally about two inches as it swings through its arc. The Malawi pump was installed in October 1983 on a dug well with a total depth of 55 feet and a static water level of 41 feet (see Illustration 4). The installation was made using a three-inch diameter AID-design pump cylinder assembly manufactured in the Dominican Republic. This handpump had three failures in five months of operation. All of the failures were caused by breakage in the topmost threaded section of the drop rod that is screwed into the handpump rod end.

4.2.8 Replace the Moyno Handpump with a Mono Handpump

After repeated failures, the Moyno handpump was removed and replaced with a Mono handpump. Because the replacement handpump had internal components identical to the first Mono handpump, which had been installed at another site and had failed, it was anticipated that this pump would also fail. An engineer associated with the Atelier Ecole was informed about the types of breakdown to expect and instructed in suitable repair techniques. The pump was installed without incident, operated for approximately two months, and failed in the mode predicted. The engineer from the Atelier Ecole was able to get the handpump repaired and back in service in a short time. The Mono company has subsequently furnished additional component parts with a modified design which have been sent to the AID Mission in Haiti.

4.2.9 Obtain a User Count on Two Test Wells

After unsuccessful attempts to get the Atelier Ecole to obtain reliable data on test-well usage, it was decided to conduct a user survey on two well sites using project field staff. The two wells chosen were considered to be representative of all the test wells in this project. The user survey was conducted from 6:00 a.m. until 8:00 p.m., with the number of users recorded every 30 minutes. Also noted were the sex and age of the users (child or adult). Information was also obtained on the size and number of water containers used (see Appendix A).

For one of the wells surveyed, it was determined that the total number of beneficiaries (family members receiving water from the well) was approximately 1,500. For the other well, the number of beneficiaries was approximately 400. After the survey, it was determined that only 200 meters from the second well site there was a small canal that, due to heavy rains, was providing water to many families who would normally use this well.

4.3 Conclusions

4.3.1 AID Handpump Design

The AID handpump design is unsuitable for use in areas of Haiti where user rates are extremely high and there is a lack of routine maintenance. The lack of mechanical ability and low community interest precluded maintenance by the village caretaker system (used successfully in other countries) during this test program.

4.3.2 Poor Quality of the Dominican Republic AID Handpumps

Even with extremely high quality AID handpumps that meet all specifications, Haiti would have been a severe test for this pump design. However, the pumps used for this test were of low quality as a result of poor threads, poor piston leathers, unhardened pins and bushings, noninterchangeable parts, and extreme porosity in cast components.

4.3.3 Underestimation of Users in Test Well Sites

At the beginning of this project, the number of beneficiaries per pump was grossly underestimated. User estimates were based on information supplied by villagers and by members of the Atelier Ecole management team. It became evident soon after the pumps were installed that the project had become an accelerated life test of the AID pump design.

4.3.4 Inadequate Commitment of Counterpart Organization

During the initial phases of this project, when various test sites were being considered, members of the Atelier Ecole's management team were enthusiastic about the project and pleased that their area and facilities were to be chosen. This initial enthusiasm was misinterpreted as a long-term commitment to handpump programs. It was also wrongly assumed that the entire Atelier Ecole operation was owned and funded by UNDP. As it turned out, the Atelier Ecole received little funding from UNDP and depended upon outside sources such as AID to provide payment for services (see Appendix I).

4.3.5 In-Country Capability to Manufacture AID Handpumps

At present no shop capable at manufacturing quality AID handpumps has been identified in Haiti. One foundry/machine shop in Port au Prince, if provided technical assistance, could produce a limited number of handpumps annually.

4.3.6 Logistics

Because of the selection of Camp Perrin as a test area, the project outran its lines of supply and communication. It was extremely difficult to obtain tools, equipment, supplies, and spare parts, either from the United States or from the Dominican Republic. Communications to the Atelier Ecole from the United States had to be relayed through the AID Mission in Port au Prince. Because Port au Prince was more than 150 miles from Camp Perrin, special trips to relay messages were out of the question. Communications by the project staff with Port au Prince or the United States while working on site were also difficult. Because there were no telephones in Camp Perrin, project staff had to drive 25 miles to Les Cayes and place calls from the local telephone office (usually a two- or three-hour wait). Because of these communication problems, there were numerous delays on the project and many misunderstandings between the project and the management team of the Atelier Ecole.

Chapter 5

RECOMMENDATIONS

Many lessons were learned from this demonstration project; most of them were about how not to conduct a handpump program. It is also obvious at this time that the handpump program in Haiti will not be continued. It is difficult in such a case to make specific recommendations related to the statement of work or to the future of this particular program. General recommendations will, however, be made on future handpump projects.

5.1 The Order of Technical Direction (OTD)

Background. The OTD is the basis for all activities related to handpump projects. It is used by the WASH office to issue work authorizations to its subcontractors. However, many times the primary purpose of the OTD is not too clear.

Recommendation. It is recommended that a brief statement of purpose be included as part of each OTD. The AID program officer understands the desired end result, but unless it is communicated effectively to the subcontractor, there is great potential for confusion. Further, it is frustrating for the AID program officer who does not obtain the anticipated results. It is also recommended that when an OTD is issued, a brief meeting be held with AID representatives, WASH representatives, and subcontractor representatives. The entire statement of work can then be reviewed and discussed so that the subcontractor is better able to satisfy the clients.

5.2 AID Handpumps Used in Handpump Programs

Background. On most AID handpump programs, the pumps are manufactured in the same country where the field installations will be carried out. Further, manufacturing technical assistance is usually an integral part of this type of program. In Haiti, however, the AID handpumps were manufactured in another country. By the time it was discovered that the poor quality of these particular handpumps was contributing to premature pump failures, it was impossible to tell whether the major cause of failure should be assigned to poor quality or to high usage.

Recommendation. In future projects of this type, only AID handpumps of acceptable quality should be used. If high quality handpumps are not readily available, the project should be delayed until they are.

5.3 Host Country Involvement

Background. WASH and its subcontractors are accustomed to working on AID handpump projects in countries where there is a reasonable degree of host country government involvement (usually with the Ministry of Health). They also expect a reasonable degree of involvement by members of host country communities. In Haiti, however, there was no governmental involvement, and the members of the individual communities seemed uninterested in all aspects of this handpump demonstration project, except for receiving water from the pumps.

Recommendation. It is recommended that the contractor acquire, at the earliest stage possible, timely information to help overcome problems associated with cultural, governmental, or geographical peculiarities of the countries in which they will work. If it is believed that there will be insufficient governmental and community involvement, the contractor should advise AID not to undertake the project.

APPENDIX A

Test Well User Survey

HAITI USER SURVEY

INTRODUCTION

In 1981, a manually operated pump demonstration program was initiated in Haiti. Sixteen AID/Batelle pumps manufactured in the Dominican Republic were installed in the vicinity of Camp Perrin, a densely populated region in the Western peninsula approximately 150 miles from Port-au-Prince.

All of the pumps failed many times because of the high number of users. The number of users per pump was initially estimated to be high because this area of Haiti has an extremely high population density and there are limited sources where communities can gather potable water, especially during the dry season. In addition, when inspecting pump test sites, the almost constant use of the pumps by community members was observed as the norm rather than the exception.

The Atelier Ecole at Camp Perrin conducted a user survey to establish data on the number of users, but some of the results appeared grossly inflated and were, therefore, considered invalid. On May 1, 1984, Georgia Tech personnel conducted a one-day user survey at two test sites where Mono pumps were installed on tube wells.

BACKGROUND

The day before the survey, personnel went to the Kans site to observe user patterns, determine potential problems, and estimate the quantity and accuracy of information that could realistically be gathered. From these observations, a standard data-gathering procedure was established to be followed the next day for the survey at the two sites.

The team was then able to anticipate some of the problems that would be encountered during the actual survey. At peak times during the day there would probably be a large number of users at the pump making it difficult to extensively interview each one of them. Also, a large percentage of the water gatherers would be children and the information supplied by them would not be reliable since they often give contradictory responses. Finally, it would be entirely possible that the users could misinterpret the purpose of the questions and distort their answers (for example, on how often they come to the well or how much water they use) in the belief that the pump was to be removed or a user fee imposed.

The team concluded that user answers to detailed questions would not be reliable and conducting such interviews would be impractical given the number of users expected. It was decided then, that the only specific information to be asked of the users was the number of people residing in his or her home. The remainder of the data for the survey would be gathered by direct observation. A missionary from the Citie Lumiere arranged for two of his workers that had mathematical skills and the language capability to assist the two Georgia Tech engineers conducting the survey.

Because the survey would be conducted at separate wells, this trial survey was necessary to standardize the data-gathering procedure. For instance, initial ideas on how to classify the water containers proved infeasible because community members used a wide variety of containers (cans, pans, bottles, pots, buckets, gourds, and an odd assortment of jugs varying in size) to transport water so a classification by type of container was unrealistic. Taking this into consideration and the fact that the workers from the Citie Lumiere providing assistance would need to understand the classification criteria, it was decided to classify the water containers by three sizes "small" (two gallons or less), "medium" (two to five gallons), and "large" (five gallons or more). Under "small" were jugs, cans, bottles and gourds, under "medium" were dishpans and pots, and under "large" were large plastic and metal buckets.

A physician from the Camp Perrin hospital provided information that the average household size was seven persons, as indicated in the results of a population survey that had recently been conducted. It was also observed that water gathering began at sunrise and ended at sunset and that usually two trips were made by two family members a day to the well. The number of families served was estimated by dividing the total number of users by four (two members of the family gathering water twice a day). The total number of beneficiaries was estimated by multiplying the number of households (families) served by seven (average persons per household).

RESULTS

The pump at the Kans site operated from 6:30 a.m. to 8:00 p.m. (a total of 13.5 hours). The total number of users (water gatherers) was 222. According to the assumptions previously stated and the family size data, these data correspond to 56 families or 392 beneficiaries. The pump at the Mizine site operated from 6:00 a.m. to 8:00 p.m. (a total of 14 hours). The total number of users was 839. According to the assumptions and the information, these data correspond to 210 families or 1470 beneficiaries.

SURVEY COMMENTS

To prevent vandalism, both communities, Kans and Mizine, usually keep the pump locked during the night and during some periods of the day. As this could have affected the validity of the user count, the Project crew asked the pastor of the Kans community to leave the pump unchained and relay this message to the pastor at Mizine. Both pumps were to be unchained for two complete days before the survey so that the pump use could stabilize. Personnel arrived at the sites at 5:00 a.m. meeting the workers from the Citie Lumiere. Both pumps were chained and locked. The locks at Mizine and Kans were removed at 6:00 a.m. and 6:30 a.m., respectively, and the survey began.

Kans Site

At the initiation of the survey, the pump was difficult to operate due to the loss of the water column. This was probably due to a defective foot valve.

Once the drop pipe was full of water the difficulty of operation was eliminated. At 40 handle RPM, the flow rate was 5 GPM.

The pump operated on a continuous basis until 9:40 a.m. when it stopped briefly because of lack of users. The pump was not operated for five- to ten-minute periods at different times until 2:00 p.m., totalling approximately a half hour of idle time. As shown by data in the tables, the pump did not work at all from 2:00 p.m. to 2:30 p.m. It also stopped for ten minuces at 3:10 p.m.

The time sequences when the pump was idle and the numerical data of users show that the pump has less users than Mizine, which had users continuously all day at a rate of one user per minute, about four times the user rate at Kans. The lower user level at Kans was explained by the presence of a small canal that ran nearby. As it had rained heavily the previous few days, the canal had plenty of water and the people of the community found it easier to gather water from the canal than by operating the pump.

Mizine site

This pump was located in a densely populated area. People were continuously using the pump during the 14 hours of this survey. At 40 handle RPM, the pump flow rate was 5 1/2 GPM.

The pump operated on a continuous basis stopping only when brief arguments started among the users. On four occasions, these arguments escalated from yelling, pushing, and arm waving into physical violence, although none of the users involved suffered serious injury. Two men from the community came and organized the users into a line at 7:15 a.m. but by 9:30 a.m. the line broke up and the site went back to its previous mob-like operation. Most users walked to the pump site but some came, probably from greater distances, on either bicycles or mules. Other users did not carry the water to their homes but used it on the site either to wash clothes or to bathe children.

MIZINE USER SURVEY

Time (AM/PM)	Total Users	Total Women	Total Children	Total Men	Small Containers	Medium Containers	Large Containers	*Avg. Family Size
6:00-6:30	10	4	2	4	1	4	5	6
6:30-7:00	35	17	15	3	7	12	19	6
7:00-7:30	30	18	11	1	13	8	18	7
7:30-8:00	38	27	9	2	16	17	16	7
8:00-8:30	37	28	8	1	26	15	18	7
8:30-9:00	33	19	12	2	6	19	12	7
9:00-9:30	28	17	8	3	7	13	13	6
9:30-10:00	31	18	10	3	6	16	14	7
10:00-10:30	27	16	10	1	8	9	14	8
10:30-11:00	22	15	6	1	10	10	8	5

*Based on questioning random users.

MIZINE USER SURVEY

Time (AM/PM)	Total Users	Total Women	Total Children	Total Men	Small Containers	Medium Containers	Large Containers	*Avg. Family Size
11:00-11:30	28	16	10	2	16	13	10	7
11:30-12:00	23	15	7	1	7	10	12	6
12:00-12:30	39	23	5	11	18	15	16	7
12:30-1:00	·30	18	8	4	9	14	13	5
1:00-1:30	32	15	13	4	13	11	11	6
1:30-2:00	36	23	9	4	13	15	12	6
2:00-2:30	25	16	9	-	14	12	6	7
2:30-3:00	33	18	11	4	25	22	12	5
3:00-3:30	30	18	9	3	13	20	6	8
3:30-4:00	25	11	13	1	10	15	8	8

*Based on questioning random users.

MIZINE USER SURVEY

Time (AM/PM)	Total Users	Total Women	Total Children	Total Men	Small Containers	Medium Containers	Large Containers	*Avg. Family Size
4:00-4:30	38	18	18	2	17	24	8	7
4:30-5:00	28	13	10	5	8	13	14	7
5:00-5:30	31	18	7	6	16	14	13	8
5:30-6:00	28	20	4	4	16	15	11	7
6:00-6:30	34	18	10	6	23	17	8	8
6:30-7:00	33	21	7	5	25	11	12	7
7:00-7:30	27	13	7	7	11	8	15	7

*Based on questioning random users.

MIZINE USER SURVEY

TOTAL TIME

Total Time	Total Users	Women	Children	Men	Small Containers	Medium Containers	Large Containers	*Avg. Family Size
14 hrs.	839	491	253	95	364	383	339	7

*Based on questioning random users.

Assuming 2 visits by 2 family members

839/4 = 210 families

Assuming 7 persons per family (based on area wide survey conducted by Camp Perrin Hospital)

210 x 7 = 1470 community members served.

KANS USER SURVEY

Time (AM/PM)	Total Users	Total Women	Total Children	Total Men	Small Containers	Medium Containers	Large Containers	*Avg. Family Size
6:30-7:00	13	1	11	1	6	13	3	6
7:00-7:30	19	0	19	0	9	21	2	7
7:30-8:00	12	3	9	0	5	8	4	7
8:00-8:30	11	6	5	0	5	8	2	7
8:30-9:00	9	6	3	0	4	1	5	7
9:00-9:30	8	5	2	1	7	1	4	6
9:30-10:00	6	3	3	0	5	5	1	4
10:00-10:30	6	3	2	1	3	3	3	5
10:30-11:00	8	5	3	0	1	3	5	8
11:00-11:30	6	1	4	1	6	4	0	7

*Based on questioning random users.

KANS USER SURVEY

Time (AM/PM)	Total Users	Total Women	Total Children	Total Men	Small Containers	Medium Containers	Large Containers	*Avg. Family Size
11:30-12:00	11	4	6	1	3	10	2	7
12:00-12:30	8	5	2	1	10	5	0	4
12:30-1:00	4	2	2	0	2	2	2	7
1:00-1:30	4	0	3	1	1	2	1	5
1:30-2:00	3	1	2	0	1	3	0	3
2:00-2:30	0	0	0	0	0	0	0	0
2:30-3:00	10	4	6	0	6	6	3	6
3:00-3:30	5	2	3	0	4	5	4	6
3:30-4:00	13	3	9	1	1	5	7	5
4:00-4:30	6	3	3	0	2	2	3	5

*Based on questioning random users.

KANS USER SURVEY

Time (AM/PM)	Total Users	Total Women	Total Children	Total Men	Small Containers	Medium Containers	Large Containers	*Avg. Family Size
4:30-5:00	5	2	3	0	0	2	3	6
5:00-5:30	13	4	8	1	6	4	3	6
5:30-6:00	8	4	4	0	5	3	4	7
6:00-6:30	11	5	6	0	1	6	7	5
6:30-7:00	12	6	5	1	4	11	5	7
7:00-7:30	5	2	1	2	4	1	2	7
7:30-8:00	6	1	5	0	2	0	5	4

*Based on questioning random users.

KANS USER SURVEY

TOTAL TIME

Total Time	Total Users	Women	Children	Men	Small Containers	Medium Containers	Large Containers	*Avg. Family Size
13:30	222	81	129	12	103	134	80	6

*Based on questioning random users.

Assuming 2 visits by 2 family members

222/4 = 56 families

Assuming 7 persons per family (based on area wide survey conducted by Camp Perrin Hospital)

56 x 7 = 392 community members served.

APPENDIX B

Trip Report Excerpt Concerning AID Handpump Quality

(EXCERPT)

TRIP REPORT

Haiti (A-2957-003)

17 September to 1 October 1981

by

Louis Montgomery

This is the first working trip to Haiti for the WASH Project under OTD No. 46. A previous stop was made in Haiti on 19 August 1981 as part of a trip to the Dominican Republic authorized under the same OTD, but this is the first of three specifically authorized trips to Haiti.

The purpose of this trip was to make firm site selection, discuss the pump installation and maintenance with the organizations involved, initiate preparation of the sites to accept the pumps and to survey local foundry capabilities. In addition an investigation was to be made of past, present and future hand pump programs in Haiti.

Monday, 21 September. -------------------That afternoon I unpacked the two boxes containing the fourteen pumps that had been shipped from the Dominican Republic. The quality of the pump assembly was very unimpressive at best. In fact, it was down right shoddy, as Jim Gardner and Frank Temmel insisted upon demonstrating to me, repeatedly. They, in fact, made it quite plain that they liked neither the design or the workmanship. Since they were "my" pumps the whole thing was not just a little embarrassing.

References were repeatedly made to a telegram from USAID/Santo Domingo saying that the pumps had been inspected and were of good quality. This telegram, which I did not have a copy of, was dated in June and said that fourteen specific pumps were in storage at the foundry and ready to be shipped. When I was in the Dominican Republic in August to secure the shipment of these pumps there were no pumps ready at the factory, but it was arranged that I could have fourteen pumps that had already been delivered to the stockyard and fourteen were pointed out as the one that they would ship over. I did not, however, take them apart to examine them nor did I mark them in such a way as to know that the ones I saw were the ones delivered to Port au Prince.

All of the cylinder caps with one or two possible exceptions were only screwed on by a couple of threads at the most and then the other threads painted over so that they need to be chased before they can be tightened properly. The same is true of the pump throat between the stand and the pump body. In addition, many of the flapper valves are poorly centered with light visible when they are held shut. One pump head is cracked and cannot be used. We have fitted on the head from an extra Indonesian AID pump that has been sitting around the office.

I took one of the cylinders out to a machine shop to see what they would charge me to turn down the caps. They told me $10 per cap ($20 per cylinder) and I was offering $3 per cap. They finally came down to $5 per cap which I still considered to be outrageous ($3 per cap was pretty outrageous too, but it was the best I could hope for without the home court advantage), so I left. I would later take them by the Fonderie National and have them done there for $3 each.

APPENDIX C

SERVICE AGREEMENT

BETWEEN

THE ENGINEERING EXPERIMENT STATION OF THE GEORGIA INSTITUTE OF TECHNOLOGY

AND

ATELIER ECOLE DE MECANIQUE AGRICOLE AT CAMP PERRIN, HAITI

In Connection With
Water and Sanitation for Health (WASH) Project

This is an agreement between the Georgia Institute of Technlogy, Engineering Experiment Station, at Atlanta, Georgia, hereafter called GIT, and the Atelier Ecole de Mecanique Agricole at Camp Perrin, Haiti, hereafter called Atelier Ecole, for a work program for monitoring, maintaining, repairing and reporting on sixteen (16) cast-iron handpumps installed in the area of Camp Perrin between May and December, 1982.

WHEREAS GIT under its subcontract to Camp Dresser & McKee Inc., hereafter called CDM, has undertaken work under Order of Technical Direction (OTD) Number 46, authorized by the Water and Sanitation for Health Project, herefater called WASH, which CDM operates under contract to the United States Agency for International Development, and

WHEREAS sixteen (16) handpumps have been installed under OTD 46 by personnel of the Atelier Ecole, under an agreement with, and with the assistance of, GIT, near Camp Perrin at the following communities:

- Madeque
- Archambeau (two pumps)
- Regis (two pumps)
- Mizine
- Barth
- Nabanbou
- Achile
- Gwen No. 1
- Gwen No. 2
- Anadere No. 1
- Anadere No. 2
- Taivan (two pumps)
- Kans

in order to determine the suitability of the handpumps for community water supply in rural Haitian villages and to demonstrate their value in improving water supply, and

WHEREAS continued maintenance and monitoring are required in order to achieve the purpose for which the handpumps were installed,

NOW, THEREFORE, IT IS HEREBY AGREED that:

The Atelier Ecole will conduct the following work program:

1. Pump Monitoring

   The Atelier Ecole personnel will visit each of the sixteen (16) handpumps at least once every four (4) weeks to determine pump condition, community acceptance, quantity of water delivered and any abnormality of either the pump or the well. They will check the greasing of the pump, and, if the pump is not satisfactorily lubricated, will thoroughly grease the pump, will note the problem and will instruct the caretaker about the propoer procedure for and importance of lubricating the pump.

Each time they visit a well site the Atelier Ecole personnel will chlorinate the well by pouring a water solution of two (2) ounces of seventy (70) percent calcium hypochlorite into the well and then pumping the well immediately for at least ten minutes or until the water no longer has a chlorine odor or taste. This procedure should also be followed after maintenance or repair work is done which involves below-ground pump parts.

At the initiation of this work program an accurate average daily usage in terms of number of houses served will be determined by direct observation at each well site for at least two (2) eighteen (18)-hour periods (3 AM to 9 PM). This will be repeated exactly three (3) months later. The intent is to obtain an accurate measure of the total usage of the pumps over a two-day period.

2. Pump Maintenance

A caretaker will be selected by the Atelier Ecole Director from each of the thirteen (13) communities in which the handpumps were installed. These communities are listed under the second "WHEREAS," above. The Atelier Ecole personnel will instruct the caretakers in proper pump lubrication procedures and will provide the caretakers with grease and tools. The caretakers shall thoroughly lubricate each pump with heavy wheel-bearing-type grease every two (2) weeks. The caretakers shall be instructed to notify immediately the Atelier Ecole Director if, for any reason, the pump fails to operate properly. Upon such notification, the Atelier Ecole will determine the cause of failure, make necessary repairs within twenty-four hours, and document the problem and the remedial action taken to prevent its recurrence.

Maintenance supplies such as grease, nuts, bolts, cotter pins, etc, will be purchased locally by the Atelier Ecole and reimbursed by GIT when invoiced. A sample of all such supplies is to be separated out and kept in storage so that GIT personnel can bring it back to GIT to document the quality of the materials.

3. Pump Repairs

The Atelier Ecole personnel will repair any or all of the sixteen (16) pumps when necessary in order to insure that the communities served have a continuous supply of water. The repairs will be made "on site" whenever possible, but, when not possible, the pump and/or cylinder will be removed, a spare pump and/or cylinder installed in its place and the faulty pump and/or cylinder brought to the Atelier Ecole for repairs. It will be the responsibility of GIT to provide for spare and repair parts. An initial stock of parts and supplies will be furnished by GIT and replenished as required. These parts and supplies will be stored at the Atelier Ecole. It will be the responsibility of the Atelier Ecole to notify GIT when additional parts and supplies are required. The following list includes all those items which will be stocked initially:

- 3 Shallow well pumps (complete)
- 3 Deep well pumps (complete with cylinders)
- 3 Handles with bushings
- 3 Fulcrums with bushings
- 6 Rod ends with bushings
- 6 Slider blocks
- 12 Long hardened steel bushings
- 24 Short hardened steel bushings
- 3 1 1/4" brass foot valves
- 6 Short hardened steel pins
- 3 Long hardened steel pins
- 24 Leather piston cups

All pump parts that are so worn or broken that they have to be replaced will be stored separately so that they can be inspected by visiting GIT personnel and, if deemed appropriate, can be brought back to GIT for detailed wear and/or failure analysis.

4. <u>Reporting</u>

On the last day of each month the Atelier Ecole will airmail a letter report to Mr. Phillip W. Potts, Senior Research Scientist. Engineering Experiment Station, Georgia Institute of Technology, Atlanta, Georgia 30332, U.S.A., with a copy to the Chief Engineer, USAID Haiti in Port au Prince. The report shall include information on pump breakdowns (number, type, community and repairs done), routine maintenance, observations of any unusual pump component wear, any additional data on average daily pump usage and any observations on community acceptance of the handpumps. Included with this monthly report will be any requests for additional parts and supplies, any invoices for locally-purchased supplies and documentation for transportation expenses. Any unusual situation affecting the handpump demonstration program should be reported via telex or cable to GIT (telex address: 542507 GTRI OCA ATL, cable address: ENGEXPSTAT). The telephone number of GIT is 404-894-3851. Costs of any mail, telephone or telex communications incurred by the Atelier Ecole in connection with this work program will be reimbursed by GIT.

5. <u>Period</u>

The work program will be conducted during the period beginning with the date of this agreement and ending May 31, 1983. It is anticipated that discussions concerning extending the work program beyond May 31, 1983 will take place before that date.

6. Costs

The total cost of materials and labor for work done under this agreement shall not exceed $2,000. It is understood that payments for labor under this agreement are for non-UNDP (United Nations Development Program) personnel.

Labor

Labor costs for handpump monitoring and pump usage survey will be $120.00.
Labor costs for maintenance and repair will be $300.

Materials, Parts and Supplies

All costs associated with materials, parts and supplies will be borne by GIT. Any costs in this category incurred by the Atelier Ecole will be reimbursed by GIT after GIT receives a substantiated invoice.

Transportation

Since transportation costs for handpump monitoring, maintenance and repair are not predictable, an upper limit of $300 is set for the total transportation costs for the work program. The only costs that will be reimbursed, however, within the $300 upper limit, are those that are documented with receipts. These costs include gasoline, oil, grease, parts and labor. Costs incurred by the Atelier Ecole in this category will be reimbursed by GIT after GIT receives a substantiated invoice.

Other

Any other costs incurred by the Atelier Ecole in the course of this program must have prior approval of GIT.

6. Program Amendment or Cancelation

This work program may be amended at any time with the mutual consent of both GIT and the Atelier Ecole. This work program may be cancelled by either GIT or the Atelier Ecole at any time upon sixty (60) days written notification to the other party.

7. Payment

Payment will be made on a monthly basis. Fixed costs associated with labor and transportation will be divided into four (4) equal payments. GIT will be invoiced monthly (along with the monthly report) for the fixed costs and any variable costs such as transportation, materials, supplies, communications, etc. Payment will be made to the Atelier Ecole in U.S. Dollars.

Signed on this ______________________ day of ______________

by both parties through their authorized representatives.

For Georgia Institute of Technology

____

For Atelier Ecole

____

APPENDIX D

Monitoring and Repair Reporting Forms

For the Month of July 1983

MONTHLY PUMP MONITOR LOG
HAITI PUMP PROJECT.

Pumps	Dates visited	Grease condition	Repairs needed *	N°people at well	Hour of day	Depth of water	Drainage condition	General ** remarks
Madèque	8/1/83	OK	Yes	10	1300	≈ 3m	GOOD	GROUT ON BASE BAD. WASTE WATER INTO WELL.
Archambeau1	8/1/83	POOR	Yes	25	1130	≈ 3m	OK	—
Archambeau2	8/1/83	POOR	Yes	25	1130	≈ 3m	OK	—
Régis ①	8/1/83	POOR	Yes	15	1330	≈ 7m	GOOD	Pump LOOSES PRIME QUICKLY. GROUT AROUND BASE FAILING
Régis ②	8/1/83	POOR	Yes	15	1330	≈ 7m	GOOD	—
Mizine	7/31/83	OK	Yes	20	0930	– OK – TUBE WELL CANNOT DETERMINE	MUDDY AROUND SITE. DRAINS TO ROAD	GROUT ON BASE BAD. WASTE WATER INTO WELL
Barth	7/31/83	BAD	Yes	15	1030	–OK– TUBE WELL CANNOT DETERMINE	MUDDY AROUND SITE. DRAINS TO DITCH	Pump FLOW REDUCED
Nan Banbou	8/1/83	FAIR	Yes	35	1400	≈ 6m	BAD MUDDY AROUND SITE. WATER STANDING	WELLHEAD DAMAGED. WASTE WATER REENTERING WELL.
Achile	7/31/83	OK	NONE	0	0830	– OK – ≈ 2m	POOR. WELL HEAD UNDERCUT FROM EROSION	OVER 300 FAMILIES FROM 5 [illegible] USE WELL
Gwen △1	8/1/83	N/A	Yes Pump missing	0	1030	OK ≈ 3m	N/A	Pump Removed 1 WEEK AGO By "BLANC"
Gwen △2	8/1/83	OK	Yes	10	1100	≈ 3m	FAIR Muddy Around well site	WELL HATCH BROKEN
Anadere [1]	8/1/83	BAD	Yes	2	1430	≈ 3m	N/A	People using open hatch to get water. Pump site not visited in a long time.
Anadere [2]	8/1/83	BAD	Yes	10	1500	≈ 2m	MUDDY AROUND WELL DUE TO RECENT RAIN	Pump site not visited in long time. Pump working even though many [illegible] missing.
Taivan ①	8/1/83	BAD	Yes NOT OPERATING	0	0930	– OK – 4.5m	N/A	Pump NOT WORKING FOR 4 WEEKS
Taivan ②	8/1/83	BAD	Yes NOT OPERATING	0	0930	– OK – 4.5m	N/A	Pump NOT WORKING FOR 4 WEEKS
Kans	7/31/83	N/A	Yes	0	1130	?	N/A	AID pump replaced with Hydro Vergnet Pump 4/83. It is not operating

* Use Pump Control Sheet

** Use additional sheet, if necessary.

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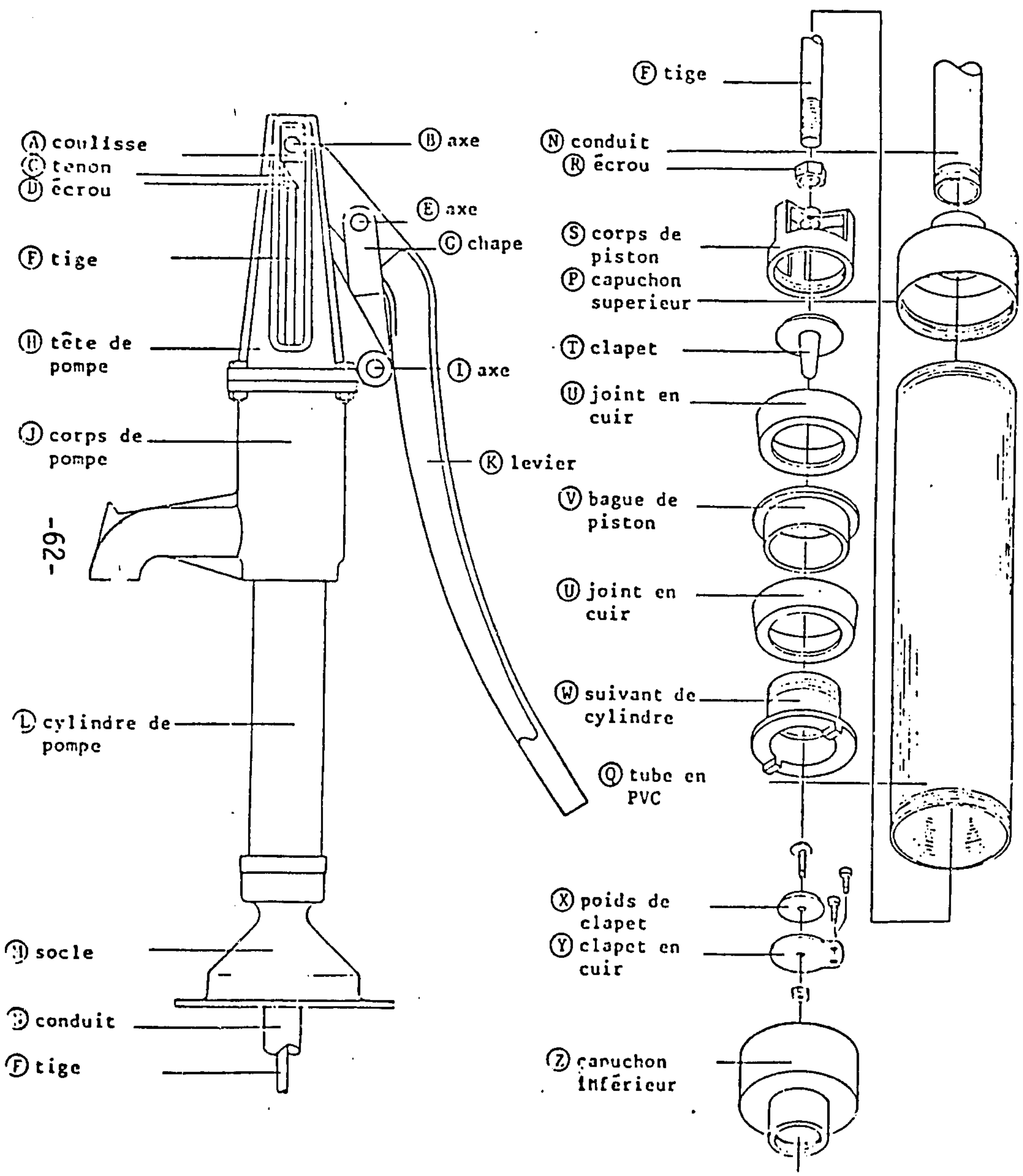
Contrôle d'Assemblage



date: 8/1/83
nom: NABANBOU
N° de pompe:

piece	✓	observations
A	✓	OK
B	X	No Keys. Pin flared on one end
C	✓	OK
D	✓	OK
E	✓	OK
F	✓	OK
G	X	Clevis cracked left side
H	X	Bushings loose in cap
I	✓	OK
J	✓	OK
K	✓	OK
L	✓	OK
M	X	Base loose
N		↑
P		
Q		
R		
S		NOT Checked
T		
U		
V		
W		
X		
Y		
Z		↓

date vérifiée: 8/1/83

signature du surveillant: [signature]

APPENDIX E

Renewal Hand Pump Monitoring, Repair and Reporting Service Agreement

SUBCONTRACT NO. 3-A-2957
between
GEORGIA INSTITUTE OF TECHNOLOGY
and
ATELIER ECOLE DE MECANIQUE AGRICOLE

This Subcontract entered into by and between the **Georgia Institute of Technology**, a unit of the University System of Georgia, with its principal office in Atlanta, Georgia (hereinafter referred to as "Contractor") and **Atelier Ecole de Mecanique Agricole**, having offices at Camp Perrin, Haiti (hereinafter referred to as "Subcontractor"),

WITNESSETH THAT:

WHEREAS, the Contractor, through its Georgia Tech Research Institute has undertaken certain efforts for Camp, Dresser & McKee, Inc., under a prime contract sponsored by the Agency for International Development; and

WHEREAS, the Subcontractor represents that it is ready, willing, and able to conduct a portion of said research effort as hereinafter set forth,

NOW THEREFORE, in consideration of the premises, as well as the obligations hereunder made and undertaken, the parties hereto mutually agree as follows:

Article I. Statement of Work

Subcontractor shall perform the effort set forth in the attached Exhibit A, which is incorporated herein by reference.

Article II. Period of Performance

This contract shall commence effective November 1, 1983, and shall terminate on April 30, 1984.

Article III. Compensation

Compensation for the work set out in Article I shall be as follows:

(a) Initial repair and inspection of designated pumps. Compensation shall be Two Hundred Fifty and No/100 (250.00) U.S. Dollars. Payment shall be made upon certification by Contractor that repair and inspection has been completed.

(b) For the regular monthly inspection, repair and maintenance of all pumps during the six-month period of this Agreement compensation shall be at the rate of One Hundred Fifty and No/100 (150.00) U.S. Dollars per month; a maximum of Nine Hundred and No/100 (900.00) U.S. Dollars.

(c) Compensation to cover expenses for local travel during the period of this Agreement shall be at the rate of Two Hundred Ten and No/100 (210.00) U.S. Dollars per month, a maximum of One Thousand Two Hundred Sixty and No/100 (1,260.00) U.S. Dollars.

(d) Reimbursement for purchase of the two kits of tools described in Exhibit A shall not exceed Seven Hundred and No/100 (700.00) U.S. Dollars.

(e) Compensation for the meeting described in Exhibit A shall be Two Hundred and No/100 (200.00) U.S. Dollars.

(f) In the event that it becomes necessary for Subcontractor to utilize a four-wheel drive jeep in the performance of the above services, the maximum reimbursement for renting said vehicle shall be at the rate of Fifty and No/100 (50.00) U.S. Dollars per day, not to exceed ten (10) days or Five Hundred and No/100 (500.00) U.S. Dollars.

Contractor's maximum liability under this Agreement is Three Thousand Eight Hundred Ten and No/100 (3,810.00) U.S. Dollars.

Subcontractor shall submit monthly invoices for work actually completed or expenses actually incurred to the Contractor's Mr. Philip W. Potts, Georgia Institute of Technology, Engineering Experiment Station, Atlanta, Georgia 30332.

Article IV. Inspection

The Contractor, through its authorized representative, has the right at all reasonable times to inspect or otherwise evaluate the work performed or being performed by the Subcontractor.

Article V. Classified/Restricted/Proprietary Data

The Contractor agrees to apprise the Subcontractor as to any information or items made available hereunder to the Subcontractor which are classified, restricted, or proprietary data either in United States Government classifications or according to Contractor's classification. The Subcontractor agrees that any such classified, restricted, or proprietary data will not be disclosed to other parties without express approval in writing from the Contractor. The Subcontractor further agrees that any such material furnished it will be returned to the Contractor at its request or upon termination of this Agreement.

Article VI. Interest of Subcontractor

The Subcontractor covenants that it presently has no interest direct or indirect which would conflict in any manner or degree with the performance of its services hereunder. The Subcontractor further covenants that in the performance of this Agreement no such person having such interest shall be employed.

Article VII. Publicity

Subcontractor agrees that no advertising or publicity matter having or containing any reference to the Georgia Institute of Technology or in which the name is mentioned, shall be made use of by the Subcontractor or anyone in the Subcontractor's behalf unless and until the same shall have first been submitted to and received the approval of Georgia Institute of Technology. The same shall apply to the Georgia Tech Research Institute or any of its divisions or units.

Article VIII. Termination

The Contractor may, by written notice to the Subcontractor, terminate this contract in whole or in part at any time, either for the Contractor's convenience or because of the failure of the Subcontractor to fulfill its contract obligations. Upon receipt of such notice, the Subcontractor shall: (1) immediately discontinue all services affected (unless the notice directs otherwise), and (2) deliver to the Contractor all data, reports, summaries, and such other information and materials as may have been prepared for and/or accumulated by the Subcontractor in performing this Agreement, whether completed or in process. The Subcontractor is entitled to compensation for expenditures and obligations incurred prior to termination.

Article IX. Changes

The Contractor may, from time to time, require changes in the scope of the services of the Subcontractor to be performed hereunder. Such changes shall be incorporated by written amendment to this Agreement. Such changes to be mutually agreed upon.

Article X. Independent Contractor and Labor Requirements

A. The Subcontractor is furnishing its services hereunder as an independent Contractor, and the Subcontractor shall not be considered an employee of Contractor.

B. The Subcontractor shall be responsible for compliance with all requirements and obligations relating to such services under local, state or federal law including but not limited to minimum wage, social security, unemployment insurance, income tax and worker's compensation. The Subcontractor shall also be responsible for all licensing requirements of any local, state, or federal jurisdiction to which the performance of his services may be subject.

Article XI. Entire Agreement

This Subcontract constitutes the sole and entire Agreement between the parties with respect to the subject matter contained herein. This Subcontract supersedes any prior Agreement, offer, or proposal between the parties with respect thereto, and may be amended only with the consent of each party in advance in writing.

Article XII. Applicable Law

This Subcontract shall be construed and performance hereunder shall be determined according to the Laws of the State of Georgia, U.S.A.

Article XIII. General Provisions

The attached clauses (Exhibit B) are hereby incorporated by reference and made binding upon Subcontractor with the same force and effect as if set forth in full text.

Article XIV. Assignment

This Subcontract shall inure to the benefit of and shall be binding upon the respective successors and assigns of the parties hereto, but may not be voluntarily assigned in whole or in part by either party without the prior written consent of the other.

Article XV. Applicability of Terms and Conditions

It is the intent of the parties that this Agreement shall not contain anything inconsistent with or contrary to the provisions that may be set forth in any Prime contracts under which this may be drawn. Consequently, the parties hereto agree that the Subcontractor shall, upon request, negotiate with the Contractor in good faith upon such amendments to this Agreement as may be necessary to make this Agreement consistent with the requirements of the said Prime Contract.

Article XVI. Lower Tier Subcontracts

No portion of this Agreement may be subcontracted nor may any consulting agreements be drawn by Subcontractor without the prior written consent of Contractor herein.

Wherefore, the parties have caused this Agreement to be executed as set forth below.

CONTRACTOR GEORGIA INSTITUTE OF TECHNOLOGY	SUBCONTRACTOR ATELIER ECOLE DE MECANIQUE AGRIC
By______________________	By______________________
Title______________________	Title______________________
Date______________________	Date______________________

EXIBIT A

STATEMENT OF WORK

The subcontractor shall carry out the following activities in Haiti during the effective dates of this subcontract:

1. Repair malfunctioning hand-operated water pumps at Achambeau I, Anadere I, Anadere II, Madeque and Taivan, and inspect and repair (if necessary) hand pumps at remaining eight (8) sites where hand pumps have been installed in the Camp Perrin area.

2. Inspect all hand pumps on a monthly basis for performance and needed repairs.

3. Repair and maintain all hand pumps as necessary.

4. Purchase two (2) kits of tools for repairing and maintaining hand pumps. Spare parts will be provided by contractor.

5. Meet with community leaders at the 13 hand pump sites for the purpose of motivating community leaders and community inhabitants in managing the hand pump areas, servicing the hand pump, and understanding the basic hand pump program.

GENERAL PROVISIONS
FIXED PRICE TYPE RESEARCH AND DEVELOPMENT CONTRACT

Clause No.	Per FPR Paragraph	Clause Title	FPR Reference
1.	1-7.302-1	Definitions	1-7.102-1
2.	1-7.302-9	Default	1-8.710
3.	1-7.302-2	Payments	1-7.302-2
4.	1-7.302-3	Standards of Work	1-7.302-3
5.	1-7.302-4(b)	Inspection	1-7.302.4(b)
6.	1-7.302-5	Assignment of Claims	1-30.703
7.	1-7.302-6	Examination of Records by Comptroller General	1-7.103-3
8.	1-7.302-7	Federal, State and Local Taxes	
9.	1-7.302-8	Utilization of Small Business Concerns	1-1.710.3(a)
10.	1-7.302-10	Termination for the Convenience of the Government	1-8.702
11.	1-7.302-11	Disputes	1-7.102-12
12.	1-7.302-12	(Reserved)	
13.	1-7.302-13	Buy American Act	1-6.104-5
14.	1-7.302-14	Convict Labor	1-12.204
15.	1-7.302-15	Walsh-Healy Public Contracts Act	1-12.605
16.	1-7.302-16	Contract Work Hours and Safety Standard Act Overtime Compensation	1-12.303
17.	1-7.302-17	Equal Opportunity	1-12.803-2
18.	1-7.302-18	Officials Not to Benefit	1-7.102-17
19.	1-7.302-19	Covenant Against Contingent Fees	1-1.503
20.	1-7.302.20	(Reserved)	
21.	1-7.302.22	Notice and Assistance Regarding Patent and Copyright Infringement	1-7.103-4
22(b).	1-7.302-23	Patent Rights - Deferred	1-9.107-5(c)
23.	1-7.302-24	(Reserved)	
24.	1-7.302-25	(Reserved)	
25.	1-3.303-7	Government Property	
26.	1-7.303-12	Subcontracts	
27.	1-7.302-26	Utilization of Concerns in Labor Surplus Area	1-1.805-3(a)
28.	1-7.402-28	Payment for Overtime Premium	1-7.202-29
29.	1-7.303-27	Competition in Subcontracting	1-7.202-30
30.	1-7.303-28	Audit and Records	1-3.814-2
31.	1-7.302-16	Price Reduction of Defective Cost or Pricing Data	1-3.814-1(a)
32.	1-7.303-29	Subcontractor Cost or Pricing Data	1-3.814-3
33.	1-7.302-31	Utilization of Minority Business Enterprises	1-1.1310-2(a)
34.	1-7.302-30	Listing of Employment Openings	1-12.1102-2
35.	1-7.302-33	Employment of the Handicapped	1-12.1304-1
36.	1-7.302-34	Clean Air and Water	1-1.2302-2
37.	1-7.303-9	Notice to Government of Labor Disputes	1-7.203-3
38.	1-7.303-22	Workers Compensation Insurance	1-10.402
39.	1-7.303-24	Required Source for Jewel Bearings	1-1.319
40.	1-7.303-55	Cost Accounting Standards	1-7.403-50
41.	1-7.303-59	Small Business Sucontracting Program	1-1.710-3(b)
42.	1-7.303-66	Preference for U.S. Flag Air Carriers	1-1.323-2
43.	1-7.304-2	Alterations in Contract	1-7.204-1
44.	1-7.304-1	Changes	1-7.404-5
45.	1-7.303-46	Insurance - Liability to Third Persons	

APPENDIX F

Handpump Ownership Transfer

April 29, 1984
Date

DEED

I, BEN E. JAMES, JR., AN EMPLOYEE OF GEORGIA INSTITUTE OF TECHNOLOGY, ACTING AS AN AGENT OF THE UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT (USAID) DO HEREBY TRANSFER OWNERSHIP OF .... ONE (1) USAID DESIGN HANDPUMP INCLUDING DROP PIPE, ROD AND SPARE PARTS ....

....

TO THE COMMUNITY OF .. ARCHAMBEAU ....

....

....

THE NEW OWNERS OF THIS EQUIPMENT AGREE TO ASSUME ALL UPKEEP AND MAINTENANCE OF THIS SAME EQUIPMENT FROM THIS DAY FORWARD AND TO HOLD USAID AND IT'S AGENT, GEORGIA INSTITUTE OF TECHNOLOGY HARMLESS FROM OTHER OR FURTHER OBLIGATIONS CONCERNING THIS EQUIPMENT.

Ben E. James JR.
Senior Research Engineer
Georgia Institute of Technology

Representing the Community
of .. ARCHAMBEAU ....

Previous Page Blank

APRIL 29, 1984
Date

DEED

I, BEN E. JAMES, JR., AN EMPLOYEE OF GEORGIA INSTITUTE OF TECHNOLOGY, ACTING AS AN AGENT OF THE UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT (USAID) DO HEREBY TRANSFER OWNERSHIP OF ....
ONE (1) USAID DESIGN HANDPUMP INCLUDING ALL
DROP PIPE, ROD AND SPARE PARTS
....

TO THE COMMUNITY OF GWEN
....
....

THE NEW OWNERS OF THIS EQUIPMENT AGREE TO ASSUME ALL UPKEEP AND MAINTENANCE OF THIS SAME EQUIPMENT FROM THIS DAY FORWARD AND TO HOLD USAID AND IT'S AGENT, GEORGIA INSTITUTE OF TECHNOLOGY HARMLESS FROM OTHER OR FURTHER OBLIGATIONS CONCERNING THIS EQUIPMENT.

Ben E. James JR.
Senior Research Engineer
Georgia Institute of Technology

Representing the Community
of GWEN

APRIL 29 1984

Date

DEED

I, BEN E. JAMES, JR., AN EMPLOYEE OF GEORGIA INSTITUTE OF TECHNOLOGY, ACTING AS AN AGENT OF THE UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT (USAID) DO HEREBY TRANSFER OWNERSHIP OF .... ONE (1) MONO ROTARY HAND PUMP INCLUDING ALL DROP PIPE AND ROD AND SPARE PARTS ....

TO THE COMMUNITY OF ..KANS..............................

THE NEW OWNERS OF THIS EQUIPMENT AGREE TO ASSUME ALL UPKEEP AND MAINTENANCE OF THIS SAME EQUIPMENT FROM THIS DAY FORWARD AND TO HOLD USAID AND IT'S AGENT, GEORGIA INSTITUTE OF TECHNOLOGY HARMLESS FROM OTHER OR FURTHER OBLIGATIONS CONCERNING THIS EQUIPMENT.

Ben E. James JR.
Senior Research Engineer
Georgia Institute of Technology

Representing the Community of ..KANS..................

April 29, 1984
Date

DEED

I, BEN E. JAMES, JR., AN EMPLOYEE OF GEORGIA INSTITUTE OF TECHNOLOGY, ACTING AS AN AGENT OF THE UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT (USAID) DO HEREBY TRANSFER OWNERSHIP OF .... ONE (1) USAID DESIGN HAND PUMP INCLUDING ALL DROP PIPE, ROD AND SPARE PARTS ....

TO THE COMMUNITY OF ... ACHILLE ....

THE NEW OWNERS OF THIS EQUIPMENT AGREE TO ASSUME ALL UPKEEP AND MAINTENANCE OF THIS SAME EQUIPMENT FROM THIS DAY FORWARD AND TO HOLD USAID AND IT'S AGENT, GEORGIA INSTITUTE OF TECHNOLOGY HARMLESS FROM OTHER OR FURTHER OBLIGATIONS CONCERNING THIS EQUIPMENT.

Ben E. James JR.
Senior Research Engineer
Georgia Institute of Technology

po HB Dugier.

Representing the Community of .. ACHILLE ....

po HB Dugier.

April 29, 1984

Date

DEED

I, BEN E. JAMES, JR., AN EMPLOYEE OF GEORGIA INSTITUTE OF TECHNOLOGY, ACTING AS AN AGENT OF THE UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT (USAID) DO HEREBY TRANSFER OWNERSHIP OF ....
..One (1)..Mono Rotary Handpump Including All..........
Drop Pipe..And Rod...And Spare Parts..................
....

TO THE COMMUNITY OF ....Mizine........................
....
....

THE NEW OWNERS OF THIS EQUIPMENT AGREE TO ASSUME ALL UPKEEP AND MAINTENANCE OF THIS SAME EQUIPMENT FROM THIS DAY FORWARD AND TO HOLD USAID AND IT'S AGENT, GEORGIA INSTITUTE OF TECHNOLOGY HARMLESS FROM OTHER OR FURTHER OBLIGATIONS CONCERNING THIS EQUIPMENT.

Ben E. James JR.
Senior Research Engineer
Georgia Institute of Technology

Representing the Community
of ..Mizine......................

April 29, 1984
Date

DEED

I, BEN E. JAMES, JR., AN EMPLOYEE OF GEORGIA INSTITUTE OF TECHNOLOGY, ACTING AS AN AGENT OF THE UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT (USAID) DO HEREBY TRANSFER OWNERSHIP OF ..ONE (1)......
"MALAWI" HAND PUMP AND ONE (1) USAID HAND PUMP INCLUDING
ALL DROP PIPE, ROD AND SPARE PARTS.....................
....

TO THE COMMUNITY OF ..TAIVAN...................................
....
....

THE NEW OWNERS OF THIS EQUIPMENT AGREE TO ASSUME ALL UPKEEP AND MAINTENANCE OF THIS SAME EQUIPMENT FROM THIS DAY FORWARD AND TO HOLD USAID AND IT'S AGENT, GEORGIA INSTITUTE OF TECHNOLOGY HARMLESS FROM OTHER OR FURTHER OBLIGATIONS CONCERNING THIS EQUIPMENT.

Ben E. James JR.
Senior Research Engineer
Georgia Institute of Technology

Representing the Community
of ..TAIVAN...................

APRIL 29, 1984
Date

DEED

I, BEN E. JAMES, JR., AN EMPLOYEE OF GEORGIA INSTITUTE OF TECHNOLOGY, ACTING AS AN AGENT OF THE UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT (USAID) DO HEREBY TRANSFER OWNERSHIP OF TWO (2) USAID DESIGN HAND PUMPS INCLUDING ALL DROP PIPE ROD AND SPARE PARTS

TO THE COMMUNITY OF REGIS

THE NEW OWNERS OF THIS EQUIPMENT AGREE TO ASSUME ALL UPKEEP AND MAINTENANCE OF THIS SAME EQUIPMENT FROM THIS DAY FORWARD AND TO HOLD USAID AND IT'S AGENT, GEORGIA INSTITUTE OF TECHNOLOGY HARMLESS FROM OTHER OR FURTHER OBLIGATIONS CONCERNING THIS EQUIPMENT.

Ben E. James JR.
Senior Research Engineer
Georgia Institute of Technology

Representing the Community
of REGIS

APRIL 29 1984
Date

DEED

I, BEN E. JAMES, JR., AN EMPLOYEE OF GEORGIA INSTITUTE OF TECHNOLOGY, ACTING AS AN AGENT OF THE UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT (USAID) DO HEREBY TRANSFER OWNERSHIP OF ....
.ONE (1)...USAID DESIGN HAND PUMP ...INCLUDING DROP PIPE, ROD ...AND SPARE PARTS ....
....
TO THE COMMUNITY OF ...BARTH..
....
....

THE NEW OWNERS OF THIS EQUIPMENT AGREE TO ASSUME ALL UPKEEP AND MAINTENANCE OF THIS SAME EQUIPMENT FROM THIS DAY FORWARD AND TO HOLD USAID AND IT'S AGENT, GEORGIA INSTITUTE OF TECHNOLOGY HARMLESS FROM OTHER OR FURTHER OBLIGATIONS CONCERNING THIS EQUIPMENT.

Ben E. James JR.
Senior Research Engineer
Georgia Institute of Technology

p.o. HB Dugier
Representing the Community of ...BARTH.......................

April 29, 1984
Date

DEED

I, BEN E. JAMES, JR., AN EMPLOYEE OF GEORGIA INSTITUTE OF TECHNOLOGY, ACTING AS AN AGENT OF THE UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT (USAID) DO HEREBY TRANSFER OWNERSHIP OF ..ONE (1)... LOT OF USAID HANDPUMP SPARE PARTS AND ONE (1) LOT OF MISCELLANEOUS HAND TOOLS...

TO THE ~~Community of~~ ATELIER ECOLE DE MECANIQUE AGRICOLE DE CAMP PERRIN...

THE NEW OWNERS OF THIS EQUIPMENT AGREE TO ASSUME ALL UPKEEP AND MAINTENANCE OF THIS SAME EQUIPMENT FROM THIS DAY FORWARD AND TO HOLD USAID AND IT'S AGENT, GEORGIA INSTITUTE OF TECHNOLOGY HARMLESS FROM OTHER OR FURTHER OBLIGATIONS CONCERNING THIS EQUIPMENT.

Ben E. James JR.
Senior Research Engineer
Georgia Institute of Technology

Representing the ~~Community~~ ATELIER
....

APPENDIX G

Well Site Data

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WELL AND PUMP DATA FOR
AID HAND PUMP PROGRAM IN HAITI

LOCATION	WELL TYPE	DEPTH TO BOTTOM	DEPTH TO WATER	DROP PIPE LENGTH	HOUSES SERVED (ESTIMATED)	INSTALLATION DATE
1. Madeque	Dug	27'	10'	21'	125	5/13/82
2. Archambeau	Dug	30'	10'		200	
Pump #1				21'		5/13/82
Pump #2				21'		11/29/82
3. Regis	Dug	47'	10'		125	
Pump #1				41'		5/17/82
Pump #2				41'		11/28/82
4. Mizine	Tube	71'	41'	61'	150	7/15/82
5. Barthe	Tube	36'	12'	31'	150	7/15/82
6. Nabanbou	Dug	21'	3'	20'	100	7/16/82
7. Achile	Dug	23'	17'	21'	100	11/30/82
8. Gwen #1	Dug	23'	13'	21'	125	7/16/82
9. Gwen #2	Dug	21'	13'	20'	125	7/19/82
10. Anadere #1	Dug	28'	18'	26'	300	7/17/82
11. Anadere #2	Dug	18'	6'	[illegible]	200	7/16/82
12. Taivan	Dug	55'	41'		500	
Pump #1				53'		7/20/82
Pump #2				51'		11/26/82
13. Kans	Tube	200'	90'	121'	200	11/16/82

APPENDIX H

Mono and Moyno Handpump Failure Report

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MONO AND MOYNO PUMPS TEST REPORT

INTRODUCTION

In order to evaluate the possibility of using hand pumps in Haiti, a demonstration project began in 1981. A total of sixteen AID/Batelle pumps manufactured in the Dominican Republic were installed in the Camp Perrin area. After a monitoring period, it was found that these pumps could not withstand the heavy use and the lack of maintenance encountered there.

There are trade offs between the level of technology of pump designs and the amount of maintenance that they require. It was considered that where a low technology pump with relatively high reauirements of maintenance was not appropriate for Haiti, a higher technology pump might succeed. As a result, two rotary progressive cavity pumps were installed; a Mono manufactured in Great Britian and a Mono manufactured in the U.S. and Canada. These were expensive pumps, costing about 3 times as much as an AID/Batelle pump. However, they have significant technical advantages such as sealed bearings, self lubricating bushings, plastic gearing, stainless steel components and chrome plated rotary elements for pumping the water.

BACKGROUND

The Mono and Moyno pumps are rotary progressive cavity, positive displacement pumps. They work on a helical rotor/stator principle with a hard chrome plated helical rotor rotating within a fixed resilient rubber stator. Water flow is directly proportional to the driving speed.

Both of these hand pumps have the rotor-stator pump assembly connected to the end of the drop pipe. The above ground mechanism is basically a casing holding a gear mechanism that converts the horizontal rotational movement of handles to the vertical rotation of the drive rod.

The Mono pump uses two plastic (nylatron) bevel gears. One of them rotates freely on a horizontal shaft, but has an engagement system that allows the gear to rotate only in one direction. This prevents the users from unscrewing the drive rod sections when turning the handles in a reverse direction. Under normal operation of the pump the drive rod coupling joints tend to self-tighten.

The Moyno pump has steel bevel gears and a ratchet mechanism to prevent the drive rod from being turned in the reverse direction.

The Mono and Moyno pump work on the same principle and have the same general design. However, the Mono pump has several installation and operation features which appear to be superior to its counterpart, the Moyno. The drive rod used in the Moyno is made of galvanized steel with cut threads whereas the Mono drive rod is made of stainless steel with rolled threads which create less concentration of stress in the root of the threads. On the Moyno, the drive rod is all the same material; from rotor-stator assembly to pump head. However, on the Mono, the first section of drive rod connected to the rotor-stator where bending stresses are greater, is made of high tensile steel. The Mono drive rod also has rubber stabilizers to prevent it from hitting the drop pipe. Also for the comfort of the hand pump users the Mono handles have sleeves.

Installation of the Moyno Pump

The Moyno pump was installed at the Kans site on a tube well that had a 95' static water level and 200' total depth. The installation was done following the Moyno factory instructions. The rotor-stator assembly was lowered first, followed by 10' sections of drive rod inside 10' sections of drop pipe. The rods were difficult to assemble due to the poor quality of threads, causing the rods not to bottom out inside the rod couplings. With each additional length of pipe and rod, there was an increasing longer length of rod protruding from the drop pipe. When the last (12th) section of pipe and rod was lowered into the well, approximately 10" of rod was protruding from the drop pipe. A total of 120' of drive rod and drop pipe were installed.

At this point of the installation process, the drive rod was cut and threaded so it could be attached to the pump head. The threading required a left-hand threading die (a point not mentioned in the factory instructions). The hot dip galvanized steel rod was difficult to thread with a manual threading die. Finally, when the die threads were completed, the pump head was lowered and fastened to the stand.

Failure of the Moyno Pump

The pump worked for about three hours before failure. The failure was due to the drive rod breaking at the root of the threads at the point where the rod was screwed into the pump head coupling. Inspection of the broken surface showed characteristic patterns of a bending fatigue failure. The drive rod was re-threaded and re-attached to the pump head so that the pump was again operational.

The pump operated for about three days before failing again. The drive rod had broken at the same place in the same manner as the first failure. While inspecting the pump head carefully it was found that a standard reducing bushing that joins the drop pipe to the pump head had been poorly threaded leaving the inner and outer threads at an angle. This caused the drop pipe to thread in at an angle also causing the drive rod to bend at that point. This seemed to be the cause of the drive rod failure. The piece of broken drive rod inside the head coupling proved impossible to extract with standard screw extractors so the head coupling was cut in half and the half with the broken drive rod removed. Half of a standard rod coupling was then welded to the head coupling. This procedure was followed since another head coupling was not available. The top 10' section of pipe and rod was removed from the well, leaving the foot valve 15' under the static water level. Then the drive rod was measured, cut and threaded. Finally, the pump head was screwed to the rod and drop pipe, lowered and secured to the stand. Again the pump was operational.

The pump worked for three more days and failed again. This time upon removal, it was found that the drive rod had broken in the extreme lower end of the system at the rotor-stator joint in the root of the threads. The pump then was deactivated. Later the entire Moyno hand pump system was removed and sent to the AID mission in Port-au-Prince.

Installation of the Mono Pump

This pump was installed at the Mizine site on a tube well that had a static water level of 43' and 70' total depth. A field engineer from Mono Pumps Ltd. came from England to assist Georgia Tech personnel in the installation.

During this installation it was observed that good design for ease of installation had been done by the manufacturers of this pump. For example, the couplings were easier to attach due to the rolled threads of the drive rods. Also, the rods bottomed out inside the couplings.

There was a minor problem in the assembly of the rotor-stator. The first length of rod to be attached to the pump assembly is the "flexishaft", a high tensile strength steel rod that is designed to endure the bending stresses produced by the lateral movement of the rotor attachment point. Because of the helical configuration of the rotor, the drive rod attachment point is not at the axis of rotation. This causes the shaft to bend slightly with every turn of the rotor. The "flexishaft" was slightly shorter than the corresponding piece of pipe, causing the coupling where the next rod should be attached to be about one inch inside the pipe. This normally would have made the installation of the rod impossible, however the rolled threads are easy to screw so that the rod could be installed without the need of actually holding the coupling. The length of each drive rod section plus the coupling matched exactly the length of each pipe section so in each successive section of pipe and rod, the coupling remained one inch inside the pipe.

The final steps of the installation of the Mono are more straightforward than those of the Moyno pump. In the Moyno pump the entire drive rod system with the rotor attached has to be raised to be connected to the pump head. This is difficult because the rotor has a tight fit inside the rubber stator. The Moyno also requires that the top of the drive rod be hand threaded "on-site". Also, there are two tightening operations to be done. The rod has to be tightened to the pump head rod coupling and then the head has to be lowered so the pipe can be tightened to the head pipe coupling.

In the Mono pump, the last section of rod does not require threading. It slides into a coupling in the pump head and is fastened with two set screws. The installation of the Mono pump head requires only the cutting to length the last section of drive rod, screwing the pump head to the drop pipe and tightening the set screws in the jack coupling onto the drive rod.

Failure of the Mono pump

This pump operated continuously for about two months before failure. The cause of failure was that the free rotating ring gear had rusted to the horizontal (handle) shaft freezing the two together. When the handles were turned in the reverse direction, so did the ring gear, causing the drive rod to become unscrewed. Somehow moisture had seeped through the shaft bushings and between the ring gear and shaft, rusting and preventing the ring gear from rotating freely in the reverse direction.

Later, the second Mono pump was installed without problems on the Kans well site replacing the Moyno pump. This pump also failed after two months in the same manner as the first Mono by having the ring gear freeze onto the shaft causing the drive rod to become unscrewed when the handles were turned in the reverse direction. Both pumps were repaired by removing and disassembling the pump head. The shaft and the internal hole in the ring gear were sanded down and slightly greased before re-assembling. The ring gear could then rotate free when the handles were turned in the reverse direction. The first Mono pump has operated without problems for five months since being repaired. The second Mono pump has operated for two months since being repaired.

CONCLUSIONS

The Moyno pump has a serious design problem with the drive rod that causes premature failure. The rod does not seem to have enough strength to endure the bending stresses created during the operation of the pump. In addition, the installation procedure is very cumbersome.

The Mono pumps failed during the testing period because of rusting of the horizontal (handle) shaft, however the quality of the overall construction seems to be well suited for use in developing countries. The installation and operation procedures are well designed for ease of installation.

RECOMMENDATIONS

The Moyno pump should not be considered for widespread application in rural water systems, until a proven solution to the driving rod breakage problem is found.

The Mono pump may be considered for rural water systems provided that methods to prevent moisture from entering the gear box are found.

APPENDIX I

Atelier Ecole de Camp Perrin Report on AID Handpump Project

U.S.A.I.D. / GEORGIA TECH RESEARCH & DEVELOPMENT

PROJECT ON BOTELLE PUMPS IN HAITI

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Jean SPRUMONT
February 1924

I.- PURPOSE

To provide a suitable site for usage tests on Botelle as requested, two years ago by the U.S.A.I.D. office in Port-au-Prince.

II.- OBJECTIVES

As we had already participated in a similar project (ref. W.H.O. Cayes Plain 1976 / 1980) as well as having conducted our own investigations, we are very happy to provide whatever assistance we could. We would like to ask the reader of this report to bear two things in mind:

1.- the ultimate objective of this project is the provision of clean water to a poor and often isolated population, and

2.- we know the nature of the terrain and the local inhabitants, as we had been involved in the digging of all the wells selected to receive the Botelle pump.

We therefore feel that the following points are relevant.

A) It is of fundamental importance that this project should not be interpreted, as an exercise to prove that only the industrialized world can solve the problems facing the third world. To prevent this from happening, we had hoped to be able to reorientate the direction of the project towards a fuller comprehension of the human factors involved.

B) We thought that a prime benefit of having regular and frequent visits from engineering experts, with their access to diverse and highly reputed sources of academic and practical experience, would be their help in solving such problems as: pump design, casting and assembly, supply of parts, corrosion.

C) We have learned through the years, that every step towards the provision of water has to be economically compatible to the local circumstances, in addition to being easily understandable. If these criteria are ignored the local population volition will disappear and maintenance will have to be undertaken by outsiders. (i.e. downtime will exceed runtime).

D) Not only is a well started and finished by outsiders completly useless, but similarly, a proven design of which can not be dug with the meagre ressource available to the average community (even assuming it could afford and maintain a reliable pump in the first place) is a solution looking for a problem.

III.- OBSERVATION ON OBJECTIVES AFTER TWO YEARS

It appears to us that the Botelle pump fulfill all the points we had hoped to avoid. This will only serve to impoverish the local people's outlook and rob them of the chance of achieving their goals with readily available techniques. Furthermore, we now have 14 pumps whose maximum unattended service life varies from one to three weeks. After the research personnel have departed, we at the atelier will be the only ones capable of maintaining them, and, as no further arrangements have been made, this will be strictly off our own hat.

We thought that our collaboration would advance the development of a workable pump, perhaps even made by Haitians for Haitians (such as our own foundry's bucket-pump). We were wrong.

We feel that the (counsel) of excellence (in attempting to perfect a single pump) has interrupted any progress in providing water to a greater number of people. The local peoples consciouness of the problems involved in maintaining their own water supply has not been heightened by one millimetre in their eyes, this is just one more project where the whites came, played around and left nothing.

The appear to have been no advance that will affect the average community in Haiti.

IV.- CONCLUSIONS

After two years, we have observed no advances to any the objectives we felt were important to Haitians. Even if the Botelle pump had seen successfully adapted to local conditions, it is not feasible to develop a powerful, durable pump if it is too expensive and sophisticated. As it is, the Botelle pump has proven to be grossly inadequate for the prevailing local conditions.

We feel that the objectives of such a well funded project have been too limited and are considerably at variance with the needs of the Haitian people. The project represents considerable engineering overkill as it does very little to solve the symptoms of the problem (not enough water available) and it does nothing to solve the problem itself (too few wells).

It is regretted that U.S.A.I.D. / Georgia Tech. Project has done nothing at all to provide more water to the people of Haiti.

RECOMMENDATIONS

Encourage the sinking of more wells using the existing local techniques (brochure attached) and voluntary labour.

PLAN DETAILLE DE COFFRAGE POUR PUITS (AVG. COST OF 50 M WELL = $500.-

INSERT

It has been proved during the course of these trials that the Botelle pump is viable for family use or use by a limited number of families. (Maximum of 10)

A few small problems still remain to ironed out, such as shaft holding pins (des goupilles fixant les axes,), the batters and the plonger cage, etc. Basically however, the basic design of the pump is sound for its intended use.

U.S.A.I.D. / RECHERCHES TECH & DEVELOPPEMENT DE GEORGIA

PROJET DES POMPES BOTELLE EN HAITI

Jean SPRUMONT
Février 1984

I.- BUT

Trouver des sites adéquats pour tester les pompes Botelle comme requis il y a deux ans par le bureau de l'U.S.A.I.D. de Port-au-Prince.

II.- OBJECTIFS

Puisque nous avons participé à un projet similaire (Ref. W.H.O. Plaine des Cayes 1976/1980) et comme nous avons aussi mené notre propre investigation, nous avons été heureux de donner toute l'assistance que nous pouvions offrir. Nous voudrions demander au lecteur de ce rapport de garder toujours à l'esprit deux choses:

1.- L'objectif ultime de ce projet qui est d'approvisionner en eau propre les populations pauvres et souvent isolées, et,

2.- Notre connaissance de la nature des terrains et des habitants de ces localités, puisque nous avons participé à la fouille de tous les puits sélectionnés pour recevoir une pompe Botelle.

C'est pourquoi nous pensons que les points développés ci-après sont édifiants.

A) Il est d'une importance fondamentale, que ce projet ne soit pas interprété comme un exercice prouvant que seul le Monde Industrialisé peut résoudre les problèmes auxquels fait face le Tiers-Monde. Pour empêcher ceci, nous avions pensé pouvoir réorienter la direction du Projet vers une plus grande compréhension de la participation du facteur humain.

B) Nous pensions que le bénéfice primordial des visites régulières et fréquentes d'experts en ingénierie avec l'accès qu'ils ont aux diverses sources académiques hautement réputées, nous auraient aider à résoudre des problèmes tels que: les dessins de pompe, la fonte, le moulage et le montage de pompes, l'acquisition de pièces de rechanges, les problèmes de corrosion, etc.

C) Nous avons appris durant ces dernières années, que chaque nouvel étage vers l'approvisionnement en eau devrait être économiquement compatible avec les situations locales, en outre elle devrait être facilement compréhensible. Si ces critères sont ignorées, l'engagement volontaire de la population locale disparaîtra et l'entretien devra être pris en charge par quelqu'un hors du milieu (c'est-à-dire que les temps d'arrêts dépasseront les temps d'utilisation).

D) Non seulement un puits commencé et fini par des gens qui ne sont pas de la région est complètement inutile, mais, similairement, un modèle de puits ayant fait ces preuves qui ne peut être fouillé avec les maigres ressources disponibles ordinairement dans les communautés (même en présumant qu'ils peuvent en premier lieu s'offrir une pompe solide, de tout repos et la maintenir en fonctionnement.) est une solution débouchant sur un autre problème.

III.- DEUX ANS APRES OBSERVATION SUR LES OBJECTIFS

Il nous apparait que la pompe Botelle a parfaitement atteint tous les points que nous avions espéré lui faire éviter. Ceci servira seulement à appauvrir les perspectives de la population locale et à leur voler leur chance d'atteindre leurs buts en mettant à leur disposition des techniques toutes faites. De plus, nous avons actuellement 14 pompes qui ont un maximum de temps d'arrêt variant d'une à trois semaines. Après qu'une enquête personnelle ait été faite, nous avons découvert que l'atelier était le seul capable de maintenir ces pompes en état de fonctionnement, et comme aucun autre arrangement futur n'a été fait, ceci n'est strictement plus de notre ressort.

Nous avions pensé que notre collaboration aurait activé le développement d'une pompe fonctionnelle, peut être même conçu par des Haitiens pour des Haitiens (comme la pompe godet de notre fonderie). Nous nous étions trompés.

Nous pensons que le conseil d'excellence (en cherchant à perfectionner un seul type de pompe) n'a interrompu aucun progrès dans leur but d'approvisionnement en eau à un grand nombre de personne.

La conscientisation de la population locale n'a pas augmenté d'un iota quant au problème de l'entretien de leur pompe. A leurs yeux, c'est encore un autre projet ou les blancs viennent, font leur cirque, et ne laissent rien.

Apparemment tout ceci ne donne aucun progrès et va affecter plutôt les communautés paysannes en Haiti.

IV.- CONCLUSION

Même si la pompe Botelle s'est adaptée avec succès aux conditions locales, elle ne sera jamais une pompe performante et durable si elle est d'un entretien trop couteux et sophistiqué. Telle qu'elle est, il a été prouvé que la pompe Botelle est pratiquement inadéquate aux conditions locales.

Nous estimons que les objectifs d'un projet aussi bien conçu ont été trop limités et ne répondaient pas exactement aux besoins de la population haitienne auquel il était destiné. Ce projet représente un travail considérable d'ingénierie, mais fait très peu pour résoudre les symptômes du problème (insuffisance d'eau disponible et trop peu de puits).

Il est regrettable que le Projet de l'U.S.A.I.D. / Les Recherches Techniques et de Développement de Georgia sur les pompes Botelle n'ait rien fait pour trouver d'avantage d'eau pour la population d'Haiti.

V.- RECOMMANDATIONS

Il faut encourager la fouille de beaucoup plus de puits en utilisant les techniques locales existantes (brochures annexées) et le travail volontaire des gens qu'ils desserviront.

Plan détaillé de coffrage pour puits (Approximativement le prix d'un puits de 50 mètres est de $500.00).

ENCART

Il a été prouvé pendant le temps d'essai que la pompe Botelle est utilisable pour une famille ou encore un nombre réduit de familles (maximum 10).