PN-AAZ-305
54696

WATER AND SANITATION
FOR HEALTH PROJECT

Operated by
CDM and Associates

Sponsored by the U.S. Agency
for International Development

1611 N. Kent Street, Room 1002
Arlington, VA 22209-2111 USA

Telephone: (703) 243-8200
Telex No. WUI 64552
Cable Address WASHAID

The WASH Project is managed by Camp Dresser & McKee International Inc. Principal cooperating institutions and subcontractors are Associates in Rural Development, Inc., International Science and Technology Institute, Inc., Research Triangle Institute, Tropical Research Group, University of North Carolina at Chapel Hill.

FEASIBILITY OF HANDPUMP INSTALLATION AND MANUFACTURE IN THE YEMEN ARAB REPUBLIC

WASH FIELD REPORT NO. 224

JANUARY 1988

Prepared for
the USAID Mission to the Yemen Arab Republic
WASH Activity No. 372

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to the Yemen Arab Republic
under WASH Activity No. 372

by

Dennis B. Warner, Ph.D., P.E.

and

Daniel M. Varisco, Ph.D.

January 1988

Water and Sanitation for Health Project
Contract No. 5942-C-00-4065-00, Project No. 936-5942
is sponsored by the Office of Health, Bureau for Science and Technology
U.S. Agency for International Development
Washington, DC 20523

TABLE OF CONTENTS

CHAPTER		Page
	GLOSSARY OF ACRONYMS	v
	EXECUTIVE SUMMARY	vii
1.	INTRODUCTION	1
2.	BACKGROUND	3
	2.1 WASH Involvement	3
	2.2 Scope of Work	3
	2.3 Water Needs in Yemen	5
	2.4 USAID Concerns	6
	2.4.1 Previous USAID Involvement	6
	2.4.2 Continued Involvement in Water/Sanitation Sector	6
	2.4.3 High Costs of Project Implementation	6
	2.4.4 YARG Institutional Capabilities	6
	2.4.5 Locally Sustainable Systems	7
	2.4.6 Responding to the Physical Quality of Life Index (PQLI)	7
	2.4.7 Project Success	7
	2.5 Methodology of Study	7
3.	TECHNOLOGICAL FEASIBILITY	9
	3.1 Definition of Technological Feasibility	9
	3.2 Applications of Handpumps	10
	3.2.1 Groundwater Conditions	10
	3.2.2 Handpump Capabilities	12
	3.2.3 Maintenance Services	13
	3.3 Manufacturing/Assembly of Handpumps	13
	3.4 Cost Components	15
	3.5 Summary: Technological Feasibility	16
4.	SOCIOECONOMIC FEASIBILITY	17
	4.1 Definition of Socioeconomic Feasibility	17
	4.2 Community Acceptance of Handpumps and Related Low-Cost Systems	18
	4.3 Training and Promotion Needs	24
	4.4 Demand for Handpumps	24
	4.5 Consumer Profile	25
	4.5.1 Small Communities	26
	4.5.2 Individuals	26
	4.6 Summary: Socioeconomic Feasibility	26

TABLE OF CONTENTS

CHAPTER		Page
5.	YARG AND CLCCD INVOLVEMENT	27
5.1	Overall YARG Involvement	27
5.2	CLCCD Involvement	27
5.3	Local Acceptance of YARG Involvement	30
5.4	Summary: YARG and CLCCD Involvement	33
6.	PRIVATE SECTOR INVOLVEMENT	35
6.1	Private Sector and YARG Relations	35
6.2	Private Sector Interests and Needs for Import/Manufacturing of Handpumps	35
6.3	Private Sector Capabilities	36
6.4	Marketing Issues	37
6.5	Summary: Private Sector Involvement	38
7.	CONCLUSIONS	39
7.1	General Conclusions	39
7.2	Specific Conclusions	40
	7.2.1 Feasibility of Handpumps in Yemen	40
	7.2.2 Private Sector Involvement	41
8.	RECOMMENDATIONS	45
8.1	Types of Handpumps for Yemen	45
8.2	Local Assembly/Manufacture of Handpumps	46
8.3	USAID Actions	46
BIBLIOGRAPHY		53
PHOTOGRAPHS		57
APPENDICES		
A.	List of Persons/Organizations Contacted	65
B.	Wadi Mawr Village Water Supply Project	71
C.	Results of UNDP/World Bank Handpump Comparisons	75
D.	Log Frame for PUMPS Project	79

TABLE OF CONTENTS

FIGURE		Page
1.	Administrative Structure of CLCCD (Sana'a)	29
2.	PUMPS Project Organizational Chart	46

TABLE		
1.	Summary of CLCCD Water Projects in 1986	31
2.	Summary of Total CLCCD Projects in 1986	32

GLOSSARY OF ACRONYMS

CLCCD	Confederation of Local Councils for Cooperative Development
CYDA	Confederation of Yemeni Development Associations
DOH	Department of Hydrology
GTZ	German Agency for Technical Cooperation
lcd	liters per capita per day
LDA	Local Development Authority
LDB	Local Development Board
MAF	Ministry of Agriculture and Fisheries
MOH	Ministry of Health
MPW	Ministry of Public Works
NTF	New TransCentury Foundation
NWSA	National Water and Sewerage Authority
PQLI	Physical Quality of Life Index
RWSD	Rural Water Supply Department
S&T/H	AID Office of Health, Bureau for Science and Technology
STC	Save the Children Foundation
TDA	Tihama Development Authority
UNDP	United Nations Development Program
YAR	Yemen Arab Republic
YARG	Yemen Arab Republic Government
YR	Yemen Riyals ($ 1 = 10 YR)
USAID	U.S. Agency for International Development

EXECUTIVE SUMMARY

INTRODUCTION

The WASH team of Dr. Dennis B. Warner, sanitary engineer, and Dr. Daniel M. Varisco, anthropologist, conducted a three-week study (October 19-November 9, 1987) on the feasibility of use and local manufacture of handpumps in Yemen, including a possible demonstration program in the Tihama region. The USAID mission was interested in maintaining a presence in the water sector after 15 years of major support but, given funding and staff limitations, was not interested in a major, formal project. The team conducted interviews at various government levels and with the private sector and rural villagers. The consultancy included a 9-day field trip through the Tihama, Taiz, and Ibb areas.

FINDINGS

The feasibility of using handpumps in rural Yemen is considered from a technological, financial, and socioeconomic perspective. The technological feasibility is defined as the appropriateness of water sources, equipment, local manufacturing, and maintenance systems. While groundwater supply data are still limited, the average depth to groundwater in the Tihama is 10-40 m and thus appropriate for handpumps. Of the estimated 14,000 wells in the Tihama, over 8,000 have motorized pumps on them, especially in the important wadis of Surdud, Mawr, Siham, and Zabid. The majority of these wells appear to be hand dug.

While there are handpumps appropriate for the Yemeni context, only a very limited number of handpumps are found in the country. These are either broken or not yet accepted by villagers. Yemeni mechanics tend to have the necessary skills for pump maintenance and repair, but these will need to be organized and a system for providing spare parts ensured.

The criteria for determining community acceptance and interest for handpumps and related systems are tied to the recognized need for such systems, previous experience, local mechanisms for promotion, consideration of the views and needs of actual users, willingness to accept the "level" of technology and to pay for it, attitudes toward use of the technology and treatment of public and private property, and community means for mobilizing support. Some hands-on training and promotional workshops have been suggested as important for the successful introduction of handpumps. There is interest in such activities by the local cooperative councils. The demand for handpumps does not yet exist and will be limited without promotion of the health, labor and cost benefits. The potential consumers include small communities and individuals wishing to supplement existing supply.

Efforts in rural water supply may involve a variety of Yemen Arab Republic Government (YARG) institutions, including the Confederation of Local Councils for Cooperative Development (CLCCD). In 1986 the CLCCD sponsored 333 new and

maintenance/rehabilitation projects costing YR 63,969,740 ($6,397,000). Of these costs, some YR 24,991,365 ($2,499,000) was contributed by the people served. Water projects now have a greater priority in relation to road construction than in the past decade. The CLCCD has recently improved its capabilities and is now better accepted and more responsive to local communities.

The private sector has long been involved in rural water supply development, but it increasingly must work in conjunction with YARG institutions. Due to the recent foreign exchange crisis, restrictions on imports have greatly curtailed the freedom of the private sector and its ability to expand local production except in terms dictated by YARG policy. There is still much mutual suspicion between the private sector, YARG and the rural population, but there is an increasing need to cooperate in development. There is limited interest in local production of handpumps; it is not seen as an important profit-making venture nor necessarily competitive with imports of handpumps. A number of problematic marketing issues limit private sector ability to effectively promote and distribute handpumps.

CONCLUSIONS

Six general conclusions arise from this study:

1. There is a need for a variety of low-cost water supply systems in the rural areas.

2. Local development boards (LDBs) are the most promising channel for rural development assistance.

3. Considerable development resources exist in the rural areas.

4. The private sector is very active in rural water development.

5. Local manufacture can play only a limited role in handpump production at present.

6. USAID can take a limited, but crucial, role in low-cost rural water supply development.

RECOMMENDATIONS

1. A variety of handpumps are appropriate for Yemen. Suitable high lift handpump (to 45 m) imports include Afridev, India Mark II and Monolift. High-lift handpumps for local assembly/manufacture in Yemen include Afridev, Bestobell, SWN81, and Volanta. Low-lift handpumps (to 10 m) and direct action lift pumps include Nira AF85, Wavin and Tara.

2. USAID should offer informal technical assistance and information to any business groups or manufacturers interested in local production of handpumps. Initially, however, USAID should encourage importation of a suitable handpump in order to promote acceptance and use in rural areas.

3. USAID and the CLCCD should establish a project of limited technical and financial assistance to encourage villages and local councils to initiate, implement, and maintain simple, low cost rural water supply systems. The project should promote local initiative and responsibility through the development of small water supply projects, including handpumps, diesel pumps, small piped systems, and rehabilitation of existing systems. The USAID contribution should include cost sharing (50 percent to a maximum of YR 20,000 per project) and technical assistance (through a Direct Hire National Technical Advisor and short-term consultancies). The CLCCD should provide overall coordination and liaison with the local development boards (LDBs). A three-year project costing YR 10,125,000 (approximately $1,012,500) with a USAID component of YR 4,125,000 ($412,500) is outlined in the report. It is expected that a modest project of this type will establish USAID links with the CLCCD, leverage USAID resources, and provide improved water systems to small and/or remote rural villages.

Chapter 1

INTRODUCTION

The purpose of this report is to provide USAID/Sana'a with findings on the feasibility of handpumps and local manufacture of handpumps in the Yemen Arab Republic (YAR). Drawing on the conclusions from a three-week WASH study in October-November 1987, several recommendations are made for future USAID action within the recognized funding and staffing limitations.

The report begins with the relevant background information on Water and Sanitation for Health (WASH) Project involvement in terms of the scope of work and the methodology of study. Also addressed are the water needs that prompted interest in the subject and specific USAID concerns with the water sector, private sector development, and cooperation with institutions of the Government of the Yemen Arab Republic (YARG). The findings regarding technological feasibility relate to both the applicability of handpumps to Yemen's environmental context and the potential for local manufacturing or assembly of handpumps. The issue of socioeconomic feasibility addresses concerns of community acceptance as defined by a number of general criteria. Training and promotion needs are considered. The potential demand is estimated, as well as a general profile of consumers for handpump systems. The relations of any initiatives to YARG, and particularly the Confederation of Local Councils for Cooperative Development (CLCCD), as well as the Yemeni private sector are then discussed.

The findings lead to major overall conclusions and a range of specific conclusions regarding the feasibility issue. The recommendations provide specific details on what technology is appropriate and what can be done to stimulate private sector involvement. The WASH team has also provided a preliminary project outline for USAID cooperation with the CLCCD for providing the benefits of handpumps to rural communities and at the same time promoting cooperation of the CLCCD and communities with the private sector.

Chapter 2

BACKGROUND

2.1 WASH Involvement

In June 1987, the USAID Mission in Sana'a initiated discussions with the AID Office of Health (S&T/H) in Washington, D.C. regarding WASH assistance in the rural water supply sector in Yemen. Later that month the WASH Project was requested by the Mission (Sana'a 04789) to assess the feasibility of locally manufacturing handpumps in Yemen and to design, implement, and evaluate a demonstration program of handpump-based water supplies in the Tihama region of the country. The Mission was concerned with funding low-cost alternatives to the relatively sophisticated, high-cost, piped water supply systems that it had been supporting for the past 15 years.

Over the following two months, an approved scope of work was developed and a consultant team was organized. The main focus of WASH assistance was to assess the feasibility of using handpumps in rural Yemen and local manufacturing of handpumps, and to identify village sites and design a demonstration program around handpumps.

The WASH team, composed of Dr. Dennis B. Warner, sanitary engineer, and Dr. Daniel M. Varisco, anthropologist, arrived in Yemen on October 19, 1987. They presented their findings and recommendations to the Mission on November 8. While in Yemen, the team was assisted by Mr. Elliott Smith, USAID Assistant Project Officer, who participated in all aspects of the work.

2.2 Scope of Work

The initial scope of work, as approved by USAID/Yemen and AID/Washington, was as follows:

- The team will develop recommendations for the type of handpump program (import, local assembly or local manufacture) and for the design and scheduling of a demonstration project. Specifically, the team will

  1. Assess the technical feasibility of using appropriate technology handpumps.

  2. Estimate the financial feasibility of private sector involvement in the manufacturing/assembly of handpumps.

  3. Identify and select as demonstration sites up to 3 of the 72 villages participating in USAID's Tihama Primary Health Care Project.

4. Review the information on groundwater availability and quality to determine the size of the potential market for handpumps.

5. Assess community and government capability for maintenance of handpumps.

6. Assess potential for community acceptance of handpumps, willingness to pay for maintenance, and willingness to maintain the pumps.

7. Evaluate the availability and skills of local resources.

8. Recommend the handpump(s) to be used.

- Based on the results of these studies and the type of program proposed, the team will also provide the Mission with recommendations on the scheduling of possible longer-term technical assistance needed to

  1. Design and supervise the manufacturing or assembly of handpumps.

  2. Provide training on the installation, use and maintenance of handpumps.

  3. Monitor and evaluate the impact of the new systems.

  4. Prepare a proposal for extending the demonstration program.

- The WASH team will prepare a report of their conclusions and recommendations and present a draft version of the report prior to departing Yemen.

Upon arrival in Yemen of the WASH team, discussions were held with Mission officials to clarify the issues in the scope of work. In the course of these discussions the Mission expressed a number of concerns, which were informally incorporated into a revised scope of work. The main issues of concern were as follows:

1. Selection of demonstration sites for handpump installation was not wanted. Instead, the Mission wanted a rationale for a demonstration program, including a generic project description, development approach, and estimated costs. Such a program could be based on PL 480 local currency funds.

2. The Mission did not want to consider establishing a formal USAID project. Instead, it wanted to show the potential for handpump application and manufacturing in Yemen. In addition, it hoped that the WASH report would serve as a catalyst to encourage the Confederation of Local Councils for Cooperative Development (CLCCD) and the private sector to undertake initiatives in the rural areas.

3. The Mission wanted the report to be written for the local government councils and the private sector rather than for USAID. The report, therefore, was to address the questions and programmatic needs that would arise from a Yemeni point of view. It was agreed that WASH could prepare a separate appendix section written for Yemeni officials, with the main report directed at USAID.

2.3 Water Needs in Yemen

The YAR has an official total population of 9,300,000 according to the 1986 census. The actual recorded population in country is 7,700,000 with more than a million and a half estimated emigrants temporarily residing outside the country. About 85 percent or 6,600,000 of the population lives in rural areas (defined as towns of less than 2,000 population). Rural water supply conditions are generally poor throughout the country, and serious attempts at rural water improvements have been made only within the past 15 years. Although exact figures do not exist, it is estimated that only 25-30 percent of the rural population is served with adequate and safe drinking water. The vast majority, perhaps as many as 5,000,000, rely on traditional water sources that suffer from seasonal irregularities, surface pollution, and distant, often hard-to-reach locations.

The typical traditional source of domestic water in Yemen is a spring or, more commonly, a hand-dug well, usually 1.0 to 1.5 meters in diameter (sometimes 5 to 6 meters in diameter), lined with stones or bricks, and having a depth ranging from 5 to 45 meters. Such wells are open at the top, and water is drawn with a rope and bucket either by hand or with the aid of a donkey. Because wells are usually located in wadi bottoms, while villages tend to be sited on high points, it is not uncommon for people to walk several kilometers over very difficult mountain terrain to reach the closest well. Depending on the difficulty of drawing and carrying water, average water use in the villages is relatively low, probably between 10 and 20 liters per capita per day (lcd) for most of the rural population. Other sources of water, such as rivers and rainwater collection, are also used, but the open, hand-dug well or spring remains the primary source of domestic water in Yemen.

The consequences of inadequate domestic water supplies in rural Yemen are far reaching. Because of the need to make long journeys for water or the difficulty of extracting it from the source, overall water consumption remains low and insufficient amounts of water are used for personal hygiene, clothes washing, and other forms of sanitation. Water quality also is generally low, both from the pollution found in all open wells as well as contamination caused by unclean water-carrying containers. As a result of these problems

people use less water than necessary for good health, the water itself becomes a vehicle for transmitting diseases, and enormous amounts of human and animal energy are required to fetch the daily supply. The lack of adequate and safe water, therefore, becomes a major constraint upon social and economic development.

2.4 USAID Concerns

2.4.1 Previous USAID Involvement

USAID has been directly involved in the water/sanitation sector since 1973, working primarily with the National Water and Sewerage Authority (NWSA), the Rural Water Supply Department (RWSD) of the Ministry of Public Works, and the Department of Hydrology (DOH) of the Ministry of Petroleum and Mineral Resources. This has included water and sewerage supply for Taiz, emergency water supply for Sana'a, water resources planning and management, water and mineral survey using LANDSAT imagery, and rural water supply. Project 044, contracted with New TransCentury Foundation (1979-1987), was designed to provide rural water systems, training and institutional development with the RWSD.

2.4.2 Continued Involvement in Water/Sanitation Sector

Given the 15 years previous experience and continued interests of YARG, USAID is interested in maintaining a role in the water/sanitation sector. Because of difficulties with RWSD, another institutional locus is preferred. USAID is also interested in coordinating future efforts in this sector with other donors, particularly UNDP.

2.4.3 High Costs of Project Implementation

USAID is very concerned with the high costs of implementing improved rural water systems, especially when viewed against the magnitude of unserved water needs in much of the country. Unofficial estimates indicate that nearly 14,000 Yemeni villages remain without improved sources of potable water. Project 044 resulted in about 172 completed systems at a total project cost of $6.1 million in U.S. assistance. Given USAID's present funding constraints, a major water project is not envisioned. As noted in the 1987 USAID/Sana'a Action Plan, no funds are available within the $22 million budget for FY 88 for national water policy work.

2.4.4 YARG Institutional Capabilities

A major constraint noted in the 1987 USAID/Sana'a Action Plan is the limited YARG support for previous initiatives, the continuing inability of YARG to develop and implement necessary controls in water resource development, and the widespread lack of human resources to achieve change. While previous efforts with the Confederation of Yemeni Development Associates (CYDA) in

providing rural water systems have been problematic, the Mission is interested in working with the reorganized and apparently rejuvenated CLCCD. USAID/Sana'a recognizes the priority given by YARG to CLCCD for development growth in rural Yemen.

2.4.5 Locally Sustainable Systems

Given the previous dynamics of the private sector in local development and the limitations of YARG, USAID/Sana'a is interested in encouraging local manufacture and greater business involvement in the development process. Since resources do exist at the local level, it is important to promote locally sustainable systems rather than relying on the slow and difficult path of major technical assistance projects coordinated with a ministry at the national level.

2.4.6 Responding to the Physical Quality of Life Index (PQLI)

The promotion of improved rural water supply systems is recognized as an important response to the demonstrated health and sanitation needs in rural Yemen. Previous efforts have aided larger villages and towns, but little assistance has been directed at the poor rural hamlets and villages dependent on shallow, open wells. Those who are least able to afford assistance or are furthest removed from access to government projects have been ignored in the project coordinated through government ministries. No donor is currently assisting with low-cost, appropriate technology water systems or promoting the role of the private sector in developing and distributing this technology.

2.4.7 Project Success

Evaluation of several previous USAID projects, particularly 045 (Local Resources for Development), indicates that a major problem has been overly ambitious goals and the failure to focus on limited but achievable initiatives. USAID has had only limited success in promoting development with direct technical assistance at the local level, and it has been unable to stimulate the institutional development envisioned in previous projects. As suggested in the Social and Institutional Profile of North Yemen, there is a need for well-focused, limited initiatives that can be built in for future project expansion. To the extent that large amounts of money must be absorbed through YARG and a number of YARG institutions are involved, the chances for project success are greatly complicated.

2.5 Methodology of Study

The WASH team met for a 2-day team planning meeting prior to arrival in Yemen. The work in Yemen included briefings and conversations with USAID officers, interviews with a variety of government officials, private businessmen and villagers, and a nine-day field trip through the Tihama, Taiz and Ibb areas. (See Appendix A for a list of persons and organizations contacted.) During the field trip the team was facilitated by Mr. Husayn al-Amri from CLCCD and Mr. Elliott Smith of USAID.

The primary sources of information for the study include previous documents on USAID involvement in the water sector and with CYDA, data from the DOH (Sana'a) and Tihama Development Authority (TDA) (Hodeidah), personal interviews, visits to local manufacturers and distributors, and observations of wells and village environments during the field trip.

In the course of the work a number of potential sources of information relevant to the project were identified. Because these sources either were not readily available or required further exploration, they are noted here for future reference:

(1) MOH Survey of Water Supply to Tihama Health Sites, June, 1987. Note that this very simple survey was ineffectively implemented with practically no useful results. The only general conclusion is that health units tend to be in villages with existing water projects.

(2) Survey of TransCentury Water Supply Project Sites, currently being conducted by Dr. Abdo Ali Uthman (Dept. of Sociology, Sana'a University).

(3) Survey of domestic water use by women in several communities, now being coordinated by Yoke Buringa as a Dutch aid project with Yemeni women in several Yemeni institutions.

(4) Household surveys by a Dutch sociologist in Tihama Basin Water Resources Survey Project (TDA/Hodeidah).

Chapter 3

TECHNOLOGICAL FEASIBILITY

3.1 Definition of Technological Feasibility

Technological feasibility, simply defined, is the degree to which systems or processes are capable of functioning when only physical conditions are considered. Thus, a handpump is technologically feasible if it is capable of lifting desired quantities of water from the bottom of a well to the surface, and it is technologically unfeasible if it is incapable of performing an essential physical function.

Technological feasibility can be considered in terms of four key elements: water source, equipment, manufacturing, and maintenance services. Each element can be posed as a question.

1. Water source. Is the water source adequate? This element should be assessed in terms of the quantity of water available, the quality of water (especially as it concerns human health), the reliability of the source (permanent or seasonal), and the accessibility or distance to the source from the village.

2. Equipment. Is the equipment appropriate? Pumps, for example, must be able to deliver the desired flow of water (discharge), be capable of drawing water the required height (corrosion- and abrasion-resistant), and easy to operate (especially for women and children).

3. Manufacturing. Can local manufacturing be established? Successful pump manufacturing requires the use of special tools (molds, dies, and other industrial equipment), an assured supply of materials (specialty metals, plastics, lubricants), adequate industrial capacity (machine shops, plastics factories, foundries), and competitive production costs.

4. Maintenance services. Can the equipment be maintained? This aspect can be assessed in terms of the skill level of those responsible for maintenance, the reliability (or frequency) of maintenance services, and the availability of spare parts.

This chapter will assess the technological feasibility of using handpumps in Yemen in terms of these four elements and will outline the main characteristics affecting costs of implementation.

3.2 Applications of Handpumps

3.2.1 Groundwater Conditions

Because of limited rainfall over most of the country and high temperatures in the Tihama area, there is little surface water available for domestic use. Most of the country receives considerably less than 1,000 mm per year of rainfall. Although some mountain areas receive over 1,500 mm per year, precipitation on the Tihama Red Sea coast averages between 50 and 250 mm annually. Rainfall is highest along the western escarpment of the mountains and progressively declines as one moves eastward towards the Rub el Khali desert in Saudi Arabia or westward towards the Tihama plain and the Red Sea. When rainfall occurs, typically during the "rainy seasons" of April-May and August-October, normally dry stream beds quickly fill with water and flow in a torrent until the surging waters are absorbed by the lower portions of the wadis. Because few streams flow year-round, the great majority of Yemenis have always relied on wells and springs for their water needs. It is expected, therefore, that future domestic water development will continue to be based upon groundwater.

It is difficult to describe typical, or average, groundwater conditions in Yemen because of the great variations in topography, rainfall, and geologic factors and the general lack of hydrogeologic information. Little is known about the number or status of traditional dug wells. Mechanized well drilling began only 20 years ago, and formal compilation of geologic and groundwater information has occurred only since that date. Despite growing interest in water resources development on the part of YARG and the international donor community, vast areas of the country remain unstudied. The Ministry of Oil and Mineral Resources, with Dutch technical assistance, currently is developing a data base of water resources information on hydrology, hydrogeology, and climatology. This data base is still in an early stage of development and is not yet capable of providing information in a form readily adaptable for planning purposes. Within a year, however, it is expected that water resources information covering approximately half of the country will be available in a computerized format.

Some areas have been more extensively studied than others. In the Tihama, which is the low plain extending along the entire Red Sea coast of Yemen, the Tihama Development Authority (TDA) has been overseeing the compilation of a water resources inventory since the early 1980s. The Tihama coastal plain has a width of 30 to 60 km and a length of 400 km. Approximately 1,200,000 people live in an area of rolling sand dunes and dry wadis that receive on the average only 400-600 mm of rainfall annually. Being part of the Great Rift Valley complex, the Tihama plain consists of unconsolidated Quarternary sediments varying in thickness from 50 to 200 m in depth. Groundwater moves relatively easily through these deposits with the average depth to groundwater ranging from 10 to 40 m in the most heavily populated areas of the Tihama. Groundwater levels tend to be shallower and more saline near the coast and deeper, but less saline, near the eastern escarpment. Electrical conductivity, which is a measure of the saline content of the groundwater as well as its potential for corrosion of pumping equipment, is generally considered to be acceptable for human consumption over 52 percent of the Tihama (EC < 2000 micros/cm).

TDA estimates that there are approximately 14,000 wells in the Tihama, of which over 8,000 currently have diesel-driven pumps on them. The largest number of pumped wells are found in the central Tihama in the vicinity of Wadis Mawr, Surdud, Siham, and Zabid, while the fewest are found in the southern Tihama near Wadis Dhubab, Rasyan, Hays, and Jahabah. Although specific breakdowns are not yet known, the pumped wells include essentially all existing boreholes (drilled wells) plus a significant number of dug wells. In Wadi Surdud, for example, there are around 1,000 wells, of which 90 percent are hand dug. Approximately 70 percent of all wells have pumps, the vast majority of which are dedicated to irrigation purposes. A large but unknown number of the remaining 300 unpumped, open wells are used primarily for domestic water supply purposes. The average depth to water in the wells is 29 m, with groundwater depths generally varying between 10 and 30 m in the populated areas, although dug wells exceeding 40 m in depth can be found.

In general, dug wells in the Tihama contain water throughout the year. The high rate of irrigation pumping in recent years has caused a serious net loss of water from the groundwater reservoir (annual recharge = 650 x 10^6 m^3/year; annual outflow and withdrawal = 1210 x 10^6 m^3/year), with the result that groundwater levels in the Tihama are declining an average of 0.4 m/year.

Near the coast, where water levels are near the ground surface, dug wells are generally found in the villages and sometimes within individual compounds. Away from the coast, the wells tend to be located outside the villages in wadi bottoms. When asked about their water supplies, people who use traditional wells invariably state that the quantity is insufficient but the quality is very good. This local perception of water quality contrasts with the likelihood that most open wells are probably contaminated with fecal coliforms, perhaps 20 percent have a high saline content, and a few areas contain groundwater with excessive levels of fluorides or nitrates.

Limited available information from the mountainous areas of Yemen indicates that many villages draw their domestic water from open wells. In the Sa'ada area in the north of the country, for example, groundwater depths average 20 to 40 m over the Sa'ada plain. The electrical conductivity of the water is generally less than 1,000 micros/cm, meaning that it is low in salts and not likely to cause significant corrosion. The groundwater levels, however, have been declining around 1.5 m/year in recent years, a problem found in many areas where large volumes of irrigation water are being withdrawn.

More than 2,000 wells are found in the Sa'ada area, with approximately 75 percent of them fitted with diesel-powered pumps. The remaining 500 wells without pumps most probably are used for domestic water supplies.

From the above, it can be assumed that traditional open wells serving rural villages can be found throughout the mountainous areas of Yemen. The WASH team inspected several open wells in the Taiz and Ibb governorates and was told of numerous other areas where open wells existed. This is not to imply that groundwater conditions suitable for relatively shallow wells can be found everywhere. The widespread drop in groundwater levels in recent years due to excessive pumping rates has caused open wells in many areas, such as the Sana'a Basin, to go dry. Although the total number of such wells is still unknown, it is likely that 10,000 or more open wells exist and are used for domestic water supply purposes.

3.2.2 Handpump Capabilities

A revolution in handpump design and manufacture has occurred in the past few years. Because of a major effort involving testing and comparison of handpumps by UNDP and the World Bank, information is now available on handpumps most suitable for village-level operation and maintenance (VLOM).[1] The UNDP/World Bank study has highlighted the special characteristics and problems of rural communities in the Third World and this, in turn, has prompted manufacturers to modify and even develop new handpump designs to meet the needs.

Handpump characteristics are classified in the UNDP/World Bank study in readily comparable categories (see Appendix C). The discharge rate, for instance, is dependent upon pumping lift and is rated at 1.5 m^3/day, 4 m^3/day, or 8 m^3/day. Pumping lift is classified into 0-7 m (suction lift), 0-12 m (low lift), 0-25 m (intermediate lift), and 0-45 m (high lift). Mechanical reliability is assessed in terms of the frequency of breakdowns and the pump's resistance to corrosion and abrasion. Ease of operation is assessed informally in terms of whether women and children can operate the pump.

The results of the UNDP/World Bank study show that there is a range of well designed pumps available on the market. It is dependent upon the purchaser, however, to select the pump best suited to local conditions. For groundwater conditions in Yemen, where pumping lifts average 10 to 40 m, suitable high-lift handpumps include Afridev, India Mark II, Monolift, SWN 81, and Volanta. Procurement of these or any other pumps must be by importation from manufacturers abroad.

There appears to be some experience with handpumps in Yemen. The TDA with the support of GTZ (German Agency for Technical Cooperation) installed 45 Monolift handpumps over large diameter (1.0 m) drilled wells as part of a demonstration project near Wadi Mawr in the Tihama. The handpump component of the project appears to have been unsuccessful because the local people reportedly refused to use the pumps (see Appendix B for details). An equipment distributor in Hodeidah city currently is selling the Monolift at a price of YR 15,000.

The WASH team also saw three Nira AF76 handpumps in the field in the Manakha area about 50 km west of Sana'a. All three pumps were inoperative for a variety of mechanical reasons, and the local people were drawing their water from the wells with a rope and bucket dropped through an opening in the cover slab.

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(1) Saul Arlosoroff et al. Community Water Supply: The Handpump Option. Washington, D.C., World Bank. 1987.

3.2.3 Maintenance Services

Proper maintenance is absolutely essential for the long-term operation of pumping equipment, whether hand powered or diesel driven. Without periodic, routine maintenance, even a handpump is unlikely to function more than six months in the field. Typical maintenance problems include breakages of the handle, fulcrum linkages, and pump rods, failure of cylinder seals, and corrosion of steel components.

In Yemen, it is uncertain at present whether adequate maintenance services can be assured for handpumps. There is no question but that the basic skills for routine maintenance and repair are widely available in the rural areas. Many Yemenis have had experience working as mechanics and technicians throughout the Gulf area. The problem, therefore, is one of organization of existing skills at the village level so that the village accepts the responsibility for pump maintenance and ensures that adequate maintenance services are provided.

The availability of spare parts is another issue that must be addressed. Since Yemen currently does not have many handpumps, there are no readily available spare parts. This is not an insuperable problem, however, because larger Yemeni towns usually have one or more equipment distributors, and a network of spare parts dealers probably would be established by the business community if there were a market for them. In short, maintenance of handpumps is a potentially serious problem that would have to be overcome by careful organization at the village level and by establishment of spare parts distribution by the private sector.

3.3 Manufacturing/Assembly of Handpumps

The second major technological question is whether handpumps can be locally manufactured or locally assembled from imported components. The easier of the two issues, of course, is local assembly, but even here several problems exist. Labor costs represent a relatively small part of handpump manufacturing, and if all components are imported, little in the way of cost savings can be expected. To the extent that importation of components can be minimized and local manufacturing maximized, the potential for cost savings is increased. For handpumps, the most difficult component to manufacture is usually the pumping cylinder. The solution is to select a handpump design which requires importation of only the cylinder with the remainder of the components fabricated locally. Fortunately, a number of handpumps, such as the Afridev, SWN81, and Volanta, allow this approach. Other problems affecting importation of components include import restrictions, time delays, and lack of control over supply.

For local manufacturing, a reasonable industrial base is required for most of the handpump designs currently available. Yemen has some manufacturing capabilities in the form of machine shops, metal-working plants, and plastics factories. However, the larger companies tend not to be interested in allocating any of their resources to the production of handpumps, while the smaller firms generally lack the manufacturing capability to produce the pumps.

The WASH team visited a large plastics production plant in Taiz and several small industrial facilities in Sana'a. In Taiz, the National Company for Sponge and Plastic Industry Ltd., which is part of the giant Hayel Saeed Anam & Company complex, produces PVC water and sewer pipe. Despite the fact that this firm operates with modern computerized equipment and meets the needs of the entire country for PVC pipe, it must import all of its pipe extrusion dies and pipe-fitting molds. Company officials indicated that they were not interested in producing handpump components, whether of plastic or any other material.

In Sana'a, on the other hand, a small multi-function industrial firm, al-Raiby Company, has been actively trying to develop a low-cost handpump. The owner of the company has eagerly responded to USAID ideas and suggestions regarding local manufacture of handpumps. He has built one handpump of his own design and recently imported the SWN81 handpump from the Netherlands in order to copy it in his workshops. Although his production capability is extremely limited, he believes that a market for handpumps will arise as soon as he is able to develop a workable prototype. As an indication of his commitment to this effort, he says that he is willing to invest up to YR 100,000 ($10,000) in development and initial start-up costs. Specific information on other manufacturing firms is not available, but it is probable that because of the current absence of a market for handpumps small firms are more likely to see attractive opportunities for local manufacturing than are large ones.

The main constraint to local manufacture of handpumps is the current lack of specialty tools, in particular plastics extrusion molds, needed to fabricate some handpump components. Recent worldwide efforts to simplify the manufacture of handpumps have substituted newer PVC and other plastic materials which can be injection molded to exact specifications, for steel and other metals, which usually must be machined to exacting tolerances. While this trade off has reduced the level of manufacturing sophistication necessary to produce handpumps, it has introduced new costs in the area of tools and equipment. The Afridev handpump, for example, has been designed specifically for village-level operation and maintenance and to promote local manufacture. The plunger and footvalve of the Afridev pump are identical and are made of PVC materials which are available in many developing countries. Unfortunately, the injection molds for these PVC components are difficult to fabricate locally and must be imported at a cost of $50,000.

Another problem is the importation of raw materials as well as finished components. Current restrictions on imports make it difficult to bring into Yemen specialty equipment and cause uncertainty regarding future supplies of imported raw materials.

A third problem involves the need for quality control, especially in metal fabrication and machining. The degree of industrial quality control in Yemen is unknown but can be assumed to be higher in large firms than in small enterprises. Without reasonable quality control, no locally made handpump will be able to survive comparison with imported models.

Lastly, there is the problem of price competition in the manufacture of handpumps. Experience in other countries has shown that local manufacturing cannot easily compete with less expensive imported products. In Yemen, there are examples of locally produced products determining the overall market price and, in the process, allowing cheaper imports to be sold at the higher domestic market price.

In summary, there is only a limited potential for local manufacturing or assembly of handpumps in Yemen at this time. The main technological constraints on the private sector are a weak industrial base, lack of experience in handpump fabrication, and a lack of specialty tools and equipment needed in the production process. An optimistic note in this situation, however, is the enthusiasm and commitment of one small Yemeni firm to produce a marketable handpump for the country.

3.4 Cost Components

Handpump costs can be viewed in terms of importation, local manufacturing, installation, and maintenance. Importation costs include elements of production, transportation, and local profit. The production costs of current handpump models range from about $150 to $900, depending on materials, design, and country of origin. Transport costs are highly variable and can range from under 10 percent of production costs when large shipments are ordered to 30 percent or more for small, special orders. As an example of production and transport costs, a SWN81 handpump was recently imported from the Netherlands. The factory price for the pump, cylinder, and 48 m of pump rods and rising main was $1,100, but packing and air freight to Cyprus prior to shipment to Yemen added another $600 to the cost.

Local profit is also highly variable. In Hodeidah, the WASH team found a trading firm selling the Monolift pump for YR 15,000 ($1,500). According to the UNDP/World Bank study, the 1985 price (in the U.K.) for this pump was around $400 (approximately YR 4,000). It is to be expected that effective price competition in both locally manufactured and imported handpumps would bring the Hodeidah price down.

Handpumps are installed on concrete slabs which allow the water to drain away from the pump base. Depending on whether the well is a small diameter borehole or a large diameter dug well (3 to 4 m dia.), the materials cost for the necessary concrete, steel, and lumber will range from YR 1,000 to YR 5,000. For the common 1.0 m diameter dug well, materials will cost about YR 2,000, while the completed slab with the installation of the handpump will total about YR 3,000.

Maintenance of handpumps can be very inexpensive if local self-help services are used or very costly if an outside technician makes routine visits to a pump or if maintenance is ignored until a serious breakdown occurs. Under the assumption of local self-help maintenance, the annual out-of-pocket costs for replacement parts and infrequent overhauls should not exceed 5 to 10 percent of the construction costs.

Overall, the procurement and installation of a suitable handpump for a rural community in Yemen should cost about YR 15,000. The approximate breakdown of this cost is as follows:

handpump, rising main, and cylinder	YR 10,000
local transportation	1,000
slab construction and pump installation	3,000
miscellaneous (well deepening)	1,000
Total	YR 15,000

3.5 Summary: Technological Feasibility

* Traditional open wells used for domestic water supply purposes are found throughout Yemen.

* There are several well designed handpumps available on the international market which are suitable for Yemen.

* There is only a limited potential for local manufacturing or assembly of handpumps in Yemen at this time.

* The procurement and installation of a suitable handpump for a rural community will cost about YR 15,000.

Chapter 4

SOCIOECONOMIC FEASIBILITY

4.1 Definition of Socioeconomic Feasibility

This chapter is concerned with the issues of community acceptance and community demand for handpump systems in Yemen. It is assumed that successful introduction and/or promotion of handpumps and related inexpensive pipe systems is dependent on a range of social and economic factors apart from the availability of financing handpumps, pipes, or spare parts on the local market. It is further assumed that these social and economic factors may vary considerably within Yemen according to region, the local environment, and social category. Thus, it is important to distinguish the criteria for assessing the acceptability of handpumps and related systems to communities and individual consumers prior to formulating proposals for introduction or promotion of these in the country.

The criteria for determining community acceptance and interest in handpumps and related systems include

1. Recognition of need for improved water systems (e.g., health benefits, cost savings, labor savings, etc.);
2. Previous knowledge/experience with handpumps (e.g., observations in other countries, media, samples seen in Yemeni stores, etc.);
3. Local mechanisms for spread effects in promotion;
4. Extent to which views of actual users coincide with views of community leaders, government officials, local businessmen;
5. Willingness to accept the level of technology;
6. The fit with traditional beliefs and customs regarding water use, water rights, and local cooperation in use of community resources;
7. Attitudes and practices concerning treatment of public and private property (e.g., vandalism, theft, careful use);
8. Willingness to pay for installment and servicing of systems;
9. Community means for mobilizing financial arrangements and managing proper use and servicing.

The purpose of this chapter is two-fold: (1) to identify constraints and the potential for use of handpumps from a social perspective and (2) to assess in general terms the levels of community acceptance and community demand for handpumps currently existing in Yemen. In addition to the issues of the

purchase and installation of handpumps, are there any objections to this intervention and are there social and religious factors which may enhance the successful introduction of handpumps and related systems to Yemeni consumers? The information provided here stems from interviews and observations in the Tihama, Sana'a, and Taiz areas, as well as relevant comparative data from previous projects and research. While the focus is on the Tihama region, comparison is made when possible to other regions in which handpumps are technically feasible.

4.2 Community Acceptance of Handpumps and Related Low-Cost Systems

For North Yemen it is important to identify the socioeconomic milieu in which handpumps may be introduced. From a geographical perspective it appears that the Tihama coastal region has the most potential for possible intervention because of the relatively shallow water tables and the large number of small communities without improved potable water systems. Villages and hamlets in the Tihama differ considerably from communities in the mountains and highland plains as a result of historical and cultural contacts. In a number of ways coastal villages have greater affinities with African communities than with highland Yemen, as is immediately apparent from the architecture, social attitudes and subsistence activities. Thus the acceptability of handpumps and related systems within Tihama communities may not be similar to other parts of the YAR.

Improved water systems have been introduced in a number of coastal towns and larger villages, although these are not all operable at the present time. Because of the focus on agricultural development, a large number of wells with pump systems are currently in use. The beneficiaries for handpumps, however, will tend to be smaller villages and hamlets which still depend on traditional, unsanitary rope-and-pulley well systems. These may range from a cluster of 10 to 20 compounds to villages of up to 75 compounds. Such communities consist of closely related kin and, at least on the surface, appear to be among the poorest in the country. A high percentage of young males work abroad, generally on unskilled and short-term jobs.

Socially, a distinction must be made between communities with strong tribal (i.e., traditional) leadership and those more oriented toward the emerging national administrative system. For example, in the district of al-Mansuriya the head of the local development board (LDB) is also an important tribal shaykh with a considerable local power base and little accountability to YARG. In Bayt al-Faqih District, by contrast, the head of the LDB has better links with the central government structure but not as strong a traditional tribal base of support. Similarly, those villages with important local leaders or near the main roads tend to have more access to government resources than those further away from the main towns and LDB offices. Although, in general, transportation is not a problem on the flat coastal plain, there are differences of political influence and economic prosperity between communities in the same administrative district.

Applying the criteria for community acceptance of handpump and related systems to Tihama villages and hamlets, the following observations can be made.

1. Recognition of need for improved water systems

In small communities (from 150 to 300 people) the residents usually say the water in the traditional wells is clean and good to drink. This means it is sweet (malih) rather than bitter (murr) or salty (milh), and that no direct links are seen between water quality and health problems. In those communities where diesel/electric pumps are not used for domestic water supply, the traditional rope-pulley systems are seen as relatively cost-free. The donkeys used to lift the buckets have a wide variety of uses (e.g., transport, agricultural work) and thus their feeding and care are not seen as an expense solely for water systems.

While the people who use the wells admit the work is hard, there is no evidence that this labor is perceived as a major burden or physically detrimental. Young boys and women are able to operate the rope-pulley systems without difficulty.

The use of donkeys with the rope-pulley system requires at least two people, although not necessarily two adults. One individual drives the donkey along the path leading away from the well, while the other maneuvers the water bucket out of the well to fill the portable plastic or clay containers. While such a system is more labor intensive than use of a handpump or piped system, no one mentioned this as a major problem. There appear to be plenty of children available within the household to help with this task.

In highland villages where there is as yet no improved water system, the primary concern is establishing a reliable supply and reducing the time and effort spent in carrying water to the house. Villagers here discriminate between water sources according to perceived quality, so that women will travel several kilometers to obtain clean water from a well rather than use collected flood flow or rainwater for drinking.

2. Previous knowledge/experience with handpumps

While a few handpumps have been installed in Wadi Mawr under a TDA project, most villagers have no knowledge of this technology. The English Monolift handpump is available in at least one showroom in Hodeidah, but it is doubtful if any villager has ever come to see it. Yemeni officials at the local level who have had some training or experience abroad have seen handpumps. A health worker at the health center in al-Mansuriya had seen handpumps on television in Egypt, as had several LDB officials interviewed. For the population as a whole, however, there is as yet no awareness of handpump technology.

In a wadi near Manakha in the western highlands several handpumps were recently installed through private effort. None of these are currently working, so the women have returned to the traditional use of rope and bucket.

3. Local mechanisms for spread effects in promotion

A feature common to many regions of Yemen is the relative ease with which information on new technologies and interventions can be communicated even to isolated communities. Television and radio coverage extends to most of the country. Even in poor mud hut compounds in the Tihama one can find television powered off automobile batteries. Given the high rate of male emigration from the Yemeni countryside, most communities have someone who is at present working abroad or in a major Yemeni city. Even though travel may be difficult in the mountains, most communities are accessible by vehicles.

The specific local mechanisms for spreading information vary somewhat according to the location and level of economic development of a community. Throughout the Tihama and much of the country the most common forum for exchange of news and information is the afternoon qat chewing session. Qat is a widely cultured green-leaved plant which contains alkaloids and, when chewed, acts as a stimulant in much the same manner as caffeine. Qat chews occur in both traditional communities, where a shaykh's house may be a focus for chews, and among local government officials including LDB offices, extension workers, and other government workers. Yemeni extension workers view the qat chew as having great potential for communicating health or related messages to a wide segment of communities.

Government agencies have thus far made little progress in communicating with rural communities. This is especially the case when government officials are not from the local area. Only a few local health units are functioning at the present time. These tend to be in the villages which are already better off. The local council, which is elected by the local population, is an important forum in that it has money and resources and tends to include individuals with local political power. It must be noted, however, that not all the council boards are responsive to community needs or able to cover the population in their area.

4. Extent to which views of actual users coincide with those of officials

In assessing the acceptability issue it is apparent from conversations with villagers, local officials, government officers, and businessmen that interest in handpumps and low-cost piped systems is not uniformly spread across the social spectrum that would be involved in promotion of such pumps.

Actual users in villages at present do not recognize health benefits, while health extension workers immediately respond to the safer environment associated with a handpump. Businessmen, especially major importers, tend to underestimate rural Yemenis and consider them as being too ignorant to appreciate such a technology, while local leaders and government officials tend to view the businessmen as corrupt and unresponsive to people's needs. As illustrated in the TDA handpump project in Wadi Mawr (Appendix B), failure to consult local residents can result in their rejection of the intervention.

A potential problem for most highland communities is the strict division of labor in which women and children are responsible for water collection in traditional systems. Since the men, who generally make most decisions about local improvements, do not have personal experience with water collection, they do not always recognize the laborious work of women in obtaining water. In coastal villages, men appear to be involved in obtaining water to a great extent. While use of a diesel pump system is almost always a male activity, in the highlands the handpumps would be seen primarily as an extension of the traditional system (i.e., women's work). Although no recent data are available on male/female attitudes, it is probable that men in many highland communities would be less likely to see the handpump as a priority improvement because they would not be involved in its use.

5. Willingness to accept level of technology

A potential problem raised during interviews is that Yemeni villagers may not want handpumps because they may be viewed as inferior to the water systems seen on television or already built in other villages. This view was expressed by both government officials and businessmen and is justified by consumer patterns for other items (e.g., larger and more expensive tractors being preferred to more appropriate models). While there is no evidence that poor rural villagers would always rather have a certain "level of technology" rather than a simple, inexpensive intervention, it is necessary to promote handpumps and low-cost piped systems on their own merits so that potential consumers do not become convinced that a handpump is necessarily inferior to diesel or solar pumps and to piped distribution systems.

6. The fit with traditional beliefs and customs

Principles of water use and broader patterns of water use, particularly for domestic supply, reflect both local customary practices and formal Islamic beliefs. There is nothing about the handpumps per se which conflicts with local attitudes and religious practices. In fact, a handpump (which covers an open well) is advantageous in the Islamic system where water should

be "clean" for ritual as well as general health reasons. In Islamic law, procedures are laid down for ensuring that wells are not polluted and for cleaning water systems. While most rural Yemenis may not be familiar with the details of Islamic law, they are receptive to changes in behavior justified on religious grounds. There is often a keen interest in improving water supply for mosques.

Although handpumps themselves do not present a problem, the total water system must take into account traditional and religious practices. For example, in one village the people said it would be wrong to wash clothes on a slab associated with a well, because this would contaminate the well water. In traditional systems domestic animals are generally watered in simple troughs (often of mud) next to the well; this could be incorporated into the design of a handpump system for such villages.

7. Attitudes and practices concerning treatment of public and private property

Since the handpump is a new technology, it is important to determine how traditional attitudes toward public property will relate to the acceptance and care of the pumps. In most small villages theft and vandalism are virtually non-existent since most of the local population is intimately related and readily accountable. If a handpump is located along a road, where people from other areas may stop and use it, there is a potential for misuse and theft of parts. Unless the local users are given training in careful use of handpumps, systems may break down, not through willful misuse, but due to ignorance. This was illustrated by the broken handpumps seen near Manakha.

8. Willingness to pay for installment and servicing of handpumps

Willingness to pay for handpumps is difficult to measure from casual interviews. In general it is a common practice for villages to cooperate in financing local development--water systems, electricity, roads, schools--a factor demonstrated in both the CLCCD movement and local cooperative initiatives. Since the recurrent costs are minimal as compared with diesel pumps, for example, and initial costs would be cheaper than diesel pumps, there is no reason to expect that individuals in a community would be unwilling to jointly pay for a public handpump or simple pipe system. In 1986 Yemeni citizens provided YR 24,991,365 ($2,499,136), almost half of the total costs, for CLCCD water projects.

A related issue is the value in a sense of ownership. For the TDA handpump project in Wadi Mawr, the pumps and wells were provided free alongside the existing systems. Failure of the communities to use these new systems suggests several strategic issues. First, if there is no local investment, there is no

sense of ownership. Second, when alternative sources of water supply are available, there is no compelling reason to adopt the new systems just because they are given freely. Third, by ignoring the role of the local community in design and placement of the handpumps, the new systems can become symbolic of unwanted government intervention and mismanagement.

9. Community concerns for mobilizing cooperation and financing

The community means for mobilizing cooperation and financing are well entrenched in Yemen. Close family relationships define the household or extended family network as a unit to provide labor or money for community initiatives. Local shaykhs can arrange affairs within a village or tribal unit and larger shaykhs can, with somewhat less success, mobilize affairs within a tribal area. There are often trusted individuals, such as the remittance agents, to whom villagers may turn for help.

It is important to note that much of the development of local infrastructure in the past has taken place through community initiative apart from the formal LDB structure promoted by the YARG. For example, if people in three villages want a road or track to connect them with a main road, the shaykhs and leading men will meet and arrange for each household to pay a certain amount (and/or donate labor) to hire a bulldozer. Similarly, shaykhs and local leaders can call on their constituents to help repair or clean community resources (e.g., repair of a barrage, cleaning of a cistern). This system is not always successful with new interventions, such as car roads, when there is no common standard.

The most important new institutional means for mobilizing community support and development is the CLCCD with LDBs at the district levels. As the capabilities of the LDBs evolve, many are gaining respect from villagers and are increasingly turned to for assistance. It is important to stress that the role and effectiveness of the LDB has changed over the past few years. Previous assessments had given a generally negative view of CYDA and LDB efforts to foster local development (see section 5.2).

In the smaller communities with no improved water systems, it is often difficult or impossible to find someone to fix problems arising from new technology. While there are mechanics available in the market towns and potentially through the LDB, some local training would be necessary for the minimal care and servicing of handpump systems. The private sector does not yet have the capabilities or interest in responding to needs of smaller, more isolated communities which would be likely to install handpumps.

4.3 Training and Promotion Needs

Interviews and observations by the team indicate that most villagers are not aware of the range of potential health problems from existing water systems nor are they able to use and maintain new technologies properly without some local training or provision of information. This parallels findings in studies of health issues that a prime cause for the poor quality-of-life indicators in Yemen is ignorance or lack of information rather than economic deprivation. Thus, there is a need to provide hands-on training and information, preferably through existing channels of health workers and LDB officials, along with promotion of the handpumps and related systems.

For initial promotion the LDB represents a primary channel for reaching rural communities. Several LDB officials as well as health unit workers suggested that local workshops involving demonstrations and basic information on handpumps would help stimulate interest and at the same time sensitize the LDB officials to the benefits of such simple systems. The CLCCD has previous experience in similar promotional workshops at various levels, including the LDB.

The mechanics associated with CLCCD and LDBs will need additional training and information on installation and servicing of handpump systems as well as improved pipe systems or rehabilitation of existing systems. It was suggested that this could be conducted through short workshops or perhaps provision of simple manuals developed by CLCCD, or by USAID for CLCCD.

Sensitizing villagers to the health, cost and labor benefits of handpump systems is an important need. Health workers currently are attempting to improve local sanitation and related health practices, but they recognize that most people are still unaware of the range of health links from water systems currently in use. The extent of local health units is very limited and is still at a very rudimentary stage in providing services. LDB officials at present do not have practical means of educating villagers on these issues, but recognize a role for local health workers and local primary schools.

4.4 Demand for Handpumps

Potential demand for handpumps and related low-cost, simple systems in rural Yemen is dependent on the present number of shallow wells (i.e., less than 45 m depth) in the YAR, and particularly in the Tihama where the watertable for domestic supply is usually shallow enough for handpump use. The World Bank estimated in 1986 that more than 20,000 pumps had been installed on wells and boreholes in the past 20 years. They estimated 7,000 irrigation wells in the Tihama and 10,000 drilled wells in the highland plains. The TDA estimates about 14,000 wells in the Tihama, of which 8,000 currently have pumps on them. For the hydrologic survey of Wadi Surdud about 1,000 wells were recorded, 90 percent of these being hand dug. About 70 percent of all the wells in Wadi Surdud had pumps, mostly for irrigation.

For the Tihama there are apparently a maximum of 6,000 wells without pumps. Perhaps 20 percent of these will not be suitable for handpumps on technical grounds, and at least another 40 percent will no doubt have diesel pumps installed given the current trend documented for Wadi Surdud. This leaves a universe of some 2,000 wells in the Tihama for which handpumps may be used. Although data are not available for the country as a whole, it is reasonable to assume that another 2,000 wells would be suitable in the highland plains and eastern plateau.

The difficulty in establishing existing potential demand and future market possibilities is related to a number of issues that cannot be resolved from the available data.

(1) Apparently very few hand-dug wells are still being constructed in areas with relatively shallow watertables. Most new well construction, done by drilling, is undertaken for irrigation purposes. Thus, an expansion of the suitable wells for handpumps is not anticipated in the future. The rapid drawdowns currently occurring in some regions will further decrease the number of suitable existing wells as time goes by.

(2) There is a market preference for diesel pumps, even when these are more expensive and powerful than needed. Since handpumps at present are not available for the vast majority of rural Yemen, there will continue to be a rapid expansion of powered pumps.

(3) Some villages without improved systems want the types of water projects seen on television or found in neighboring villages. Although it is difficult to assess at this time, the level of technology represented by the handpump will be a hindering factor in promotion of such systems in some areas.

(4) Even though the potential number of suitable wells may be estimated, the existing distribution system is not adequate for reaching the more isolated and poorer communities where handpumps are more likely to be accepted.

Given these difficulties, the WASH team does not see a sizable market for handpumps sufficient to stimulate major interest within the private sector at this time. Annual sales will be in the hundreds rather than the thousands and the market will decrease as future development occurs. Without an export potential, only a small, low-cost workshop could justify production economically.

4.5 Consumer Profile

Apart from potential market demand for handpumps and related systems, it is important to identify the range of consumers and their needs. Two broad types need to be distinguished: small communities installing community public water systems, and individuals of various economic levels interested in improving an existing rope-pulley system or in providing an inexpensive alternative to a diesel pump for domestic or irrigation use.

4.5.1 Small Communities

Hamlets and small villages may need one or more handpumps or related systems to replace traditional and unsanitary rope-and-pulley systems. The financing and care would be a shared enterprise, which lends itself to support through the LDBs. Credit does not appear as a constraint. In some cases the handpump may lead to a more complex and expensive water system in the future.

4.5.2 Individuals

In general individuals interested in handpumps for use on privately owned wells may purchase one to supplement existing (or community) access to water or to save on expensive operation costs of diesel pumps. In some coastal villages with shallow watertables, such systems may be affordable now or in the near future. In various parts of the country, small in-field or garden plot irrigation wells may be chosen for handpumps or selected smaller powered pumps. These individuals would represent a more direct market for local businessmen and manufacturers.

4.6 Summary: Socioeconomic Feasibility

* Rural inhabitants generally recognize the need for improved water systems in terms of reliability of supply and the time and effort necessary to carry water.
* There is little knowledge of or experience with handpumps in Yemen.
* Radio, television, and qat chews are important means of spreading information in Yemen.
* The extent of women's labor in obtaining water is not well recognized by officials.
* Handpumps are not in conflict with traditional beliefs and practices but may need to be promoted as an acceptable level of technology.
* Unless a village develops a sense of ownership of a water project, it will not be properly used and maintained.
* Community support for small water systems can be enhanced through the cooperation of the CLCCD and the local development boards.
* Training is needed to sensitize people to potential health problems and to develop skills in the installation and servicing of handpumps.
* It is estimated that handpumps could be used on approximately 2,000 existing wells in the Tihama and 2,000 wells in the highland plains.
* The potential market for handpumps includes small communities using communally owned wells and individuals and small businesses using privately owned wells.

Chapter 5

YARG AND CLCCD INVOLVEMENT

5.1 Overall YARG Involvement

The government is directly involved in improving water systems for rural communities through a number of institutions. The RWSD has developed many projects, some of which are conducted with direct assistance of foreign donors (e.g., USAID 044). In the Tihama, the TDA has also installed rural water systems with donor assistance. Throughout the country the local development boards (formerly LDAs, but now called LDBs) help coordinate financing and construction of improved rural water systems either through their own resources or in conjunction with other government agencies. In addition, the Ministry of Agriculture and Fisheries through various donor projects has provided or facilitated some irrigation wells and other systems in the rural areas.

The government is indirectly involved in improving rural water and sanitation systems through limited programs in the Ministry of Health, and to a lesser extent through curriculum chosen for local primary schools. Although there are only a limited number of functioning rural health units, the trained workers have the capability to communicate the health aspects of water use.

The government in recent years has played an increased role in controlling the import and manufacture of materials used in rural water systems. This represents a constraint readily recognized within Yemen's private sector (see section 6.1).

5.2 CLCCD Involvement

The Confederation of Local Councils for Cooperative Development (CLCCD) is currently the primary institution for promoting improved water systems in rural Yemen. This institution replaces the Confederation of Yemeni Development Associations (CYDA), established in 1973 to foster rural development. The lessons learned from a number of previous donor projects left a negative assessment of CYDA as a whole, as reflected in Yemen's Social and Institutional Profile. Evaluations of USAID's Project 031 in Mahweit (STC) and Project 045 in Hajja (Chemonics) indicated that implementation of initiatives at the local level was largely unsuccessful due to the political environment in which USAID was enmeshed at both the local and national levels. Although the reorganization of CYDA into CLCCD is very recent, it appears to represent a YARG priority to enable local development to take place and to promote increased participation of Yemenis in choosing local representatives both for development and administrative purposes.

The administrative structure of CLCCD is pyramidal and is based on elections which were conducted in 1985. In this election, 17,549 representatives were elected (about 1 for each 500 people) to the People's General Congress. These, in turn, elected representatives for 219 administrative boards, or

LDBs, at the district level with 7 to 11 representatives for each board, or a total of about 1900 representatives at this stage. Above this level are branch councils at the governorate level, chaired by the governor, and ultimately a national board of 24 members plus certain ministers and deputy ministers. The overall structure is ultimately chaired by President Ali Abdullah Salih. The national board consists of 12 members in Sana'a with the rest located in the various governorates (where they share this responsibility with other positions). The administrative structure of CLCCD at the national level in Sana'a is illustrated in Figure 1.

The reorganization of CYDA into CLCCD is officially structured in Law No. 12 for 1985 of the YARG. This sets forth a variety of general functions that the councils are given, including

(1) participate in survey and study of needs

(2) prepare of development plans

(3) oversee administration and operation of facilities relevant to other functions

(4) participate in raising the level of local economic production and marketing

(5) develop programs in sanitation, afforestation, lighting, paving roads, health improvement, literacy training, adult education, organizing of public market activities

(6) develop work opportunities for unemployed and needy

(7) participate in administration, operation and maintenance of relevant government projects

(8) propose projects they cannot administer

(9) encourage setting up of special cooperative assemblies

(10) advocate role in community self help

(11) raise level of consciousness of objectives of the Revolution, especially Islamic principles and national loyalty

(12) assist in solving local problems relating to development projects

(13) supervise administrative committees in communities

(14) discuss general questions concerning citizens in area.

Figure 1

Administrative Structure of CLCCD (Sana'a)

Secretary General

Assistant Secretary General

Departments:

* Public Relations
* Finance and Administration
* Agricultural Associations
* Research and Studies
* Legal
* Planning and Statistics
* Project Activities
* CLCCD Affairs
* Training
* Sec. Gen. Secretariat

Total Headquarters staff: approximately 200

(Source: Assessment of USAID Institutional Development Strategies, February, 1986)

The administrative role of the council is undertaken by a local development board (LDB), which is charged with such tasks as preparing draft plans and budgets, carrying out work requiring hire, purchases contracts and services, receiving donations and contributions, preparation of periodic reports and general administration of council activities. The chief officer of the LDB is the Secretary General (Amin 'Am), but other officers include a deputy and financial officer. Each council is allotted a portion of government revenue and maintains an account in the Agricultural Cooperative Credit Bank.

In practical terms the development projects implemented by LDBs and their predecessors have been directed at road-building, schools, water supplies and health clinics. During the first decade (1973-1983) of its official existence, CYDA was responsible for 947 water projects costing a grand total of YR 170,600,000 ($37,000,000 at then-current exchange rates). During the same time period YR 838,600,000 was spent on roads and YR 248,700,000 on schools. For 1986, the first year of operation after reorganization, CLCCD sponsored 333 water projects (both new and maintenance/rehabilitation) worth YR 63,969,740 ($6,400,000). Of this, YR 24,991,365 was provided directly by the people served, YR 16,255,149 by the councils' government revenues, and YR 22,723,316 through other (i.e., foreign donor) aid. These expenditures are broken down by governorate in Table 1. Expenditures on other types of projects for 1986 are shown in Table 2.

At the present time it is obvious that water projects within the CLCCD are very dependent on both donor and private financial support. The rural beneficiaries of water systems have actually contributed more than foreign donors working through the CLCCD. (Note that donor projects with other ministries are not reflected in these figures.) A preliminary trend away from road building to water systems can be seen in the shift of expenditures between 1973-1983 and 1986. Relative to water systems, projects in education received more funding in both the 1973-83 and 1986 periods.

5.3 Local Acceptance of YARG Involvement

The cooperative movement in the YAR draws on a long tradition of community self-help, primarily within a tribal context. The government's attempts to stimulate and direct cooperative efforts at the local level have resulted in a number of problems. A number of these were outlined in the experience of USAID's Project 045, in which USAID technical advisors and PCVs were directly involved with the local councils. Perhaps the main problem was in the differing expectations and multiple confusion of those involved. It is clear that Yemenis are interested in the resources that can be provided by the LDBs, but due to inefficiencies and some corruption there is still suspicion about the role these entities play. In general the Yemeni population is locally oriented, especially along lines of tribal affiliation, and nationalism is a recent phenomenon in the countryside.

Observations and interviews of the team in the Hodeidah, Taiz, and Ibb governorates indicated that local attitudes toward the CLCCD vary according to the strength and perceived honesty of the LDB officials. In one district there were complaints that the head of the LDB used his position to

Table 1

Summary of CLCCD Water Projects in 1986

Governorate Branch	New Projects		Project Maintenance/ Rehabilitation	
	No.	Costs (YR)	No.	Costs (YR)
Sana'a	7	7,192,575 (total)	12	1,308,384 (total)
		1,569,000 (people)		117,450 (people)
		1,623,575 (councils)		200,243 (councils)
		4,000,000 (other)		990,691 (other)
Taiz	53	18,428,392 (total)	3	40,450 (total)
		3,610,000 (people)		1,000 (people)
		2,374,392 (councils)		39,450 (councils)
		12,444,000 (other)		-
Hodeidah	66	20,623,311 (total)	10	131,450 (total)
		14,366,643 (people)		-
		5,610,043 (councils)		131,450 (councils)
		646,625 (other)		-
Ibb	86	4,097,647 (total)	11	1,108,647 (total)
		1,340,603 (people)		355,000 (people)
		2,526,044 (councils)		453,647 (councils)
		231,000 (other)		300,000 (other)
Dhamar	6	2,116,837 (total)	-	-
		1,213,450 (people)		-
		903,387 (councils)		-
Hajja	19	5,723,111 (total)	5	508,910 (total)
		573,879 (people)		360,000 (people)
		1,146,232 (councils)		148,910 (councils)
		3,993,000 (other)		- (other)
Sa'ada	3	54,486 (total)	3	33,750 (total)
		-		-
		54,486 (councils)		33,750 (councils)
		-		-
Beidha	19	1,439,042 (total)	22	683,098 (total)
		908,400 (people)		475,000 (people)
		530,642 (councils)		176,098 (councils)
		-		32,000 (other)
Mahweet	2	43,400 (total)	-	-
		10,700 (people)		-
		16,700 (councils)		-
		16,000 (other)		-
Marib	6	436,250 (total)	-	-
		80,150 (people)	-	
		286,100 (councils)		-
		70,000 (other)		-
Jawf	-	-	-	-
		-	-	-
		-	-	-
		-	-	-
Total	267	60,155,051 (total)	66	3,814,689 (total)
		23,682,825 (people)		1,308,450 (people)
		15,071,601 (councils)		1,183,548 (councils)
		21,400,625 (other)		1,322,691 (other)

(Source: CLCCD, September, 1987. Note that "other" refers primarily to foreign donor assistance.)

Table 2

Summary of Total CLCCD Projects in 1986

Governorate Branch		No.	Roads Costs (YR)	No.	Education Costs (YR)	No.	Health Costs (YR)	No.	Misc. Costs (YR)	Total * Costs(YR)
Sana'a	*	60	2,465,030	97	19,446,850	3	183,335	41	11,381,399	40,669,189
		243	4,702,211	89	2,069,472	10	101,092	25	988,131	9,219,290
Taiz		68	7,235,821	123	12,879,013	23	2,066,282	49	6,838,141	47,447,649
		100	3,456,167	55	2,555,916	4	48,718	32	3,122,541	9,223,792
Hodeidah		12	1,482,847	34	8,868,274	3	585,825	33	11,359,505	42,919,762
		3	93,046	11	1,004,555	-	-	10	115,462	1,344,513
Ibb		28	2,788,587	95	8,502,264	4	320,974	37	4,013,080	19,722,552
		149	3,681,091	43	2,322,951	5	260,500	27	611,013	7,984,202
Dhamar		39	4,186,564	17	1,864,077	-	-	3	2,185,322	10,352,800
		53	1,324,497	3	2,957	1	15,852	6	208,713	1,552,019
Hajja		53	2,931,829	55	19,549,660	8	836,500	31	923,068	29,964,168
		123	4,141,874	42	2,227,245	6	428,743	15	250,910	7,557,682
Sa'ada		31	4,612,688	15	1,894,060	1	46,130	5	157,287	6,764,651
		47	2,887,719	46	1,511,715	3	17,451	1	40,000	4,490,635
Beidha		14	415,910	11	706,720	2	543,151	17	793,346	3,998,169
		25	480,799	30	497,792	1	30,000	24	719,020	2,410,709
Mahweet		18	1,430,596	31	1,430,795	5	200,886	11	856,480	4,062,157
		31	1,673,184	6	111,500	-	-	1	50,000	1,834,684
Marib		3	99,000	4	417,100	-	-	-	952,350	952,350
		3	9,000	7	15,080	-	-	-	-	24,080
Jawf		-	-	-	52,897	-	-	2	62,000	114,897
		-	-	1	30,000	20	7,000	-	-	37,000
Total		326	27,648,872	497	85,502,293	62	6,475,525	261	45,029,998	224,811,739
		777	22,449,588	333	12,349,183	31	959,356	141	6,105,790	45,678,606
GRAND TOTAL		1101	49,098,460	830	97,851,476	93	7,434,881	402	51,135,788	270,490,345

(Source: CLCCD, September, 1987.
* Note that for each governorate, the first figure is for new projects and the second for maintenance or rehabilitation. Grand totals include funding at capitol city level. Totals for governorates include water project costs listed in Table 1.)

consolidate his role as a powerful shaykh in dispensing favoritism. In an adjacent district the head was well-trained and concerned about fulfilling the functions assigned to the LDB. It is important to note that neither USAID nor the WASH consultants could determine the effectiveness or appropriateness of LDBs. Allegations of corruption appear to be frequently used in local political maneuvering and it is very difficult to evaluate these from outside the system.

A number of individuals in the business community complained about problems they had with the CLCCD and YARG ministries. The private sector is understandably concerned about YARG policies, since the recent trend has been for stricter controls. At the same time representatives of YARG complained in turn about businessmen who are only concerned with making profits. What becomes readily apparent from these conversations in the field is that there is a high degree of mutual suspicion, while at the same time increased incentives to cooperate. The issue of rural Yemeni perceptions of the CLCCD and YARG efforts is changing, which is a positive factor for donor involvement, but it will take a long time for long-standing suspicions to subside.

The recent reorganization of CYDA into CLCCD is in part a response to what YARG saw as a threat to the national development process from conservative religious groups who gained considerable momentum in the early 1980s. Conservative religious elements, for example, generally resent the major use of zakat (the traditional 10 percent religious tax) by the LDBs and YARG for "secular" development. The reorganization is also a recognition of regional imbalances in development efforts. By establishing a national grid with democratic support, YARG demonstrates its commitment to help those regions virtually left out in the past through the CLCCD. YARG also views this "cooperative movement" as a positive factor in promoting its international image.

5.4 Summary: YARG and CLCCD Involvement

* The YARG is becoming increasingly involved in the improvement of rural water and sanitation systems.

* The CLCCD has existing capabilities to promote and install handpump systems in rural communities, but it also has need for USAID assistance.

* The CLCCD is currently the best institutional locus for promotion and installation of handpumps in rural Yemen.

Chapter 6

PRIVATE SECTOR INVOLVEMENT

6.1 Private Sector and YARG Relations

North Yemen has long been recognized as a country where private business initiatives have greatly contributed to development but where relatively little YARG involvement has occurred in the past. This "entrepreneurial" focus of many Yemenis is recognized as a positive factor for USAID concerns, but it is clear that due to recent economic problems the YARG has become far more involved in directing and constraining the private sector. Businessmen and manufacturers cannot operate legally without a range of government licenses and permits. As outlined in the private sector assessment by USAID, the most relevant entities are the Ministry of Trade and Supply and the Ministry of Economy and Industry.

Because of the severity of the foreign exchange problem, austere measures have been taken to limit and virtually curtail imports. Businessmen and manufacturers view this as a major obstacle for their operations, especially when it is necessary to import machinery or products for local production. Compounding the problem are political splits within the private sector, which can become quite complicated. There is a basic split between the traditional leading trading houses, which are dominated by Yemenis from the south (particularly Aden), and an emerging community of firms with northern tribal and urban Sana'a links. While the traditional houses have amassed the greatest profits and largest operations, their influence has been curtailed in recent YARG policy. The perception of many Yemenis that these old-line houses are outsiders and unresponsive to the country's needs has contributed in part to the YARG restricting their activities and co-opting their resources for government concerns. While some of the houses are adapting to the more vigorous YARG involvement, others are being increasingly alienated.

6.2 Private Sector Interests and Needs for Import/Manufacturing of Handpumps

In assessing private sector potential for promotion of handpumps, it is necessary to recognize the strong interest in "help" from the United States. There is a general attitude, especially among the leading houses, that the country would be better off without the current restrictive measures imposed by YARG. Thus, the question is raised within the private sector of what USAID or the U.S. Government might do to help with economic policy needs at the national level. Most businessmen are not clear as to what kind of assistance they need, nor do they understand the types of assistance USAID could offer. While it is possible to elicit "grocery lists" from those with more experience in Europe and the United States, it is far more difficult to determine the needs of smaller businessmen and manufacturers.

Conversations with several potential manufacturers produced mixed results about interest in handpumps. One enthusiastic manufacturer in Sana'a has already set aside YR 100,000 to develop handpump production with existing machinery and whatever new components are needed. While he believes it is technically possible to duplicate the design and to find a market, he admits it is a gamble. Part of his interest is said to be in manufacturing an item of practical value to Yemen's development needs. In this case there is also the challenge and pride of being able to duplicate the product. This manufacturer was very interested in technical and marketing advice that USAID might provide. However, he was not clear as to how this might be done formally, apart from casual contacts such as he has at present.

A potential manufacturer in Hodeidah was very interested in receiving help, but did not view handpumps as worth his while. In fact his firm has imported British Monolift handpumps and has at least 20 in stock, but not one has been sold. He noted that when he tried to provide handpumps free to help poor villagers, none of the relevant government officials were interested. He also doubted if Yemeni villagers would be able to appreciate the benefits of handpumps, i.e., if a market could be created. Furthermore, he doubted if it could be manufactured locally except at a far greater price than imports.

Discussions at one of the largest manufacturing firms in the country made it clear that a project of this sort was far too limited and outside their future plans. While this firm owns a company that manufactures PVC pipes, it is not interested in developing new capabilities in handpump production, particularly the metal components. Part of the problem at present is the foreign exchange crisis and the difficulties this presents for bringing in new machinery (e.g., tool dies, raw materials).

When asked what kind of help might be needed to manufacture handpumps locally, several general responses were usually given. The first is the need to know the technical specifications of handpumps. As is understandable, there is at present little understanding of the range of handpumps available. A second concern was marketing feasibility, which was seen as something for which foreign expertise was especially useful. This reflects in part YARG insistence that proposed manufacturing projects be justified on the basis of potential in the sector and general financial feasibility. A number of firms in Sana'a at present can develop these necessary feasibility "studies" for local businessmen, and large firms have their own marketing divisions. Only the larger firms seem to have an interest in developing their marketing capabilities. Others seem to address marketing issues because it is a requirement for obtaining a license, rather than seeing it as a practical and normal business activity. Yemeni entrepreneurs, unless they have extensive foreign contacts, have a tendency to assume that almost anything will sell.

6.3 Private Sector Capabilities

A potential source of assistance for promotion of handpumps is the Yemen Chambers of Commerce, which have offices in major cities. Although their present effectiveness and coverage of private sector businesses is still limited, the Chambers do provide information on government regulations, basic services and directories of businesses. In addition, they represent an existing channel for future promotion of handpumps; their role, however, will be limited because of the narrow focus of the systems and the priority given to larger scale, profit-making ventures.

The large trading houses and business firms, many of which are identified in the Yemen Private Sector Assessment (February 1985) of USAID, generally have planning divisions and an interest in marketing feasibility studies. However, the manufacture of handpumps would require new machinery and offers limited profit potential at a time when these firms are already suffering from government import restrictions. The larger Yemeni firms could develop and produce handpumps with little or no USAID support, but there is at present no incentive to do so. Discussions with officials of the National Company for Sponge and Plastic Industry in Taiz indicated that they would not be interested in handpump production but would be interested in providing PVC products with existing capabilities.

The smaller manufacturing and workshop businesses in a few cases may be able to produce duplicates of handpumps with only minimal modification of existing equipment, but the issues of quality control and availability of raw materials are problematic. There is room for a few firms to consider limited production of handpumps, but there is little likelihood of expansion on this particular product. The smaller firms which might want to manufacture handpumps are in a poor position to effectively market them and would have great difficulty in developing export markets.

Examination of a factory in Sana'a in which the owner is at present trying to duplicate the SWN 81 handpump (from the Netherlands) produced mixed results. In this case the owner showed great ingenuity and success in adapting his machinery for local production. However, quality control is limited by the skills of his workers, lack of a clearly defined operations plan, and difficulties in obtaining necessary materials through legal means. Since the owner controls virtually all aspects of the operation of the factory, production of handpumps is very much related to his present interest and expectations of informal advice and assistance from USAID.

6.4 Marketing Issues

If handpumps are to be imported or locally manufactured in Yemen, a number of marketing issues should be addressed. While it is difficult to assess market demand for a new product such as a handpump, a number of general issues can be described.

(1) Since handpumps are virtually unknown in Yemen, it is necessary to promote their benefits, but this is an activity in which the private sector has yet to develop capabilities. Most of the potential consumers will be rural villagers who are the least likely to visit showrooms in the cities. Thus, the potential of the private sector to become involved will depend heavily, at least in the initial stages, on promotion through governmental channels (e.g., CLCCD).

(2) As shown by the inoperative handpump systems seen in the Manakha area, it is not enough simply to manufacture or import handpumps without corresponding mechanisms to provide parts and servicing.

While there are many skilled mechanics available for the common diesel pumps, there is no evidence that there are Yemenis who know how to work with handpumps. The danger is that since a handpump appears to be such a simple system the necessary maintenance and service need not be addressed. To the extent that broken handpumps will not be effectively repaired, the potential market demand will obviously be decreased.

(3) One of the difficulties in promoting handpumps within the private sector is the small existing market for this product. A workshop devoted exclusively to handpumps, given the present lack of demand, would be hard to justify. Factories with existing capabilities or facilities that can be modified would have a greater chance of success. But it will also be necessary for such factories to interest pump distributors in the cities to include handpumps in their showrooms. The question arises as to what incentive the distributors will have when most of their potential customers will not be likely to visit the showrooms and the profit margin will be less than the currently popular motorized pumps.

(4) While the focus on local manufacture seems limited for domestic sales, there may be an incentive to eventually produce handpumps for export. The larger firms are able to obtain more foreign exchange for import to the extent that their exports generate such exchange. The major obstacle is that no manufacturer currently has the capabilities for producing quality handpumps for export and no company has experience in breaking into the rather limited world market.

6.5 Summary: Private Sector Involvement

* The private sector in Yemen has contributed greatly to development but current trade and foreign exchange restrictions prevent it from operating independently of YARG support.

* Although there is limited interest in local manufacture, production on a small scale is possible with only minor modifications of existing machinery.

* The private sector has only limited capabilities for both manufacture and effective marketing of handpumps at the present time.

Chapter 7

CONCLUSIONS

7.1 General Conclusions

There are six general conclusions that arise from this study.

1. There is a need for a variety of low-cost water supply systems in the rural areas.

   Water supply problems exist throughout rural Yemen and are especially severe in the remote and poorer communities. A variety of low-cost water systems are needed to address these problems. Depending on local conditions, these systems may include handpumps, motorized pumps with basic piped systems, individual components of piped systems, or rehabilitation of existing, but inoperative, systems.

2. Local development boards (LDBs) are the most promising channel for rural development assistance.

   Local development boards have a grass roots orientation that allows them to be more responsive to local needs than central government ministries. Rural communities, in turn, tend to have more confidence in their local LDB than in outside agencies. LDBs are rapidly improving their effectiveness in the delivery of services and overall accountability.

3. Considerable development resources exist in the rural areas.

   Many rural areas in Yemen contain significant resources in terms of technical skills as well as money. In addition, all rural communities share traditions of local self-help and community participation.

4. The private sector is very active in rural water development.

   At present, most well digging and borehole drilling is carried out by private contractors. Moreover, most irrigation work is done by private farmers and all irrigation pumping equipment is obtained through the private sector.

5. Local manufacturers can play only a limited role in handpump production at present.

   Private sector manufacturers generally are reluctant to consider local manufacturing of handpumps because of lack of experience, high investment costs, and import restrictions. There is no current demand for handpumps to stimulate local manufacture. Although some interest in local production has been expressed, it will take time to develop an effective manufacturing capability.

6. USAID can undertake a limited, but crucial, role in low-cost rural water supply development.

Future USAID expenditures on rural water supply will be greatly reduced from the recent past. No new water projects are planned and any new program support will probably have to be drawn from PL 480 local currency funds. Nevertheless, opportunities exist for USAID to maintain an active role in the rural water supply sector, to promote private sector involvement, and establish a working relationship with the CLCCD by supporting the implementation of low-cost rural water systems through the LDBs to villages.

7.2 Specific Conclusions

7.2.1 Feasibility of Handpumps in Yemen

Conclusion:

Handpumps can be effectively used in Yemen as long as technological conditions regarding groundwater and pumping equipment are appropriate, social factors are taken into account, and institutional arrangements for implementation and maintenance are in place.

Significant findings:

* A large number of rural Yemenis still use traditional dug wells as their source of domestic water.

* Groundwater conditions in many parts of Yemen, but especially in the Tihama, are appropriate to the installation of handpumps.

* Existing open well systems, especially in the Tihama, are contaminated and detrimental to rural health.

* Yemeni villagers generally are not aware of the health benefits from handpumps and covered wells.

* While there has been active development of piped systems and water storage tanks, virtually no attention has been paid to low-cost simple technologies.

* In many parts of the country the use of a handpump is not seen to be as important as locating a new water source or piping water to a location within the community.

* Community means for mobilizing cooperation and financing are well entrenched in rural Yemen, although there are regional variations.

* The cooperative movement, particularly with the reorganization of the CLCCD, has become more effective in providing development services and responding to community needs.

* Handpumps are more likely to be accepted when requested by local communities in response to promotion rather than through a major donor program (e.g., through the RWSD).

* Islamic emphasis on clean water for ritual and domestic use will aid in promotion of handpump systems.

* Rural credit schemes will not be necessary because of the demonstrated ability of Yemenis to contribute to the financing of local development and because of the relatively low cost of handpump systems.

* In areas where women are exclusively involved in obtaining water, male decision-makers may not recognize this as a major priority for change.

* Yemeni women are very interested in lessening the drudgery of water collection.

* Once handpumps are successfully introduced, the available means for spreading information and promotion are extensive, both through the media and community forums.

* Installing handpumps without adequate promotion of their benefits or without mechanisms for care and repair may be detrimental to future acceptance.

* Handpumps may be viewed as an inferior technology when a community sees the opportunity to obtain a more expensive system (e.g., the TDA handpump project in Wadi Mawr).

* Existing mechanics will need guidance and training to service and repair handpumps.

* Potential consumers for handpumps will be small rural communities and individuals wishing to supplement or economize existing water supply.

7.2.2 Private Sector Involvement

Conclusion:

The private sector can play only a limited role in local handpump manufacturing at present because of lack of experience, high investment costs, and the absence of markets.

Significant Findings:

* At present, Yemeni manufacturers have no capability to produce handpumps locally. They could develop such capability quickly if they chose to make the necessary investments.

* It is possible to manufacture an appropriate VLOM (village-level operation and maintenance) handpump in Yemen with existing Yemeni skills and industrial resources and an initial investment in special equipment (tools, injection molds for plastic components, etc.).

* At present, the private sector is playing virtually no role in importing handpumps, although they do supply motorized pumps.

* Yemeni manufacturers and businessmen desire USAID assistance but generally do not know what this should be in specific terms or how this assistance should be formally channeled.

* Yemeni manufacturers are usually quite innovative in producing new commodities, although standards are not always high.

* Some Yemeni businessmen are interested in taking on ventures which help improve the poor quality of life in rural areas even when no profit is envisioned.

* It is unlikely that local production of handpumps initially can be done cheaper than direct importation.

* The austere restrictions on imports due to the foreign exchange problem make manufacturers reluctant or unable to import new machinery or materials necessary for local production of handpumps.

* There is still much mutual suspicion between private sector businessmen, government officials, and citizens.

* The traditional "entrepreneurial" focus of Yemenis has been curtailed in the past few years by strict government regulation of the private sector.

* There is little enthusiasm in the private sector for local manufacture, except for one manufacturer who sees it in part as a goodwill gesture rather than a profit-making venture.

* Promotion of handpumps will have to be done through government channels given the lack of capabilities of the private sector and the general lack of interest within the private sector for this product.

* Local manufacture of handpumps must be supported by mechanisms for maintenance and spare parts.

* A factory devoted exclusively to handpump production would be an economic gamble given the present lack of demand and limited potential.

* Pump distributors will have little incentive to promote inexpensive handpumps.

* While a number of Yemeni firms are eager to develop export potential, handpumps are an unproven and risky commodity at present.

Chapter 8

RECOMMENDATIONS

8.1 Types of Handpumps for Yemen

There are a variety of handpumps appropriate for existing groundwater conditions and for the potential maintenance services and manufacturing capabilities that can be developed in Yemen. No particular pump or pump type is recommended, for no single pump meets all of the needs of the rural areas. Selection, instead, should be based upon the particular aspects of importance, such as cost, ease of maintenance, capability for local manufacture, etc.

For Yemen, the following list contains representative examples of suitable handpumps. Other pumps undoubtedly also could be used in, or adapted to, Yemeni conditions. Further details on pump selection can be found in the UNDP/World Bank report (Arlosoroff et al., 1987), while additional technical information can be obtained from the manufacturers.

High-lift handpumps (to 45 m)
Imported

Name of Pump	Country of Manufacture	1985-86 Manufacturing Cost
Afridev	Kenya	$450
India Mark II	India	$300
Monolift	United Kingdom	$500

High-lift handpumps (to 45 m)
Local assembly/manufacture in Yemen

Name of Pump	Initial Country of Manufacture	1985-86 Manufacturing Cost
Afridev	Kenya	$450
Bestobell	Zambia	$300
SWN 81	The Netherlands	$900
Volanta	The Netherlands/ Burkina Faso	$600

Low-lift handpumps (to 10 m)
Direct action lift pumps
Imported or local assembly/manufacture

Name of Pump	Initial Country of Manufacture	1985-86 Manufacturing Cost
Nira AF85	Finland	$340
Wavin	The Netherlands	$350
Tara	Bangladesh	$103

8.2 Local Assembly/Manufacture of Handpumps

Because conditions for local assembly or manufacture of handpumps in Yemen are not favorable at this time, it is recommended that USAID not take any direct action with the private sector but, instead, offer informal technical assistance and information to any business groups or manufacturers interested in local production. As the use of handpumps becomes more common in Yemen, it is likely that the private sector on its own will initiate investment into local manufacturing. USAID should first encourage importation of a suitable handpump in order to promote handpump acceptance and use in the rural areas. When a market for such pumps finally develops and private businesses start to become interested, USAID then should consider offering more direct and formal assistance to the private sector.

As in the previous section, no single handpump is recommended for local assembly or manufacturing. The final choice should be based on considerations of cost, market size, manufacturing difficulties, and ease of maintenance. Four pumps, believed to be appropriate for Yemeni conditions, are recommended as representative examples that could be locally manufactured. As given in section 8.1, these pumps are Afridev, SWN 81, Bestobell, and Volanta.

Additional technical information can be found in the UNDP/World Bank report or obtained from the overseas manufacturers.

8.3 USAID Actions

Because of the strongly expressed concern of USAID that it remain active in the Yemen rural water supply sector, the WASH team concluded that a small project of limited technical and financial assistance was the best means of achieving mission objectives. Therefore, it is recommended that USAID establish a project of limited technical assistance and financial support to the CLCCD to promote local initiatives in implementation of low-cost rural water supply systems. Details of the proposed project are given below, along with a proposed organizational chart (Figure 2).

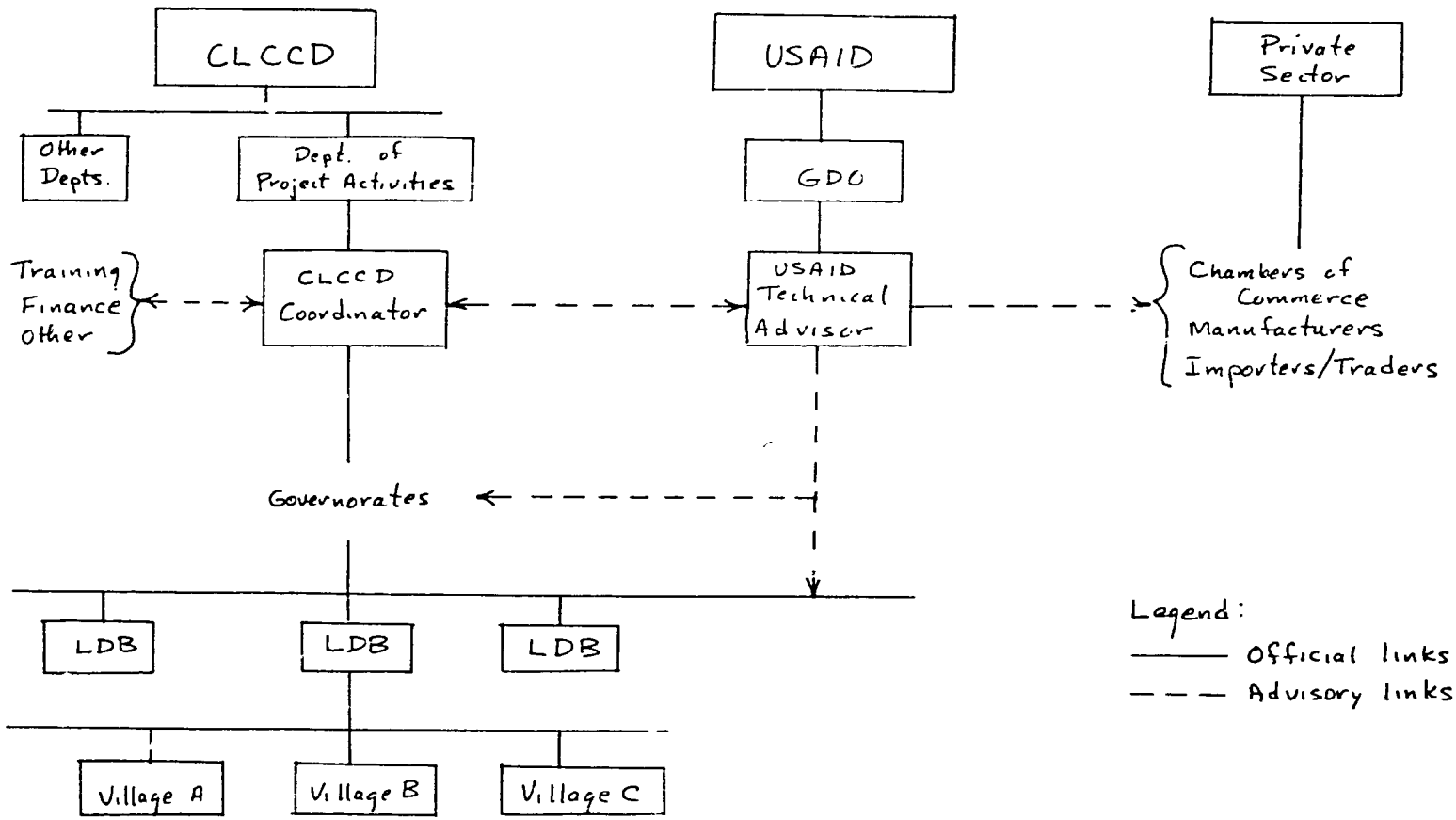

Figure 2. PUMPS Project Organizational Chart

Name of Project: PUMPS Project (Promotion, Undertaking, and Implementation of Pump Systems)

Duration: 3 years

Project Description: PUMPS is a project of limited USAID assistance to the CLCCD to promote simple, low-cost water supply systems in rural Yemeni villages. It is intended to encourage local initiative and responsibility at the village and LDB levels to initiate, implement, and maintain handpumps and basic piped water systems. No expatriate advisors are proposed. USAID assistance is limited to construction cost sharing and a small amount of technical assistance.

One of the primary USAID inputs to the PUMPS Project will be a technical advisor (Direct Hire National), who will work closely with a CLCCD coordinator to provide a direct working link between USAID and the CLCCD. The USAID technical advisor will be expected to review and approve the technical aspects of cost sharing requests from LDBs. Where necessary, he will provide technical advice and assistance to the CLCCD and LDBs.

Underlying Assumptions:

1. There is great need for improved water supplies in the rural areas, and the current rate of providing improved systems is not adequate for these needs.

2. To be effective, development activities must involve the local communities.

3. The CLCCD has high government priority and substantial public support for developing improved water systems in rural areas.

4. USAID has only limited funding and staff for any new efforts in the rural water supply sector.

5. USAID will be able to use PL 480 local currency funds for new rural water activities.

USAID Objectives:

1. To strengthen the role of local councils in promoting rural development.

2. To establish USAID links to the CLCCD.

3. To maintain the long-standing USAID role in the water supply sector.

4. To leverage USAID resources.

5. To promote the private sector.

6. To improve water supply conditions in poor rural villages.

Project Operation: The project is designed to encourage local initiative in implementing low-cost, simple water supply systems in rural areas. Operation of the project is expected to take place in the following manner:

1. A concern for an improved water supply originates at the village or district level.

2. A request for financial assistance for the water scheme is sent to the LDB.

3. The LDB reviews the request and negotiates a cost sharing agreement with the local community.

4. The local community collects the cash component of its cost share and deposits it in the district cooperative bank.

5. The LDB then submits a request for cost sharing to the CLCCD.

6. The CLCCD and USAID review the request, note whether any special technical assistance is required, and approve the disbursement of funds to the LDB.

7. The LDB collects all funds from village, district, and national levels and releases them, as needed, for construction of the water system.

8. Throughout this process, the LDB provides minor technical assistance to the village and ensures accountability for all project funds.

Project Support:

1. USAID to provide:

   - cost sharing for all approved village systems. (The USAID cost share is to be 50 percent of system construction costs to a maximum of YR 20,000 per system.)

   - limited salary support for the CLCCD coordinator

   - technical advisor (Direct Hire National) to work closely with the CLCCD coordinator

   - limited technical assistance and training support.

2. CLCCD to provide:

   - appointment of an official to act as coordinator of all CLCCD activities on the PUMPS Project. (This is a half-time work load.)

- all project coordination

- minor technical assistance and training support to the LDBs.

3. LDB to provide:

   - cost sharing for all approved village systems. (The LDB cost share is to be negotiated with individual project villages.)

   - minor technical assistance to the villages.

4. Village to provide:

   - cost sharing for all approved systems. (The village cost share is to be negotiated with the LDB.)

   - self-help labor and materials, as needed

   - full responsibility and support for operations and maintenance.

Implementation Timetable:

Pre-project Implementation: (6 months)

* Negotiate project agreement between USAID and CLCCD.

* Negotiate agreement between USAID and YARG to allow importation of up to 200 handpumps (approx. $40,000) over life of the project.

* Recruit USAID Direct Hire National to be technical advisor to the CLCCD.

Project Implementation: (3 years)

Year 1:

* Organize and hold workshop on low-cost water system development for LDB representatives.

* Promote handpump manufacturing within Yemeni private sector.

* Implement several handpump demonstration projects in the field.

* Begin to review and fund requests for village water systems.

Year 2:

* Continue activities initiated in year 1.
* Carry out external evaluation of project at end of year 2 to assess progress of project and sustainability of completed schemes.

Year 3:

* Continue activities from years 1 and 2.
* Consider continuation/termination of project.

Technical Criteria:

Types of water systems:

* handpumps
* motorized pumps with basic distribution systems
* one or more components in a larger piped system
* rehabilitation of an existing system

Number of water systems:

* estimated number of feasible systems	=	2,000
* estimated number of requests	=	250
* estimated number of handpump systems	=	200
* estimated number of piped systems	=	50

Unit costs:

* average cost handpump system	= YR 20,000
* average cost piped system	= YR 100,000
* USAID cost share	= 50% to max. of YR 20,000/system
* total construction cost (200 x YR 20,000)+(50 x YR 100,000)	= = YR 9,000,000
* USAID construction cost share (200 x YR 10,000)+(50 x YR 20,000)	= = YR 3,000,000

Project Budget:

	Total Project	USAID Share
Construction costs: 250 systems	YR 9,000,000	YR 3,000,000
Personnel costs:		
- CLCCD coordinator salary 1/2 time over 3 yrs @ YR 50,000	75,000	75,000
- USAID/DHN technical advisor full time over 3 yrs @ YR 100,000	300,000	300,000
Training costs: materials, technical supplies, demo pumps, workshops, etc.	250,000	250,000
Support costs: USAID transport, per diem, etc.	500,000	500,000
Subtotal (local currency)	YR 10,125,000	YR 4,125,000
External TA (short-term)	$50,000	$50,000

Project Outputs:

250 water supply systems serving 90,000 people

- 200 handpump systems @ 200 people
- 50 piped systems @ 1,000 people

Benefits to USAID:

1. establish links to CLCCD
2. leverage USAID resources
3. maintain USAID role in water/sanitation sector

Benefits to Project Users:

1. improved water quality
2. reduced water collection effort
3. release of labor for other activities
4. increased availability of water
5. increased quantity of water
6. strengthened local councils
7. promotion of local manufacture
9. supplemental irrigation water
10. transition to more complex water systems in future

Scope of Work for USAID Technical Advisor (DHN):

Qualifications:

Yemeni National with basic English language competency. Background in engineering with experience desirable in rural water systems, local manufacturing, and business administration. Ability to work closely with both Yemeni and U.S. officials a necessity.

Responsibilities:

* Responsible to USAID/GDO for project implementation
* Works closely with the CLCCD Coordinator to review the technical aspects of LDB requests
* Provides technical advice and suggestions to CLCCD Coordinator and LDB as necessary
* Assists in the design and implementation of workshops and training programs
* Actively promotes private sector participation and local manufacturing in the project.
* Provides technical information and advice to Chambers of Commerce, importers, and manufacturers
* Conducts ad hoc visits to review project activities in the field
* Prepares reports on project progress for USAID.

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BIBLIOGRAPHY

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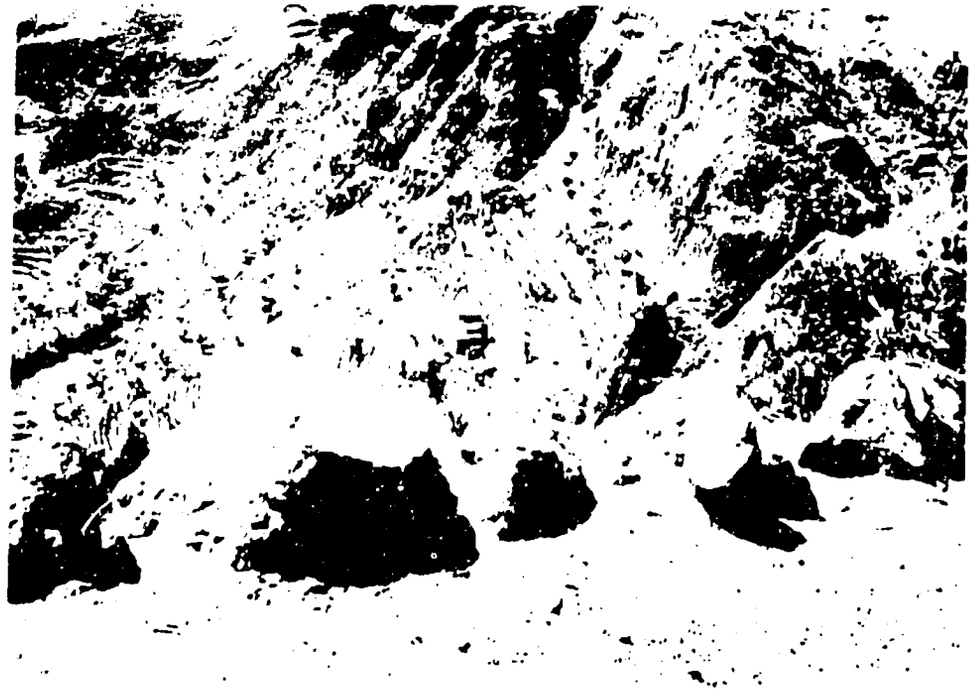
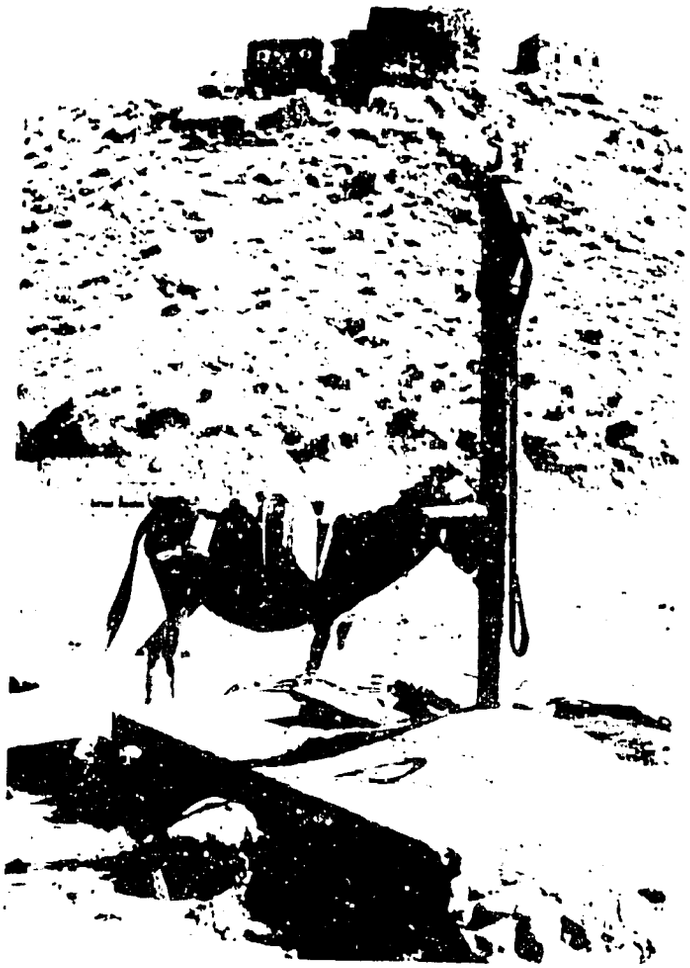
PHOTOGRAPHS

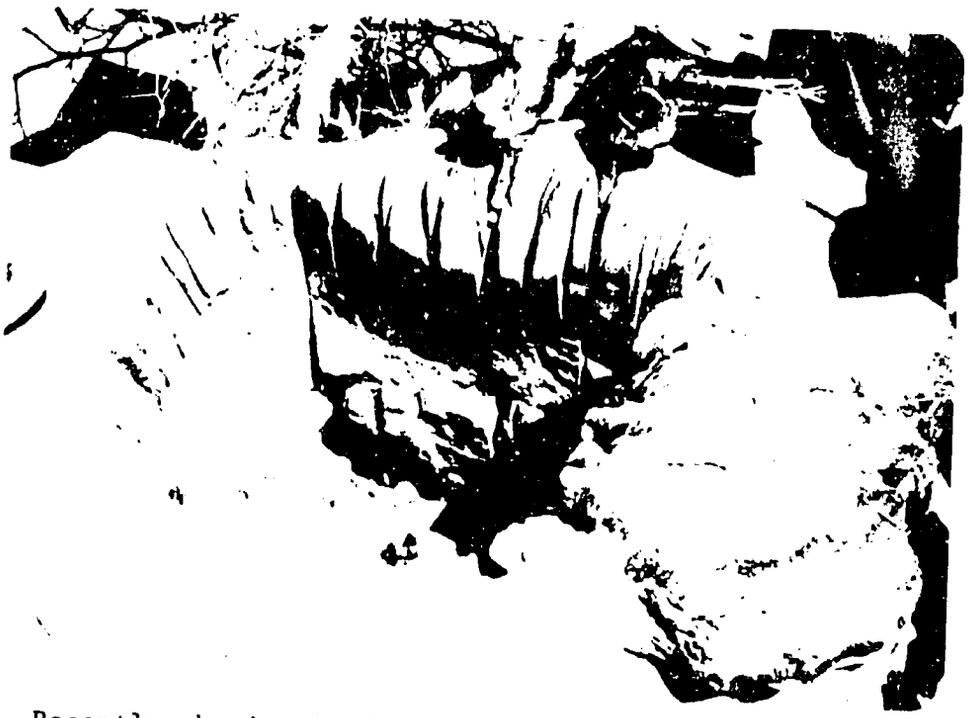
1. Typical highland scene of terraces and scattered mountain villages.



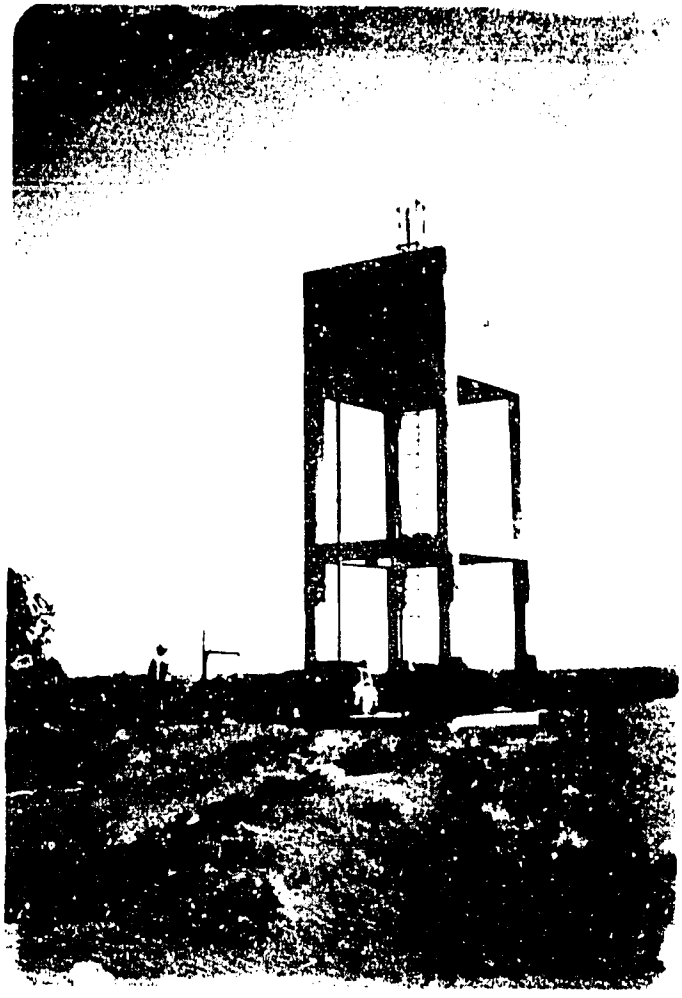
2. Mountainside terraces and villages



3. Broken Nira AF 76 handpump near Menakha. Cover has been removed from the well slab and water is drawn by rope and bucket.

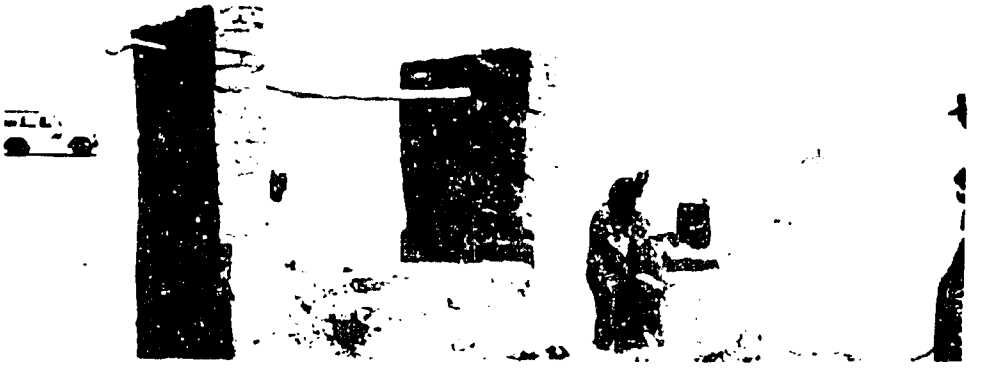


4. Recently abandoned well in Taiz Governate. Rocks have 5-cm deep grooves cut over the years by ropes. Three months earlier, the village began using a diesel-pumped well.



5. Elevated storage tank in USAID-financed village water supply project in Tihama region. There are over 200 USAID-financed systems of this type in Yemen.

6. Diesel engine driving deep well turbine pump for irrigation in Tihama Region. There are approximately 8,000 such pumps in the Tihama.



7. Typical Tihama well consisting of a raised-parapet open well with crossbar for a pulley. Adjacent to the well is a small water cistern.

8. Young boys alongside traditional open well in the Tihama. Most open wells are between 10 and 40 meters deep.

9. Villager fills clay jugs with water drawn from a 35-meter deep well in the Tihama.

10. Donkeys are frequently used in the Tihama to draw water from wells and to carry water containers. To use a donkey in water lifting, one person must walk with the donkey as it pulls the bucket out of the well and a second person must take the filled bucket and pour it into the water containers.

11. Drawing water from a well in the Tihama with the aid of a donkey, a pulley system, and a rubber bucket. There are approximately 6,000 open wells in the Tihama, used primarily for domestic water supply. Nationwide, it is estimated that at least 10,000 open wells are sources for domestic water supplies.

12. Villagers viewing and commenting on pictures of handpump at traditional open well in the Tihama.

APPENDIX A

List of Persons and Organizations Contacted

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List of Persons and Organizations Contacted

USAID/SANA'A

Kenneth H. Sherper	Director
Michael F. Lukomski	Deputy Director
Robert E. Mitchell	General Development Officer
Geraldine M. Donnelly	Program Officer
Elliott T. Smith	Asst. Project Officer
Dean D. Moody	General Engineering Advisor
Mansour Shameri	Program Assistant
Rashida Hamdani	Program Assistant
Huda Hashem Taleb	Research Assistant
Diaa Hammamy	Chief of Party, REACH
Leslie Perry	Project Administrator, REACH

MINISTRY OF PETROLEUM, DEPARTMENT OF HYDROLOGY

F. Charles Dufour	Co-Project Manager
Philip S. Nota	Hydrologist
Wim Luxemburg	Data Base Expert
Noori Gamal	Hydrogeologist

CLCCD

Sana'a

Mohamed Hanash	Director of General Relations
Mohamed Saed Al-Aqbari	Director, Public Relations
Abd al-Malek Salam	Deputy, Public Relations
Husayn al-Amri	Public Relations Officer

Hodeidah Governorate

Hibatullah Shuraym	Director General
Abd al-Rahman al-Zabidi	Deputy Director
Nu'man al-Haydari	Chief Engineer

Bayt al-Faqih District

Ali Futayn	Head of Council
Ibrahim Hakimi	Deputy Director
Hasan Mohamed	Engineer

al-Mansuriya District

Ahmed Ibrahim al-Bahr	Head of Council
al-Jamali Muhamad Muhayn	General Secretary
Faraj Hasan Dukhn	Officer
Dr. Mohamed Taha	Medical Officer, Mansuriya Health Clinic

Zabid District

Abdullah Atiya	Head of Council

al-Durayhami District

Taiz Governorate

Yahya Rasi	Director General
Omar Dahabali	General Secretary

Misrah District

Hasan Lutfi al-Garidi	General Secretary

Ibb Governorate

Mohamed al-Sabri	General Secretary

SMALL RURAL WATER SUPPLY PROJECT (New TransCentury Foundation)

Abdul Razak	Project Director (Project 045)
D.S. RamaKrishna	Structural Engineer
Khalid Al-Shami	Water Laboratory Technician

UNICEF

Bilquis al-Dabbi	National Officer
Hind Masri	Health Officer

SANA'A UNIVERSITY

Nuriya Ali Humad	Department of Sociology
Abdu Ali Uthman	Department of Sociology

GOVERNMENT OF NETHERLANDS/DGIS

Joke Buringa	Consultant Anthropologist

TDA/HODEIDAH

Jaap Bijl	Project Manager, Tihama Basin Water Resources Study
Yusuf Ali	Head, Hydrology Section
Graham Smith	Deputy Project Manager
Karel Heynert	Hydrologist
Mohamed Anwar	Senior Hydrologist

UNDP (Sana'a)

Bahman Kia	Deputy Representative

PRIVATE SECTOR

Hail Saeed Anam Company (Taiz)

Mahmoud K.F. Nasr	General Marketing Manager
Abdulla A. Rahman el Kershi	General Manager, National Co. for Sponge & Plastic Industry
Yassin Abdul Wadood Anam	Deputy General Manager, National Co. for Sponge & Plastic Industry
Radman Ahmed Saad	Technical Manager, National Co. for Sponge & Plastic Industry

Bahaj Trading Stores (Hodeidah)

Omar Ali Bahaj	Manager

Al-Shaqqa and Brothers (Hodeidah)

Abdulla al-Shaqqa	Manager

Al-Raiby Trading-Industry & Contracting (Sana'a)

Saleh al-Raiby	Managing Director

Al-Wazir Trading Group (Sana'a)

Chamber of Commerce (Taiz)

Abdul Hadi Ali Hameed	Deputy Manager

APPENDIX B

Wadi Mawr Village Water Supply Project

APPENDIX B

Wadi Mawr Village Water Supply Project

In October 1984, the West German technical assistance organization (GTZ) and the Tihama Development Authority (TDA) began a two-year project of domestic water supply and sanitation in villages located in the general vicinity of the administrative center of Az Zuhrah in Wadi Mawr. The basic purpose of the project was to develop low cost, technologically appropriate water supply systems for small to medium rural communities. Each project community was given one (or two) handpumps as well as a new dug well (20 meters deep), a concrete well cover, a 4 m^3 ground-level reservoir with taps, a soakaway pit, and a single demonstration latrine. Larger communities were given handpumps driven by diesel engines, while the smaller villages (around 200 persons), especially those with relatively limited groundwater supplies, were given hand operated pumps. A total of 51 villages received manual handpumps and 21 communities received one or more motorized pumps. All pumps, whether hand or motor driven, were British-made Monolift pumps which use a helical steel rotor within a helical flexible stator to force water up the rising main.

All project costs were borne by the TDA including the construction of 70 new dug wells. These wells were dug with a mechanical clamshell excavator and lined with prefabricated concrete well rings. No cost contributions or self-help inputs were levied upon residents of project villages. Moreover, local residents were not involved in project selection or planning. Villages were selected and systems were designed by TDA solely on the basis of population and water availability. Operations and maintenance, however, was made the responsibility of the recipient village and the local development board.

Actual costs are not yet available, but estimated costs during the planning stage were YR 137,000 ($13,700) per scheme for hand-operated pumps (YR 669/capita). A total of 10,500 people were expected to be served by 51 hand-powered village schemes.

As of October 1987, construction of projects had been completed, although only seven of 72 schemes had been handed over to the local people. It was reported that all pumps, both motorized and hand-operated, were in place and functioning properly. Unfortunately, residents of project villages were not using the hand-driven pumps and, instead, were continuing to use their traditional open wells. The reasons for this are not fully understood, but it is likely due to the fact, first, that the pumps and their installation were provided free by the TDA and, second, that local villagers were not consulted or involved in project implementation. The villagers claim that the new handpumps do not improve their previous water supply situation. They are actively demanding that TDA replace the hand-powered pumps with motorized pumps, as found in the more fortunate villages of the area. Although TDA has intentions to eventually install diesel engines on all project handpumps in the future, no specific decision regarding the current status of the hand-powered pumps has been made.

APPENDIX C

Results of UNDP/World Bank Handpump Comparisons

Appendix C

RESULTS OF UNDP/WORLD BANK HANDPUMP COMPARISONS

1	2	3	4			5			6	7	8			9	10	11
Pump name	Data source	Discharge rate	Ease of maintenance A	B	C	Reliability for (m^3/d) 1.5	4	8	Corr. res	Abr. res	Manufacturing needs 1	2	3	Short list	Price (US$)	Remarks
HIGH LIFT PUMPS (0-45 meters)																
1 Abi-ASM	L (F)	—	—	oo	oo	oo	o	—	oo	o	—	o	o			See Note 1
2 Afridev	(F)	o	oo	oo	oo	oo	oo	o	o	o	o	oo	oo			See Note 2
3 AID Deny Deepwell	L F	oo	—	oo	oo	oo	o	—	—	—	—	oo	oo			
4 Bestobell	L	o	—	oo	oo	oo	o	—	o	o	o	oo	oo			
5 Climax	L	oo*	—	—	oo	oo	oo	o	—	—	—	—	oo			
6 Dragon 2	L	o	—	oo	oo	oo	o	—	—	—	—	o	oo			
7 Duba Tropic 7	F	oo*	—	o	oo	oo	o	—	—	—	—	—	oo			See Note 7
8 GSW	L (F)	o*	—	oo	oo	oo	oo	o	—	—	—	o	oo			
9 India Mark II (standard)	L F	o	—	oo	oo	oo	oo	oo	—	—	—	o	oo			See Note 9
10 India Mark II (modified)	(F)	o	—	oo	oo	oo	oo	oo	—	o	—	o	oo			See Note 10
11 Jetmatic Deepwell	L	o	—	oo	oo	oo	oo	o	—	—	—	o	oo			
12 Kardia	L (F)	o	—	oo	oo	oo	oo	o	oo	o	—	o	oo			
13 Korat	L F	oo*	—	oo	oo	oo	oo	o	—	—	—	oo	oo			
14 Maldev	L F	oo*	—	oo	oo	oo	oo	o	—	—	o	oo	oo			See Note 14
15 Monarch P3	L F	oo*	—	oo	oo	oo	oo	o	—	—	—	o	oo			
16 Monolift	L (F)	—	—	—	oo	oo	oo	o	—	oo	—	—	oo			See Note 16
17 Moyno	L F	—	—	—	oo	oo	oo	o	—	oo	—	—	o			
18 Nira AF84	L	o	—	oo	oo	oo	oo	o	oo	o	—	o	oo			
19 Philippines Deepset	(F)	o	—	oo	oo	oo	o	—	—	—	o	oo	oo			
20 SWN 80 & 81	F	oo*	—	oo	oo	oo	oo	oo	oo	oo	—	oo	oo			
21 Vergnet	L F	—	o	oo	oo	oo	oo	o	oo	o	—	o	o			See Note 21
22 VEW A18	L	o	—	o	oo	oo	o	—	oo	—	—	—	o			
23 Volanta	L F	oo	o	oo	oo	oo	oo	oo	oo	oo	o	o	oo			See Note 23
INTERMEDIATE LIFT PUMPS (0-25 meters)																
24 Consallen LD6	L F	oo*	—	oo	oo	oo	oo	o	oo	o	—	o	oo			
25 DMR (Dempster deriv.)	F	oo*	—	oo	oo	oo	o	—	—	—	—	oo	oo			
26 Nira AF76	L F	oo*	—	oo	oo	oo	o	—	—	o	—	oo	oo			
LOW LIFT PUMPS (0-12 meters)																
27 Blair	F	o	oo	oo	oo	oo	o	—	oo	o	o	oo	oo			
28 Ethiopia BP50	L	oo	o	oo	oo	oo	o	o	o	—	o	oo	oo			7m max. lift
29 IDRC-UM	L	oo	o	oo	oo	oo	o	—	oo	—	o	oo	oo			
30 Kangaroo	L F	oo	—	oo	oo	oo	o	—	o	oo	—	o	oo			See Note 30
31 Malawi Mark V	F	oo	o	oo	oo	o	—	—	oo	o	o	oo	oo			7m max. lift
32 Nira AF85	L F	oo	oo	oo	oo	oo	oo	oo	oo	o	o	oo	oo			
33 Tara	L F	oo	oo	oo	oo	oo	o	—	o	—	o	oo	oo			
SUCTION PUMPS (0-7 meters)																
34 AID Suction	F	oo	o	oo	oo	oo	o	—	—	o	—	oo	oo			
35 Bandung	L	oo	oo	oo	oo	oo	oo	o	o	o	—	oo	oo			
36 Inalsa Suction	F	oo	o	oo	oo	oo	o	—	—	—	—	oo	oo			
37 Jetmatic Suction	(F)	oo	o	oo	oo	oo	o	—	o	o	—	oo	oo			
38 Lucky	F	oo	o	oo	oo	o	—	—	—	o	—	oo	oo			
39 New No. 6	L (F)	oo	oo	oo	oo	oo	o	—	—	oo	—	oo	oo			
40 Bower	L (F)	oo	oo	oo	oo	oo	oo	o	o	o	oo	oo	oo			See Note 40
41 SYB-100	F	oo	o	oo	oo	oo	oo	o	o	oo	—	oo	oo			
42 Wasp	F	oo	o	oo	oo	oo	o	—	—	o	—	oo	oo			
ADDITIONAL PUMPS																
A1																
A2																
A3																
A4																

* Indicates that discharge ratings are based on choice of the correct cylinder size from a range offered by the manufacturer.

Source: S. Arlosoroff et al, Community Water Supply: The Handpump Option, WorldBank, Washington, D.C., 1987.

APPENDIX D

Logical Framework
Pumps Project

APPENDIX D

Logical Framework
Pumps Project

NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	MEANS OF VERIFICATION	IMPORTANT ASSUMPTIONS
GOAL: to improve rural water supply in neediest communities	Replacement of open well systems with safe, enclosed handpump and related systems	(1) Records provided by CLCCD on completed projects (2) Field visits by DHN (3) Health records from local Health Units	(1) Existing programs not reaching majority of poor rural communities without potable water supply (2) USAID can play an important, although limited, role in the water sector
SUBGOAL: to enhance capabilities of LDB and private sector in responding to community needs for water systems	(1) increase in low-cost water supply systems from present rate (2) local import or manufacture of handpumps (3) continuation of CLCCD coordinator's activities at EOP or request for project expansion	(1) Records provided by CLCCD (2) Visits by DHN to local manufacturers (3) Internal monitoring for USAID after EOP	(1) CLCCD has high YARG priority for rural development (2) Mechanisms already in place for CLCCD implementation of projects (3) Private sector already active in rural water supply
PROJECT PURPOSE: to promote simple, sanitary, low-cost water supply systems, especially handpumps in rural areas	(1) completion of handpump projects through CLCCD (2) local import or manufacture of handpumps	(1) Records provided by CLCCD (2) Field visits by DHN	(1) Considerable development resources exist in the rural areas (2) Local manufacturers can have only a limited role in handpump production at present (3) USAID can maintain linkage with CLCCD

NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	MEANS OF VERIFICATION	IMPORTANT ASSUMPTIONS
OUTPUTS:			
(1) Workshops at national and district levels to promote handpumps	(1) One workshop at national level, six workshops at district level	(1) Participation of DHN	(1) CLCCD has continued interest in workshops
(2) Handpump systems and related simple systems in operation	(2) 200 handpump systems and 50 related low-cost systems	(2) CLCCD records and field visits by DHN	(2) Communities exist which cannot afford expensive water supply systems
(3) Increased experience of LCCD coordinator in responding to LDB requests for projects	(3) Feedback from CLCCD officials	(3) Reports by DHN and EOP evaluation	
(4) Stimulus for local production of handpumps	(4) Actual attempts at handpump manufacture	(4) Visits by DHN or USAID officials	(4) Handpumps can be marketed for a profit.
INPUTS:			
USAID:			
(1) Limited technical assistance	(1) $50,000 for external consultants. Consultant to train DHN; consultant to help organize workshops, evaluation team	USAID Review of relevant records; signed agreements	(1) No large funding or staffing for large project
(2) Cost-sharing in the PL480 funds for low-cost handpumps and related systems	(2) YR 3,000,000 over 3 years ($300,000 equivalent)		(2) Availability of PL 480 funds
(3) LDH to coordinate project	(3) YR250,000 ($25,000 equivalent) for information materials, books, catalogs, workshops		(3) Funding and position for DHN in GDO
(4) Technical information for private sector on handpumps	(4) YR500,000 ($50,000 equivalent)		(4) Information available from manufacturers and relevant organizations (e.g., World Bank HP Program)
(5) Support Costs			
CLCCD:			
(1) Aid in negotiating release of foreign exchange for initial import of 200 handpumps	(1) Agreement with Ministry	CLCCD Review of relevant records; signed agreements	(1) CLCCD has high government priority
(2) Coordinator in Dept. of Project Affairs	(2) One Yemeni official in CLCCD post		(2) Niche available in existing CLCCD structure
(3) Normal administrative work	(3) Project completions		(3) CLCCD interest in project
(4) Funds available for water projects	(4) YR6,000,000 ($600,000 equivalent) including local private funding		(4) Formal requests made through LDBs