WATER AND SANITATION FOR HEALTH PROJECT

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FINAL EVALUATION OF THE RURAL WATER SYSTEMS AND ENVIRONMENTAL SANITATION PROJECT PERU

WASH FIELD REPORT NO. 294

FEBRUARY 1990

Prepared for
the USAID Mission to Peru
WASH Task No. 087

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by

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RELATED WASH REPORTS

Report on the Peru Rural Water Systems and Environmental Sanitation Project, by Harold Shipman. January 1981. Field Report No. 6.

Recommendations for the Rural Water and Environmental Sanitation Project in Peru, by David Donaldson and Charles S. Pineo. April 1982. Field Report No. 38.

Establishing a Human Resource Development Unit within the Directorate of Sanitary Engineering (DISAR) in Peru, by Hortense Dicker. May 1984. Field Report No. 126.

Progress Evaluation of the Rural Water Systems and Environmental Sanitation Project--Peru, by L. Mondada, D. Collins, O. Cordon, and J. Faigenblum. March 1985. Field Report No. 134.

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ACRONYMS AND DEFINITIONS

Administrative Junta	Village-level committee elected by the community to manage its water system
CEPIS	*Centro Panamericano de Ingenieria Sanitaria* (Pan American Sanitary Engineering Center)
CP	Community Participation
CSA	Child Survival Action
Chicha	Andean alcoholic beverage made from fermented corn
DDC	Departmental Development Corporation
DISABAR	*División de Saneamiento Básico Rural* (Division of Basic Rural Sanitation)
DSE	Directorate of Sanitary Engineering
EOPS	End of Project Status
GAO	U.S. General Accounting Office
GOP	Government of Peru
HE	Health Education
HRD	Human Resources Development
IDB	Inter-American Development Bank
IPH	Integrated Primary Health
IPSS	*Instituto Peruano de Seguridad Social* (Peruvian Social Security Institute)
Kermess	Fund-raising benefit held at the local level
LOP	Life of Project
LPCD	Liters per Capita per Day
LPS	Liters per Second
MEF	Ministry of Economy and Finance

MIS	Management Information System
MOE	Ministry of Education
MOH	Ministry of Health
O&M	Operation and Maintenance
ORT	Oral Rehydration Therapy
PACD	Project Assistance Completion Date
PAHO	Pan American Health Organization (*Organización Panamericana de Salud*)
PHC	Primary Health Care
PIL	Project Implementation Letter
PP	Project Paper
PROAG	Project Agreement
PSI	Pounds per Square Inch
PVC	Polyvinyl Chloride (pipe)
RWSES	Rural Water Systems and Environmental Sanitation
Sierra	Mountainous area of Peru
SOW	Scope of Work
TA	Technical Assistance
UDES	*Unidad Departamental de Salud* (Departmental Health Unit)
USAID	U.S. Agency for International Development
USG	U.S. Government
VIP	Ventilated Improved Pit (Latrine)
WASH	Water and Sanitation for Health Project
WHO	World Health Organization (*Organización Mundial de Salud*)

EXECUTIVE SUMMARY

Project Design. The project paper (PP) presented a convincing rationale for authorizing and implementing this project. However, the lack of detailed and coordinated plans for executing its eight major components created delays and problems in project implementation. The fact that the executing agency, DISABAR, had an ongoing rural water supply program and an organizational structure in place (albeit not one envisioned for the project's decentralized operation) provided the framework for implementing the project.

Project Start-up. MOH and DISABAR were insufficiently involved in the project development process. As a result, DISABAR lacked knowledge of USAID regulations, procedures, and requirements. This was partly reflected in the long delays that occurred during project start-up. Although the project agreement was signed 25 September 1980, the conditions precedent remained unmet until August 1981 (eleven months later). The first (local) procurement of major construction materials was not ordered until the beginning of 1982, and the first project vehicles were not delivered until late 1983, three years after the project agreement was signed. The first new regional engineers were not hired until mid-1983.

Project Management and Support. Through its project managers and staff assigned to monitor project implementation, USAID/Peru provided constant attention to RWSES. Frequent meetings were held with DISABAR senior staff to discuss issues and resolve problems. From the start, DISABAR provided full support for the water supply component. As the project progressed, DISABAR senior staff became strong proponents of decentralization although the agency was less aggressive in implementing other project components. Both USAID/Peru and DISABAR experienced several turnovers of project management staff, causing discontinuities in project operations.

FINDINGS

The findings that follow are based on document reviews, interviews with officials and community members, visits to four regional offices, and inspection of 15 beneficiary communities.

1. Water Supplies: Status as of 30 June 1989

   - Systems completed - 941 of 1200 planned
   - Systems under construction - 138*
   - Systems designed - 139
   - Population served - 367,000 (This represents 87 percent of total target population)

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* 45 of these systems were completed by 30 September 1989.

This project component was one of the most successful. The focus on installing spring-fed gravity systems resulted in high-quality water for consumers on a 24-hour basis. These gravity systems are providing far better and more reliable service than most departmental capitals provide. Furthermore, the outlook of sustaining a satisfactory level of service over the systems' 20-year design life is within the reach of the communities themselves, and is far more likely than for pumped systems.

2. Latrines

The latrine promotion, installation, and utilization component failed to achieve project goals. The numbers reported installed are impressive, but observations made during visits to regional offices and target communities indicate that these numbers are unreliable. Not all households connected to the water systems had latrines installed.

The project provided one basic latrine-slab design, usually including an oval concrete riser. Many beneficiaries found the riser design unsatisfactory; however, most latrines inspected were being used.

3. Operation and Maintenance

The quality of water depends in part on the degree of operation and maintenance (O&M) service the system receives. Insufficient attention was provided to this component. Beneficiaries took no preventive maintenance actions, instead making repairs only when absolutely necessary.

4. Decentralization and Institution Building

Achievements in this component were the project's greatest success. Historically, DISABAR/Lima had controlled all its programs from conception to completion. However, the regional DISABAR offices began to assume more and more responsibility for field activities—from preparing annual operational plans and budgets, to designing and constructing water systems and promoting and installing latrines, to supervising and monitoring the operation and maintenance of these systems.

Over three hundred professional, technical, and support personnel were recruited, hired, trained, and assigned to regional offices. To house staff and handle project commodities, 14 offices and 14 warehouses were built. A total of 48 vehicles were purchased and assigned to the 18 regional DISABAR offices.

5. Community Participation and Organization

The development of community participation and organization was a major project component. Sanitation technicians in the regional offices were assigned primary responsibility for helping organize communities to receive water systems, for helping form the Administrative Junta and providing its O&M training, and for extending health education to water

users. Technicians were also responsible for promoting latrine installation and usage.

Communities have fulfilled their construction-phase obligations to the project (labor, materials, cash). However, their responsibilities for system operation and maintenance are not being met by the juntas because they have received insufficient training (including administration) and supervision.

6. Integration with the Primary Health Project

The goal of coordinating activities of the Integrated Primary Health (IPH) Project with those of the RWSES Project was not achieved because a formal plan for integration was never developed. The consequent loss to the project was greatest in the areas of community health education and environmental-sanitation training.

7. Health Education

The design of an effective health education component was to draw upon a "knowledge, attitudes, practices" latrine study that was never conducted. Nor were there coordinated health-education activities between the IPH and RWSES. No effective health education plan was developed, and sanitation technicians/promoters provided minimal health education to water users during the course of the project.

8. Training

The DISABAR Training and Applied Research Office became operational in early 1987. A total of 708 participants received project-related training (in-country and third-country) in a variety of professional and technical topics: project planning, budgeting, and management; water test equipment operations; and community organization activities. Formal training courses for Administrative Juntas and water users were organized but never executed. However, the project's training component surpassed the numerical targets set forth in the PP for professional and technical staff.

9. Technical Assistance

The PP together with the project amendment called for 50 months of technical assistance; the project ultimately provided approximately 40 person-months. The Human Resources Development (HRD) and Management Information System (MIS) advisors developed specific action plans and recommendations for DISABAR. WASH teams also produced reports recommending a series of decisions and actions to be taken by DISABAR and USAID/Peru. The long-term sanitary engineering advisor provided direct day-to-day advice and support to DISABAR over a period of almost three years.

10. Special Studies

The PP proposed five special studies; two of them were conducted. DISABAR, with support from CEPIS, ran a year-long water consumption study in three rural villages with MOH-built water supplies in 1975 and 1976; per capita water consumption in the sierra was found to be 50 liters/day. DISABAR also studied design and operation of simplified water treatment plants. The final report on this study has not yet been completed.

11. Role of Women

As principal domestic water users, women have benefited greatly from having safe, convenient water. Following the tradition of communal labor, women have contributed equally to water system construction, and traditionally provide room and board to construction workers. Community women have had a negligible role in decision making with respect to water system planning and implementation: only three women were found in a total of 15 Administrative Juntas whose combined membership is 75. No apparent effort was made to involve women's organizations (mothers clubs) or other community organizations in project health and sanitation activities. Through lack of coordination with the IPH and the absence of a health education plan, the opportunity was lost to target women for family-health activities.

RECOMMENDATIONS

1. Overall Recommendations

Find some way to provide funding for DISABAR to continue executing its rural water supply and sanitation mandate. Due to the GOP's bleak economic outlook, DISABAR will need foreign donor funding to keep its decentralized field activities operating at even substantially reduced levels. One funding alternative that should be thoroughly explored is to add a rural water supply and sanitation component to the ongoing Child Survival Action (CSA) project.

2. Rural Water Supply and Sanitation Program

Target future RWSES program activities in zones having good security. All 18 regional offices should continue to operate, but those in areas of poor security should reduce both scope of activity and staff. Staff from these regional offices should be reassigned to other regions in order to build up their programs.

3. Engineering

- Locate selected communities in areas where it is possible to travel for supervision and inspection.
- Keep construction of spring-fed gravity systems as the top priority of future programs.

- Offer alternative latrines to the beneficiaries and let them select the most appropriate design. The "Maestro de Obra" should remain longer at the construction site to advise the users in the installation of these latrines.

- Plan and conduct continuing training programs for Administrative Juntas and caretaker/operators as part of the supervision of these systems. This will improve system operation and maintenance.

4. Decentralization/Institution Building

   - Find funding to support DISABAR decentralized operations. (USAID/Peru)

   - Develop a plan to formally integrate the 18 regional offices' professional and technical staff into its permanent organizational structure. (DISABAR)

5. Community Participation and Organization

   - Include these elements in the community participation and organization component:

     (a) development of a community participation methodology for rural water and sanitation projects

     (b) training in community participation for all personnel

     (c) formal courses on system operation and maintenance, accounting, and administration

     (d) training in latrine installation and use and continuing health education for Administrative Juntas, system operators, and water users

     (e) a budget for this component adequate to develop, implement, and evaluate the priority objectives of project sustainability by self-reliant communities

6. Integration with Primary Health Care/Health Education

Although the Director Superior of the MOH was designated to coordinate RWSES and PHC, no specific action plans were developed to achieve this goal. Since the primary health care project was completed on 30 June 1986, there was no basis for further action after that date.

- Integrate future RWSES programs with the ongoing Child Survival Action project.

- Ensure that RWSES's future health education activities are an integral part of the MOH/UDES health education program.

- Develop and implement a health education module focusing on water/sanitation/health relationships and issues as a joint effort between DISABAR and the MOH as part of the MOH health education program.

7. Training

   - Maintain the level of training planned for 1990.

   - Give priority (including full budget support) to community training needs.

   - Give all DISABAR staff training in community participation.

8. Technical Assistance

   - Collaborate with DISABAR to determine specific areas where further technical assistance is needed. (USAID/Peru)

   - Based on the results of this needs analysis, design a technical assistance program describing the types of advisors needed, the purposes and outputs required, the duration, and the time frame for each assignment. (USAID/Peru and DISBAR)

9. Special Studies

   - Initiate a study of villagers' excreta-disposal habits, sociocultural considerations related to excreta disposal, and latrine design preferences. The purpose of this study would be to develop or obtain appropriate alternative latrine designs, which then could be offered to villagers.

10. Role of Women

    - Form community-based working groups with women and men in several regions to develop a plan or plans for involving more women in decision making and planning. Health education activities should specifically address women's special role in family health and well-being and as the principal domestic water users. (Regional DISABAR and MOH staff)

LESSONS LEARNED

1. Under Peru's present economic conditions, programs that build decentralized institutions need to receive continued funding to avoid collapse of those institutions.

2. Unless detailed descriptions of community participation, health education, latrine promotion, and water system operation and maintenance programs and methodologies are included in the project design, rural water supply and sanitation projects will not achieve their goals.

3. Unless the executing agency is fully involved in the project design process and takes the actions necessary to meet the conditions precedent during the design process, project implementation will experience excessive delays.

4. The tremendous difficulties and long delays in developing and implementing a training plan, and the additional problems associated with community participation in system operation and maintenance and latrine installation and use are attributable in large part to the technical focus of project activities. The lesson here is that such projects need staff trained in social science methodology, health education, and community development to prepare detailed operational plans and budgets for these software components of RWSES projects and to manage their execution. Project designs that fail to provide this information will also fail to achieve project goals in these critical areas.

FRENTE DE TRABAJO
SANEAMIENTO BASICO RURAL

◎ CAPITAL DE LA REPUBLICA

○ CAPITAL DE DEPARTAMENTO

● OFICINA SANEAMIENTO BASICO RURAL (OSABAR)

Chapter 1

INTRODUCTION

1.1 Project Description

Through its eight project components, the Rural Water Systems and Environmental Sanitation (RWSES) Project in Peru responded to specific health needs of villagers in small (less than 500) rural communities in the sierra and high jungle. The project's purpose was to provide potable water systems, latrines, and health education to these communities; its operational philosophy was based on developing a high and sustained level of community participation and self-reliance. Four other project elements included performing special studies, training both staff and village officials, providing technical assistance, and decentralizing of the executing agency, the Division of Basic Rural Sanitation (DISABAR) of the Peruvian Ministry of Health (MOH).

The budget consisted of a $10 million loan and a $1 million grant from the U.S. Government (USG) and $5.2 million in counterpart funding from the Government of Peru, (GOP).

1.2 Project History

USAID/Peru authorized the project on 22 September 1980, and the Project Agreement between the GOP and USG was signed on 25 September 1980. As originally planned, the project was funded by a $5 million loan and a $500 thousand grant from the USG and $2.6 million in counterpart funding from the GOP. The project assistance completion date (PACD) was 30 September 1985.

In August 1982, a Project Amendment authorized an additional $5 million loan and $500 thousand grant from the USG and $2.6 million in GOP counterpart funds. At that time, the PACD was extended to 30 September 1987. Project Implementation Letter No. 34 (dated 9 May 1986) extended the PACD further, to 30 June 1989. However, no additional funding was provided. USAID/Peru and DISABAR discussed the possibility of an extension through 30 September 1989, but the PACD remained 30 June. When the project ended, $2.84 million in loan funds and $260 thousand in grant funds from the USG were deobligated and returned to the U.S. Treasury.

1.3 Purpose of the Evaluation

The purpose of this evaluation was to review the RWSES history to determine its successes and failures, examine the institutional and geographical context in which the project was planned and implemented, and assess its present status. Based on these findings, a set of recommendations would be developed with guidelines that could be used in planning and implementing health-related projects for small rural communities.

1.4 Scope of Work

The scope of work (SOW) covers the eight project components: water system construction, operation and maintenance, construction, decentralization and institution building, community participation and organization, health education, training, technical assistance, and special studies. Issues of project design, implementation, and execution; monitoring and evaluation; and management and coordination relative to these components are stressed, as are the roles of women and the integration of water/sanitation activities into the MOH primary health care program. In addition, special attention is given to appropriate technologies, system performance, and water quality. The SOW also addresses constraints in project performance, issues of sustainability, and lessons learned. The SOW does not extend to budgetary and financial matters.

1.5 Methodology

In preparation for the evaluation, a two-day planning meeting took place at the WASH office to discuss evaluation objectives, define the report outline, and establish a work plan. The methodology included three elements: meetings with USAID/Peru and MOH staff, a documents review, and field visits to 4 of 18 health regions. Field visits took place at 15 communities, whose water systems represented either the construction or post-delivery phase. The communities were selected on the basis of DISABAR recommendations and accessibility, given time constraints and in-country conditions. (Appendices B, C, and E detail persons contacted, communities visited, and reference documents reviewed.)

Chapter 2

PROJECT DESIGN

2.1 General Overview

The Project Paper (PP) presents a comprehensive description of the project, including reason, goals, resources to be provided, and overall implementation plan. The target population is clearly defined as villagers exposed to high risk of disease through their lack of potable water and excreta-disposal systems. The original target area was limited to six regional departments in the sierra and high jungle, which covered eight regional offices. This area was later expanded to cover 18 regional offices.

The executing agency, DISABAR, had years of experience (since 1962) in installing potable water and sanitation systems in rural communities of under 2,000 inhabitants. This was a vertical program planned and executed from its central office in Lima. Given this history of program operation, the PP noted three key departures from past practice that would be required in this new project:

- The target communities would be smaller than those previously benefited. More significantly, these smaller communities would be characterized by lower skill levels, lesser organizational experience, fewer financial, human, and material resources, and more-limited accessibility. They would also represent a population that had received little or no attention from the GOP.

- Project operation would become decentralized by strengthening the technical and administrative structure of the environmental sanitation units within the regional health offices. The plan was to hire and train new staff and provide offices, warehouses, and support services for these regional teams.

- The water supply and sanitation project would unite with the Integrated Primary Health (IPH) Project.

The PP describes a general methodology using sanitation technicians to provide health education to the target population. It also envisions special studies to assess villagers' attitudes toward rural water and sanitation systems and the degree of their acceptance and use. To address these challenges, the paper provides a strategy of decentralization; however, it presents no strategy or methodology at the regional level to foster the integration of the rural water supply and sanitation activities with those of IPH.

The most significant inconsistency of the project design was an undue emphasis upon constructing water systems. There was a preponderance of descriptive and analytical information on the construction process, while recognizing that

continued maintenance of water systems was the least successful component of previous projects. The PP did not provide enough information that described the necessary activities and the process for developing self-reliance in target communities. Furthermore, the project sets aside only token resources for that component; less than 10 percent of U.S. funds is earmarked for promotion, technical assistance, training, education, special studies, and evaluation, items that have some bearing on community participation (CP) and system maintenance. A fraction of these funds and the resources they represent is set aside for CP and O&M activities: only 8 out of 50 months of technical assistance (TA) was to be directed at diagnosing past maintenance problems and developing manuals and activities to address those problems.

The other design shortcomings relate to the following description or elaboration of project elements.

2.2 Engineering and Physical Infrastructures

2.2.1 Water Systems

The four types of water systems considered for this project were clearly described and a wide selection of typical construction drawings were provided. Estimated per capita construction costs and per connection maintenance costs were calculated, and global costs of materials and supplies were estimated.

Several issues relate to these water systems. First, chlorination should not have been included as a long-term treatment alternative. Previous experience in Peru has demonstrated that the supplying of needed chemicals cannot be sustained. Indeed, more emphasis should be placed on protecting the water sources. Second, although standing pools and puddles of wastewater were identified as a problem in previous projects, no wastewater drainage was provided in the original design for household taps. Such drainage was, however, provided in the design of public fountains. Appropriate drainage was to be provided under the project amendment signed in 1982. Third, no arrangements were made at project start-up to provide each community with a set of basic tools and a minimum supply of pipe, fittings, glue, and repair accessories. Although basic tools were supplied starting in 1987, this did not apply to systems built earlier. And no sets of minimum repair parts were provided with the tools.

2.2.2 Latrines

Although the project included a special study on villagers' latrine use and attitudes toward them, the study was never carried out. In reality only one type of latrine slab was offered. Other known alternatives such as the VIP (Ventilated Improved Pit) and the Colombian pour-flush types should have been included. Also, the project did not describe how latrine promotion and construction was to be coordinated with the water supply component. Nor were specific arrangements made to instruct villagers in latrine installation procedures.

2.3 Decentralization and Institution Building

An RWSES goal was to decentralize project implementation to the regional level. This was to be accomplished by hiring and training new staff to form regional teams and by providing necessary support services—offices, warehouses, vehicles, engineering equipment, office supplies, and staff.

The description of this project component was comprehensive and clear. One of the unusual features of the decentralization plan was the hiring of new staff by contract rather than as permanent government employees. Section 4.3 discusses decentralization in more detail.

The typical regional team would comprise 9 engineers and technicians and 13 support staff. The regional team was to take control of the day-to-day management and operation of project activities under the overall guidance and supervision of the central DISABAR office. The supervision of community education and participation activities, both during and after the project, was to be an important feature of decentralization. However, the project design did not adequately describe the procedures for these activities at the local level, nor did it stipulate sufficient resources for their support. (See sections 4.4 and 4.6.)

2.4 Community Participation and Organization

The PP acknowledges the importance of community participation, especially in regard to system O&M after construction. The description of this component focuses heavily on the voluntary labor, money, and local materials the community was to provide during the construction phase. Reference is made to the roles of Administrative Junta and operator/caretaker in maintaining the system and to the payment of monthly tariffs by the beneficiaries. Sanitation technicians were to organize the communities and obtain their participation.

However, the PP fails to describe the community role in the design, execution, administration, and evaluation of a project—nor does it indicate whether such a methodology was to be developed. Emphasis was placed on the community as beneficiary rather than participant in decision making and planning. No strategy was established to develop community participation in the project's post-construction phase. In addition, the very critical task of promotion was never described in terms of the range of activities involved: community health planning, participatory investigations, involvement of existing community organizations (e.g., mothers' clubs, parents' associations).

2.5 Primary Health Project

Integration of RWSES with IPH (Extension of Integrated Primary Health, Project 219) in support of the MOH primary health care program was a project goal: environmental sanitation was considered an essential component of primary health activities. The IPH objectives were to strengthen the roles of the health

auxiliary and health post by providing adequate training, equipment, and basic medicines; selecting and training community promoters and midwives, and providing simple equipment and medicines; introducing community development/health education activities in environmental sanitation; and providing support for a community-level information system for management and evaluation purposes.

Integration was to take place at the regional level where RWSES staff are responsible to the Regional Health Director, using an integrated regional team (health personnel and sanitation technicians/promoters) for training in environmental sanitation, health education, and community promotion. The PP does not adequately describe how this goal was to be accomplished. No suggestions were made for initiating the dialogue necessary for coordination nor for developing a suitable mechanism to integrate the two programs.

2.6 Health Education

Community education was defined as an integral project component. Sanitation technicians and other health workers would receive continuing health education training to support them in promoting the proper use and maintenance of water systems and latrines. Specifically, this component was to focus on four activities:

- community promotion and organization for sanitation services
- continuing community education to explain proper use of water systems and latrines
- community education on the maintenance of water systems and latrines
- general health education

This component was to be integrated into the overall health education component of the MOH primary health care program, with activities to be financed under the Grant portion of the project. IPH would finance educational materials on water system and latrine use and general health education. Moreover, MOH staff would receive six months of technical assistance to determine what assistance in environmental-sanitation education would be most valuable (e.g., training manuals, improved production of audiovisual materials). Three months of technical assistance was scheduled to produce water system maintenance manuals for community use. The design of an effective health education program was to draw upon the findings of the latrine and water use studies. This component design was flawed because its implementation depended on technical assistance rather than on responsibilities assigned to DISABAR; no scope of work was written for either technical assistance position. The probability of achieving coordinated activities in water and sanitation and health projects within MOH was overestimated.

2.7 Training

The training component was divided into two main categories: in-country training and third-country training. Third-country training included participation in courses and seminars related to basic rural sanitation programs and visits to observe similar programs in other Latin American countries. In-country training would include the following:

- short courses for sanitation technicians to help them carry out community organization activities (construction and maintenance of potable water systems)
- short courses for system operators
- short courses for Administrative Juntas
- short courses in administration and O&M for engineers
- seminars and refresher courses on different project topics

The Project Amendment stated that training activities would be developed to help community-level health promoters and Ministry of Education (MOE) schoolteachers conduct effective health education activities. Training in arithmetic, bookkeeping, and other subjects would be provided for Administrative Juntas and operators/caretakers to improve their administrative and management skills. Courses were also to be developed and implemented at the regional level to upgrade health workers' teaching skills and techniques. Additional seminars and refresher courses were also planned.

While the PP sets aside funds for the training component, it provides no training plan, schedule, or agenda.

2.8 Technical Assistance

The original PP called for 35 months of technical assistance: 24 months for planning and administration, 5 months for maintenance, and 6 months for environmental-sanitation education. The project amendment added 15 months of TA for cost analysis, technical design, communications, administration, studies, evaluations, and other short-term assignments.

Neither the original project paper nor the amendment provided a TA plan outlining a schedule for providing the services of each advisor or noting how the work of each responded to DISABAR and RWSES needs.

2.9 Special Studies

The original PP proposed five special studies:

- latrine use
- water use
- system efficacy
- simplified treatment mechanisms
- well experimentation

The purpose of these studies was to produce valuable information that could be used in modifying relevant components to facilitate and improve project implementation.

The results of the latrine study were to be used in providing sanitation options that responded to beneficiary preferences. The water use study was to survey three beneficiary elements: knowledge about water/disease relationships, attitudes toward improved water supply systems, and patterns of water use. Both studies could have produced valuable information for helping project activities become more responsive to beneficiaries' preferences and needs.

The system efficacy study was to measure the reduction (if any) of diarrheal episodes after a water system was installed. A minimum of 45 communities were to be studied. An attempt was made to simplify this study by reducing its scope to that of comparing the number of diarrheal episodes before and after the installation of a water system. However, any number of other causal factors remained in the community environment that could not be controlled or even monitored. Also the time of six work-months allotted to the study was inadequate to produce the information desired.

The simplified treatment study was to test alternative water-treatment methods that use appropriate technology and local materials.

The well experimental study, to examine alternative methods of pumping water from wells, could have produced useful comparative data on the subject. However, since most project systems were to be spring-fed gravity systems, the information produced would have had limited applicability to the project. Much of the desired information could have been gathered from a review of current literature.

This study could have produced highly valuable information leading to the redesign of treatment facilities, but the ten weeks allotted were unrealistic. This time frame may have been sufficient to develop a study design, but it was totally inadequate for conducting the study itself.

2.10 Implementation Plan

The PP presented a brief description of major events that would occur during the first year, after Conditions Precedent were met.

- a planning seminar to establish the framework for developing regional operational plans for the first three regions.
- regional operational plans completed.
- subproject sites selected for the first three regions.
- community participation activities begun through the formation of village water committees; construction begun when the above components were in place.

The implementation plan outlined in the PPC (Annex II, Exhibit L) describes a chronology of major events for the project during the first 27 months. This general plan indicates that implementation would be carried out in phases. In each phase, a group of communities would be selected, water committees formed, and water systems designed and built. The major hardware components included the following:

- offshore procurement of pipe, accessories, vehicles, and equipment
- local procurement of construction commodities
- design and construction of water systems
- installation of latrines

The major software components were these:

- preparation of operational plans
- hiring and training of regional staff
- community selection
- community organization
- education on water and latrine use
- establishment of maintenance systems

While this general plan provided a broad outline of how the project was to unfurl, in reality the project did not conform to the plan. Instead, the project followed a typical activity cycle in each community, once start-up actions were completed:

- Community selection
- Community participation (formation of water committee)
- Health education
- Field survey and system design
- Agreement on community and DISABAR responsibilities
- Construction of water system
- Promotion and installation of latrine
- System turn-over to the community
- Operation and maintenance by the community
- Supervision visits by DISABAR

This project cycle was repeated in each project region as new regions were added to the scope of the project. Although project implementation deviated considerably from that originally planned, this was not an overriding constraint in meeting project goals. The greatest difficulty came from the lack of detailed plans to carry out the specific project activities, especially such software components as health education, community participation and development, and village-level training of juntas and caretakers in the administration and system O&M.

Chapter 3

PROJECT START-UP

3.1 Overview

The PP described the following start-up activities:

- meeting the Conditions Precedent
- conducting a planning seminar to establish a framework to develop regional operational plans
- initiating procurement of vehicles and off-shore materials
- initiating maintenance, latrine, and baseline health studies
- initiating recruitment of regional teams and providing technical assistance

Approximate completion dates for each activity were extracted from the General Project Plan diagram included in the PP annexes. Table 1 lists major project events, planned and actual dates for completion, and delays incurred.

3.2 Meeting Conditions Precedent

The condition precedent to initial disbursement (loan and grant) was the designation of one MOH central staff and one staff person for each of the first three health regions to coordinate project activities. The director of DISABAR, Eng. Carlos Marroquín, was named coordinator at the MOH central level. Engineers in Huaraz, Cajamarca, and Huancayo were to coordinate project activities in their respective health regions.

These were the conditions precedent to initial disbursement (loan only):

- an implementation plan
- a financial plan
- a typical staffing plan for the health regions over the five-year life of the project

The condition precedent to disbursement for commodity procurement (loan only) was a commodity-procurement plan for the LOP.

These conditions precedent were not met until 25 August 1981, which delayed project implementation for almost a year.

TABLE 1

PROJECT IMPLEMENTATION DATES
9/80 THROUGH 11/83

EVENT	DATES PLANNED	ACTUAL	DELAY
Project Paper Signed	09/30/80	09/22/80	NONE
Project Agreement Signed	09/80	09/25/80	NONE
Conditions Precedent Met	11/01/80	08/25/81	11 months
Vehicles Ordered	11/15/80	06/06/82	20 months
Project Engineers Recruited	11/20/80	09/82	22 months
Off-shore Materials Ordered	02/01/81	05/83	27 months
Technicians Ordered	04/01/81	09/83	29 months
Technicians Trained	05/20/81	10/83	29 months
Local Materials Procured	07/01/81	07/82	12 months
Vehicles in Country	06/01/81	06/18/83	24 months
Off-shore Vehicles/Materials Ordered	06/01/82	12/83	18 months
Local Materials Procured	06/15/82	11/83	16 months

3.3 Staff Recruitment and Training

The first new regional engineers (10) were hired by DISABAR in September 1983. They were given two week's orientation in the MOH and DISABAR, followed by a five-week course in Lima covering project implementation (surveys, design, construction, and O&M).

During October 1983, DISABAR conducted eight four-day courses in project management and water system O&M for 226 health auxiliaries and sanitation technicians from seven regional health offices. These courses were designed to strengthen coordination between health and rural water and sanitation projects at the regional level. Each participant received the Manual de Supervisión de Servicios de Agua Potable y Alcantarillado Rural. As a result of these courses, seven health regions authorized their health center directors to supervise the Administrative Juntas.

3.4 Commodity Procurement

Construction materials (PVC pipe, accessories, etc.) for the first 30 water systems were ordered locally on 31 January 1982. Additional pipe and accessories in the amount of $123,000 were procured locally in July 1982. The first seven vehicles, ordered in mid-1982, were checked and serviced by the local Chrysler

dealer and dispatched to their respective regional offices starting in December 1983. This represented a 30-month delay in receiving these first vehicles.

3.5 Start-up Summary

The project's start-up phase was plagued with delays unforeseen by its planners. It appears that DISABAR was inadequately involved in the project development and design process and lacked knowledge of USAID's regulations, procedures, and requirements. This was DISABAR's first experience working with USAID. Conditions precedent should have been fully discussed and necessary documentation prepared as part of the project design process. Had these plans been developed during project design, meeting the conditions precedent would have been a simple formality.

The hiring of new project staff was constrained by the GOP's bureaucratic red tape. Many months were lost in obtaining GOP approval to hire new staff under contract rather than as permanent employees. Once this hurdle was overcome, DISABAR found it easier to recruit and hire staff under the new contract salary and wage scale.

Off-shore procurement of vehicles and construction materials proved to be a major stumbling block to project implementation. USAID procurement procedures require such exact specifications that only an expert in describing each commodity would be able to meet all descriptive requirements at the first attempt. This project's off-shore procurement delays were occasioned by indecision about types of commodities to be procured, a result of inadequately detailed planning during project design.

Chapter 4

PROJECT FINDINGS AND ACCOMPLISHMENTS

4.1 Overview

Findings are based on information collected through interviews, document research, and field visits to regional office and project sites. Appendix B lists persons contacted and Appendix E lists reference documents used. Field data was based on visits to four regional offices (Piura, Puno, Cuzco, and Cajamarca) and 15 project sites. (See Chart 2, Data and Ratings for Systems Visited).

Although every effort was made to obtain data from a representative sample, the choices and number of project sites visited were severely constrained by security considerations, time limitations, and the availability of scheduled flights and reservations. However, a broad range of environmental and sociocultural settings was observed. Water systems of varying chronological ages were inspected; two were extensions of motor-driven pumped systems supplied by drilled wells, the rest were spring-fed gravity systems.

As noted in the previous chapter, project implementation was delayed for over two years. Only 22 potable water systems were constructed by December 1983. However, during 1984 the pace picked up considerably. Staff was being hired for 11 regional offices, off-shore procurement had been initiated, and regional operational plans had been developed for the first six regional health offices. Each region had a backlog of community requests, many of which met the project's eligibility criteria. These requests were generated as the result of DISABAR's previous work with rural communities under its national rural water and sanitation program.

4.2 Engineering and Physical Infrastructure

4.2.1 Engineering

The water supply construction component was one of the most successful project achievements. Of the 1,200 systems targeted, 941 were built, 139 are under construction, and 138 additional had been designed as of June 1989. (See Chart 3, Status of RWSES Project.) In a small percentage of water systems, consumption will match design capacity in a few years; however, most systems will be able to provide adequate potable water to an expanding population over the 20-year design life. In those systems where design capacities are rapidly being met, unusual and unforeseen population growth has occurred or systems designed for public faucets were installed and subsequently modified to provide house connections because villagers would not accept public faucets.

During project design, the most important decision made for the water supply component was to give overriding preference to spring-fed gravity systems with household connections. This type of system has proven to be the most serviceable and reliable in rural water systems the world over. The only major concern is that their O&M requirements are so low the juntas may be insufficiently challenged to maintain their interest and motivation over the ensuing years. Most, if not all, components for the spring-fed, gravity system designs were developed by DISABAR in earlier years for its IDB-funded rural water supply and sanitation programs. These earlier designs were revised and simplified for use in this project. The spring-fed gravity system has three major structural components—spring catchment box, storage reservoir, and pressure-reduction box—and three minor structures—air-relief valve box, supply and distribution line-valve box, and service valve box.

Catchment structures had to be designed to meet specific characteristics of individual springs; all other structures were essentially taken from standard designs. (See Chart 2, Data and Rating for Systems Visited.)

House connection faucets were also of standard design, using 1/2-inch diameter PVC pipe for the riser and either a bronze or a plastic faucet. Because of the flexibility of PVC riser pipe, the consumers installed a variety of supports to reduce breakage possibilities.

During the first four years, all field surveys and water system designs were carried out by DISABAR's central office engineers, topographers, and draftsmen. As the newly hired regional engineers and staff received training and became familiar with the project design and construction process, and with USAID's continued pressure for decentralizing, DISABAR began allowing the regional offices to survey and design water systems. However, DISABAR/Lima retained final project authorization to initiate construction. Now practically all surveys and designs, except for special structures like water treatment plants, are carried out by regional staff.

4.2.2 Water Systems

As the construction process was described in the Project Paper, DISABAR provided design, supervision, and major construction materials (pipe, fittings, cement, and reinforcing steel). The community provided unskilled labor, local materials (sand and gravel), and, in some cases, cash contributions of up to 11 percent of the estimated system cost. The initial layout (staking) of the system was done by an engineer or topographer from the regional office. Once construction got under way, the foreman *(maestro de obra)* executed the work, assisted by periodic visits from regional engineers. The sanitation technician was responsible for organizing the community and for providing health education to the people. As discussed in section 4.6, the project developed no formal health education program. Likewise, no community development strategy was planned around building self-energizing community participation.

Of the 15 project sites visited, all but two had spring-fed gravity systems with house connection. The two sites (in Piura) were supplied from drilled wells that pumped to an elevated tank from which the water flowed by gravity to house

connections. The 13 spring-fed systems provided water service on a 24-hour basis, whereas the pumped systems provided water only 2 to 3 hours per day. The high cost of fuel for the pumps is the main limiting factor in the pumped systems.

Observations on construction quality were limited mainly to above-ground concrete structures. The concrete work on spring catchments, storage reservoirs, and pressure-reduction boxes is of good quality. *Note: This observation disagrees with that made by the WASH progress evaluation team in 1984. The difference may be attributed to improved construction practices and to the fact that none of the 1984 sites were revisited in 1989.*

Many street service valve-box covers were either broken or not in place and the boxes themselves filled with sand and debris. Valve boxes should be redesigned to alleviate these problems.

The low working pressure rating (100 psi) of the PVC pipes being used is cause for concern. During backfilling, selected sand is not being used to bed the pipes in the trenches. This means the pipes will be subject to punctures from sharp rocks or to breakage due to uneven bedding. This is especially likely where the pipe is laid along roadbeds. In fact, leakage due to a pipe break was observed along the main roadway in Alto de los Mechatos in Piura Department.

Water service from spring-fed gravity systems is reported by the consumers to be reliable and continuous. Water pressures and flows, even with two adjoining faucets running, were adequate. The average flows ranged from 0.06 liters per second (lps) to 0.39 lps. One home owner complained that the flow was too low, but as it turned out she had lived in Cajamarca and was used to having more than a simple faucet in the patio. In fact, upon further inspection, she was installing a flush toilet and bathtub in her country home.

Leaking faucets are the most common problem with the gravity systems. Although the 1984 WASH team recommended bronze fittings for public taps, plastic faucets have proven longer lasting. While it is a simple job to replace the rubber or plastic washer in the bronze faucets, none of the consumers or juntas had replacement washers. This points to the perennial problem of operation and maintenance, which has received inadequate attention in this project.

4.2.3 Water Quality

Water testing kits were unavailable in most regional offices until 1987 or 1988; some regional offices have yet to receive their kits. During the early years of the project, most water samples had to be transported to central laboratories for analysis. The time required for transport exceeded the acceptable limits for bacteriological analyses. Therefore, only physical and chemical analyses were performed on samples collected, usually as part of the community selection process.

As test kits were supplied to regional offices and staff trained in their use, some bacteriological analyses were performed. According to laboratory records, a number of analyses showed unacceptable coliform levels (bacteriological

indicators of contamination). There is no record of corrective actions having been taken. Since 1988, no tests have been performed due to the lack of chemicals and test media.

Because water systems built under this project were from spring-fed sources, contamination by harmful chemicals would be unusual; however, bacteriological contamination is more likely to occur. The best defensive measure against this form of contamination is to fence the drainage basin that feeds the spring, thus isolating it from human and animal intrusion. Where bacteriological contamination is present, an alternative water source should be used. If no other source is feasible, chlorination may be required as a last resort.

4.2.4 Operation and Maintenance

Of the project's three water-system types—spring-fed gravity, pump, and handpump systems—the spring-fed gravity system is the easiest to operate and maintain. Its O&M requirements are so limited that junta members and the caretaker/operator could easily become complacent. In the systems visited, many leaking faucets have not been repaired. Where systems have been in operation for over two years, the new junta members have received no training in managing and operating the water systems. *(Note: Administration Junta members are elected to two-year terms.)* Often the caretaker/operator is a junta member or consumer who received on-the-job training from the foreman during the construction process. In the last year or more, regional staff have made no supervisory visits to project communities for lack of travel funds. At no time during the project was sufficient emphasis placed on developing sustained community responsibility and self-reliance. No effective methodology was developed to achieve these basic changes in community attitudes and practices.

Motor-driven and handpump systems demand more O&M attention than gravity systems; in fact, motor-driven pumps require preventive O&M daily. Both motor-driven and handpumps require periodic servicing, such as oil and filter changes for motors and lubrication and tightening of moving parts for handpumps. The two motor-driven pump systems were either not in service or not pumping during the field visits. No handpump systems were observed.

Several ingredients are required in the makeup of a successful operation and maintenance program:

- community members trained to become motivated and responsible community leaders
- ongoing training for junta members and caretaker/operators in administration and O&M
- an O&M plan describing the tasks to be performed, and giving instructions on task performance, and frequency and scheduling of activities
- adequate tools

- adequate spare parts
- adequate tariff rates and collection to cover O&M costs
- ongoing supervision and support by the executing agency

Of the communities visited, some were better prepared than others to assume the task of operating and maintaining their water system. Those communities that have only recently obtained a water supply have several advantages over earlier recipients:

- The systems are newer and have less wear and tear.
- The juntas and caretaker/operators have had some O&M training (second-generation juntas and caretakers often have no training).
- The community has received a set of maintenance tools.
- Residual enthusiasm generated during construction could still exist.

Such communities are in the best position to do adequate operation and maintenance. However, there is a need for a continuing program to develop new community leaders, train new junta members and caretaker/operators, monitor the O&M and tariff collection activities, and provide supervision and support to the community. Without these ingredients, enthusiasm will wane and disappear over time, and the systems will begin to deteriorate and break down.

Sooner or later, pipes will start to leak, household riser pipes will break, valves will need replacing, spring catchments will have to be cleaned, and concrete work will have to be repaired.

Unless all the ingredients necessary for a viable O&M program are present and the required actions taken, the water systems will not provide the years of service for which they were designed and built.

4.2.5 Latrines

The project design included a special study to determine the attitude of previous beneficiaries toward latrines (need for and usage) in order to develop alternative designs and thereby improve interest and acceptance; however, the study was never carried out. Instead, the project offered the traditional flat latrine slab, usually with an oval concrete riser, as the sole alternative. While these pit latrines do provide a fixed location for excreta disposal, they also concentrate unpleasant odors and are difficult to keep clean. In certain communities, especially in the sierra, some beneficiaries provided with risers to sit on found them not to their liking and moved them off to a corner of the latrine.

Many latrine pits were poorly constructed, causing the slab to crack or collapse. In one case, a wooden supporting cross-member was placed across the aperture, which led to an accumulation of excreta at slab level. Several latrines inspected had standing water in the pit. Where latrines are a good distance (30 to 50 meters) away from ground water sources, they should cause no contamination of these supplies. However, an alternative latrine design should be developed that puts the pit at least partially above ground. Latrines are often found at inconvenient locations; frequently, the user must walk through a barnyard of animal dung to reach the latrine.

These problems reveal the insufficient time and attention that the engineers, sanitation technicians, and construction foremen devote to latrine installation. Together with the decision to shelve the sociocultural study, these problems confirm the low priority being given to the project's latrine promotion and installation component. Chart 3, Status of the RWSES Project, illustrates the goals and progress made in installing water systems and latrines.

4.3 Decentralization and Institution Building

Under the project a total of 14 offices and 14 warehouses were completed. Also 7 Dodge four-wheel-drive pickups, 13 Ford pickups and 25 Toyota four-door, four-wheel-drive pickups were assigned to 18 regional offices. (See Chart 4, Regional Infrastructure and Major Commodities.)

One of the purposes of the project was "to strengthen the infrastructure of the regional health offices by promoting the creation of an environmental sanitation team which would remain intact following the conclusion of the project." The proposed regional team was to consist of nine professional and technical staff and thirteen support staff. (See Chart 1, Typical Regional Staffing.) Since most regional health offices had only three to six sanitation employees at the project's beginning, the plan was to hire and train new employees to build a typical 22-member regional sanitation team.

DISABAR's first efforts to recruit engineers received only a few responses. Their lack of interest was attributed to the low salaries offered and to the fact that many younger engineers would rather live and work in Lima than in a departmental capital. Over a several-month period during which sustained efforts were made to attract engineers, ten were hired (by September 1983). These ten engineers formed the first group to receive orientation and training specifically designed to prepare them for their leadership roles on the regional sanitation teams. These engineers were followed by sanitation technicians hired and trained in six-week courses in Chimbote and Ica. (See Appendix D, DISABAR Training Activities 1981-89, for details on training courses conducted.)

Over the nine years of project implementation, 47 engineers and other professionals, 59 topographers and draftsmen, 60 sanitation technicians, and 139 support employees were hired and trained. (See Chart 8, DISABAR Organigram, Central and Regional Offices.) Although the DISABAR central staff at first showed a degree of reluctance to fully support decentralization, their reluctance disappeared as the newly formed regional teams began to prove their effectiveness. In early 1984, the regional staffs began to participate in

preparing operational plans and budgets. These operational plans provided the necessary information for each region's project activities. Now that the teams have assumed direct responsibility for the whole project process—from initial visits to target communities, to surveys, designs, and construction of the water system—there is widespread support for the concept of decentralized project operations this project promotes.

Complete decentralization was achieved in the technical and administrative aspects of project management. However, because of GOP fiscal policies, financial operations remained under central control. Indeed, the 18 regional institutions built as part of this project together form a significant milestone in the annals of institution-building efforts around the development world. However, the dark side of this remarkable achievement lies in its future because now that project funding has stopped, these regional teams lack the operating funds to continue the momentum built over the years. In 1988, the teams built a total of 224 water systems, but by June 1989, they were able to build only 45. Chart 5, Total Annual DISABAR Disbursement, shows the history of program buildup during the first years and the precipitous decline of program operations, starting in 1988 and culminating in 1989. The same trend appears in more detail in Chart 6. Furthermore, the counterpart funding generated by PL 480 for the project will be cut off at the end of 1989, causing a further reduction in funding and in operations.

4.4 Community Participation and Organization

4.4.1 Selection

The system for identifying communities to participate in the project operated by community self-selection:

1. A community would form a water committee and make a formal request *(solicitud)* to the DISABAR regional office for a water system. The request had to be signed by a majority of community members.

2. DISABAR would determine community eligibility by sending a sanitation technician and topographer to the community to undertake socioeconomic and technical feasibility studies.

3. Based on that information, DISABAR would apply five community project selection criteria and make a decision.

4. If selected, the community would be bound by an agreement *(Convenio para La Ejecucion, Administración, Operación y Mantenimiento del Sistema del Agua Potable)*, signed by the water committee, DISABAR, and MOH, which defined the responsibilities of each entity. This document detailed the community's commitment in terms of construction and maintenance, labor, materials to be provided, and amount to be paid for construction and support O&M costs.

In 1984, construction of household latrines was made mandatory and this obligation realized in a formal agreement *(Acta de Instalación de Letrinas Sanitarias)* between DISABAR and each community.

All project files reviewed contained socioeconomic and feasibility studies. The design of the socioeconomic study was provided by DISABAR/Lima and was later adapted in the various regions. The information contained in these studies was not standardized, but variously included:

- community participation
- number of water users
- percentage of users relative to population
- economic activity (agriculture)
- presence of education and health infrastructure/services
- common diseases (upper respiratory and diarrheal)
- estimated construction cost to the community

In the case of Puno, household income and expenditures and attitudes toward the proposed water system were included. Had the socioeconomic study questionnaire been standardized and field-tested with the assistance of community members and local health and education authorities, it would have provided important baseline data to evaluate project impact at the community level. The feasibility study consisted of a topographic survey.

No evidence was found that communities were selected in view of their inclusion in the region's health plan. The project did not attempt to target poor communities or high-risk individuals within communities. However, the DISABAR/Puno office did prioritize zones for water system construction according to existing coverage and regional preventive health and development strategies.

4.4.2 Promotion

Promotion efforts made by sanitation technicians begin with the first visit to the community, where they contact government authorities (mayors, teachers, health service personnel) and community leaders, and organize a community assembly to explain the water project: health benefits and latrine construction and use, USAID and DISABAR policies and responsibilities in the project, requirement to establish an Administrative Junta, and community construction responsibilities (labor, materials, money). In some cases, promotion has involved going house-to-house to explain the project and generate participation. Also, the Administrative Junta may be elected during the first visit and given some training. Promotion efforts continue during subsequent visits to the community.

Each community was to receive four yearly promotion/supervision visits. In the regions visited, this number fell to between zero and two for part of 1988 and all of 1989 because of the lack of funds for the technicians' transportation and per diem expenses. Several consequences have resulted: first, juntas have received insufficient training in their duties and thus cannot fulfill them properly; second, sanitation engineers who continue to make site visits may or may not undertake promotion activities; third, latrine use and maintenance is generally poor; and finally, the operation and maintenance of the water system itself is placed at risk.

4.4.3 Participation

Community promotion efforts to elicit interest in a water system and generate funds for construction costs include the organization of assemblies and fund-raising activities such as bake sales, raffles, and community benefits *(kermesses)*. Participation in actual system construction ranges from 32 days per user in La Banda (Cajamarca) to 45 days per user in Tisihua (Puno). No difficulties were cited in obtaining communal labor; however, a frequent local problem resulting from individual lack of participation in system construction is that the junta has to decide whether to impose a fine or cut off the household connection. Where school and health facilities were present, communities reported labor contribution to their construction. It is estimated that communities contributed 7,744 person-years of manual labor to the project, not counting latrine construction.

4.4.4 Administrative Juntas

Whereas a water committee comprises a few people who take the initiative to request a water system, the Administrative Junta is a duly constituted legal entity, with the offices of president, treasurer, secretary, and one or two spokesmen elected by the community for a two-year term. A Junta, whose members (generally male) are elected by the community for a two-year term, is officially recognized in the *Acta de Formación de la Junta Administradora e Implantación de Tarifa de Servicio* (which also defines the water tariff per user to cover system operation, maintenance, and administration as well as the due date of first payment). Junta duties and responsibilities, in addition to those of users, are defined in various documents:

- *Convenio para la Ejecución, Administración, Operación y Mantenimiento del Sistema de Agua Potable*
- *Acta de Entrega de la Administración, Operación y Mantenimiento del Sistema de Abastecimiento de Agua Potable a la Junta Administradora*
- *Estatutos para los servicios de Agua Potable*
- *Reglamentos de los Estatutos para los Servicios de Agua Potable Rural.*

The junta receives training in system administration, and operation and maintenance (including an O&M manual.) Each junta is required to purchase a ledger and tariff receipts and is also advised to contract a system operator. Prior to 1987, juntas had to purchase tool kits; in subsequent years, they were to be provided by the project. Juntas are obliged to remit monthly financial reports to the respective DISABAR offices.

Junta performance varies widely, but a common set of problems exist. The most serious are training and supervision because although the first junta is trained by the sanitation technician, DISABAR does not train subsequent juntas, thinking that the first will train those that follow. However, even the initial training may be minimal, due to limited field visits. Other problems arise, as well: not all Junta members are literate, the operation manual may be too sophisticated and complicated, enmity may exist between old and new juntas, and the community itself may be insufficiently involved or aware of Junta activities and user responsibilities. Thus, many juntas barely function.

In this regard, a serious shortfall in project training activities was the failure to train juntas. Given the difficulty in making supervisory visits, initial and refresher courses should have been offered to juntas on a continuing basis. *Note: Scheduled DISABAR training activities for 1990 included such courses to be developed and implemented at the regional level. Also, the recently published promoter's manual addresses many of the problems cited above.*

A significant achievement, particular to Puno, has been the local-level institutionalization of juntas. In the communities of Saccacatani and Santa Rosa de Pichicho, the juntas have built offices and purchased minimal furniture and supplies, using funds from tariff collections. Such organization gives the junta membership and activities high visibility, provides a meeting place where records are kept, supports project sustainability, and may encourage further community development.

4.4.5 Operation and Maintenance

Tariff collection is supposed to cover all O&M costs. The tariff is initially set with DISABAR assistance and approval. In the communities visited, tariffs ranged from I/.100 to I/.2,500 per month. The relationship between household income and water tariff is never defined in project documents, nor is there evidence that tariff rates have been adjusted according to the user's ability to pay. Communities usually enjoy a one- to three-month grace period before tariff collection begins because of their contribution to construction costs.

The juntas interviewed reported that their tariff rates are too low to cover costs. In 1982, in an effort to index tariffs to the inflation rate and thus achieve adequate cost recovery, the household connection rate was pegged to the price of a 10 oz. Coca Cola, the treatment plant system cost per user to that of a family-size Coke, and the pump system cost per user to that of a beer. This effort has not succeeded. In addition, water users in the same community have cited different tariff amounts, indicating a lack of knowledge of the actual rate and of collection efforts. One reason is that the community collection agent *(cobrador)* may receive a stipend based on the amount collected

and either the stipend is so low that the agent is unmotivated to make the collection or the agent collects from users known to pay as opposed to all users.

Local peculiarities greatly influence cost recovery. For example, construction costs to the community as well as tariff payments were exonerated in Puno due to the flooding in 1984. Also in Puno, communities located in emergency zones are relieved of these costs. Communities in Cuzco believe that because they contributed to system construction and because water is a gift from the supernatural, no tariff should be charged. Without supervision in the form of quarterly visits from sanitation technicians, juntas may neither undertake tariff collections nor keep records and thus have no funds for maintenance and repairs. Accordingly, within one or two years of completion, water systems lacking O&M attention could fall prey to contamination or provide reduced water service.

Water use and availability is equally subject to local conditions and type of water system. Communities visited in Piura have pumped-water service 2 to 4 hours per day (early morning) and in Puno receive 24-hour (spring-fed gravity) water service. It is notable that rural water service outside Piura, Puno, Cuzco, and Cajamarca is greater than the service in these cities. Communities in Piura and Puno have system operators *(operador)*, trained by the construction supervisor, who work on a voluntary or stipend basis. In Cuzco and Cajamarca, the operator was a junta member who was also trained by the construction supervisor but received no stipend. No community was found to have more than one trained operator, which is problematic because the operators (like most men in the community) tend to migrate, leaving the system unattended. Water is used for both domestic consumption and horticulture. In Alto de los Mechatos (Piura), water service is extended from 2 hours to 8 hours on Thursdays so the women can make *chicha*. In this community, water quality is assessed on the basis of whether it makes good *chicha*.

4.4.6 Latrine Use and Maintenance

Latrine use and maintenance are very uneven in the systems visited. Latrine installation is obligatory, and the platform and riser are distributed free of cost. The sanitation technician provides instruction as to design, size, construction materials, location, and physical orientation of the latrine. This instruction is accompanied by sanitation education, and the user may also be provided with a diagram or pamphlet on latrine construction/use, including hygiene. The pamphlet distributed in Cajamarca is a good example.

It appears that latrine installation is motivated more by obligation (in order to have a water system) than by a desire for the latrine itself. The two most common obstacles to latrine use are its odors and its users' failure to adapt to the riser-style latrine (the "Turkish-style" squat slab is favored). In all communities visited, some users reported using kerosene or lye to "sanitize" latrines, either because they were unaware of the recommended means of dried animal dung or ash, or they were unconvinced by these means. In some cases, users applied the liquids in addition to dung or ash. Parents in Querapata

(Cuzco) reported that children's use of the riser-style makes them dirty because they are too small to use the latrine properly.

Latrine construction is highly variable, ranging from well-constructed, painted latrines in Puno to those elsewhere that were not built with proper support and had collapsed. Initial resistance to latrine installation was encountered in Puno because people did not want to use what little land they owned for the latrine. In 1987, DISABAR-Puno estimated latrine use at 15 percent; today the rate is estimated at between 40 and 50 percent. Reasons given are that training has improved and that it takes time for people to adapt to latrines. (Communities in Puno that were outside the project and thus ineligible for latrines have requested them. On the other hand, some eligible communities do not want them.) Most problems associated with latrine use and maintenance, especially design, could have been resolved by the proposed latrine-use study.

4.4.7 Community Development

The PP envisioned certain community development activities that might stem from the installation of water systems—rudimentary food processing or cloth dyeing, for example. These were not found. However, the tap installed at the primary school in Cuper Bajo (Cuzco) has allowed the students to undertake a small reforestation and school garden project (owing in large part to the dynamism of the director). An unanticipated project outcome over the past year is that many communities have made extraordinary efforts to obtain water systems, given DISABAR's lack of resources. For example, in Cuzco a few communities are paying all costs for foremen (at reduced rates) and for the purchase of materials and transportation. In Cajamarca, a few communities had paid DISABAR's gasoline expenses for community visits. In Alto de los Mechatos (Piura), the installation of a water system was deemed so successful that plans were being made to secure electricity. These experiences should be shared among the regions for learning purposes and for stimulating like activities.

Community participation cannot be sustained without responsible, motivated community leaders. Leadership qualities are best developed through community-based workshops that use participatory learning methods. The goal of these workshops should be to develop self-reliant community leaders who can organize and motivate the villagers to begin to control their futures.

In sum, the level of community participation during the construction phase was sufficient for communities to meet their project obligations (labor, materials, money). Participation in the post-construction phase is generally uneven or minimal due to the low level of supervision and training activities. (See section 4.7 for a full discussion of training activities.) However, a few communities visited have demonstrated that with proper supervision and training they are fully capable of system operation and maintenance and, further, that rural water systems can be a stepping stone to greater community development.

4.5 Primary Health Project

From the outset, the integration of the IPH with RWSES was beset with problems. One shared by both was the delay in project start-up—over 18 months for each. Another common problem was personnel turnover, which led to a lack of continuity for coordination purposes. In the RWSES, decentralization was linked to the build-up of regional activities over time, and this, too, influenced integration efforts.

Most importantly, however, no formal plan was developed to achieve coordination, although the groundwork was laid in the original Project Authorization covenants: "any community selected for water facilities under the Project will be included in its health region's primary health plan" and "all communities selected as beneficiaries under the Project will be located in the six health regions selected for Project activities." In 1982, USAID decided that in order to achieve maximum impact on health status, RWSES activities should be expanded to include four additional regions where health service activities were operating under the Extension of Integrated Primary Health, Project 219, and Integrated Health and Family Planning, Project 230. This activity was authorized in the 1982 Project Amendment, which extended RWSES coverage from 6 to 10 health regions. By June 1983, USAID and MOH had agreed to meet on the joint selection of rural communities to receive assistance under AID Projects 219 and 221 and on joint health education curricula to be developed separately under each project.

However, actual coordination activities were occasional. For example, a three-day meeting sponsored by MOH was held in September 1983 to coordinate activities programmed in the region under different projects with the Ministries of Education, Agriculture, and Health. In October 1983, following eight four-day courses conducted by DISABAR on project management and water system O&M for 226 health workers and sanitation technicians from seven health regions, five of the regional health directors authorized their health center directors to supervise community water committees. No information was found to indicate that any actions were taken as a result of these activities.

The Primary Health Project ended on 30 June 1985, at which time the issue of coordination with RWSES became irrelevant. The two projects never met the project goal of integration and few, if any, sustained coordinated activities were accomplished. Nor was an effective health education plan developed.

During field visits, meetings with regional health directors revealed a varying degree of current coordination between health and water services. The best example of water-services coordination and support was found in Puno, where the Departmental Rural Sanitation Plan was established in 1986 to focus on popular education. The development and subsequent execution of this plan has involved all major actors in the public sector as well as universities and nongovernmental organizations. In addition, Puno has a 40-member Community Health Commission comprising doctors, sanitation technicians, and others committed to community health, who meet monthly in different communities. Piura has adopted another approach, local integrated health systems (SILOS), that receive preventive health services from multidisciplinary teams at the district

level. These coordinated actions suggest the possibility of integrating similar projects in the future, given appropriate organization and planning.

The lack of easy access to safe water and sanitation systems are critical factors contributing to the high incidence of diarrheal diseases that claim the lives of so many children in developing countries. As the popularity of water and sanitation programs waned in the mid-1980s and that of oral rehydration therapy (ORT) and more recently child survival grew, funding for projects in the respective areas followed suit. Today there is a growing recognition of the importance of rural water supply and environmental sanitation programs to health and child survival programs.

Quoting from the draft WASH Technical Report, "Linking Water and Sanitation Programs to Child Survival, October 1989":

> One lesson that has clearly emerged over the decade since Alma-Ata is that neither "pure" child survival programs nor improved water supply and sanitation facilities alone can solve the problem of death and illness from diarrheal diseases among children in developing countries. Many evaluations indicate that water supply programs operating separately, or even when combined with sanitation, have little effect on infectious diseases such as diarrhea without a community-level understanding of health issues and corresponding changes in their health and hygiene behaviors. Similarly, although ORT is an extremely effective method of preventing death due to dehydration caused by diarrhea, it is not a primary measure and lacks curative capabilities... There is an obvious fit between the strengths and weaknesses of the two types of interventions, and linkage could optimize the impact of both... Beyond this, however, providing water creates other opportunities for entry points to better organize primary health care and social services at the community level....

During the past decades, the experience gained in child survival and water and sanitation programs points to the need to broaden the scopes of both and make them mutually inclusive.

In this regard, USAID/Peru is in the fortunate position of being able to increase the scope and impact of its Child Survival Action (CSA) project by adding an ongoing water and sanitation component operating under the auspices of the same executing agency, the MOH.

4.6 Health Education

Health education activities had not been initiated as of March 1983; thus, a decision was made to obtain technical assistance to develop a health education program in one region that would include designing materials and scheduling activities to coordinate with construction activities presented to the other regions. Operation and maintenance activities, including training of Administrative Juntas, were to be included in the program, which would also use

MOH promoters and other paramedic staff and teachers. The program was also to feature a school health component.

Technical assistance was not provided following this decision, nor as stipulated in the PP. No effective health education program was ever developed, although the DISABAR Training and Applied Research Office (established in 1985) did sponsor various seminars and courses that included health education and community participation. Although DISABAR field engineers and sanitation technicians have provided education on basic hygiene and sanitation as part of promotional activities before and during construction, these efforts appear insufficient to change sanitary habits. More importantly, they were not linked to a broader preventive health program.

4.7 Training

4.7.1 Background

From project start-up until 1984, professional training activities were largely problem-specific due, in large part, to the absence of a training office. DISABAR also experienced numerous organizational changes between 1981 and 1986, which contributed to a neglect of training activities, especially community participation. In February 1984, a training consultant was provided through technical assistance to help DISABAR organize and establish a special training unit to coordinate all project training activities. In September 1985, a Human Resources Development (HRD) Unit was formed and partially staffed to develop and coordinate technical and community-promotion training programs and to support applied research. Activities were to include the design of pilot training programs for DISABAR engineers and sanitary technicians, and for community-level water systems operators and users. No training activities were conducted in 1985. (See Appendix D for a list of training activities from 1981 to 1989.)

The turning point for project training came in December 1986, when Dr. Carmen Vargas de Mayo was contracted by DISABAR to head the Training and Applied Research Office (formerly the HRD unit). Dr. Vargas, with input from all regional offices, developed a training plan for 1987-88. Specifically, all regional offices received questionnaires to identify training needs according to four levels: engineers, chemists, biologists, administrators (Level I); sanitation technicians and auxiliaries (Level II); foremen (Level III); and Administrative Juntas and water users (Level IV). The resulting plan, the first comprehensive training plan for the project, included annual meetings. In 1987, a total of 12 short-term courses were conducted in DISABAR field offices and Lima, with a total of 365 individuals (engineers, sanitation technicians, foremen, and local community members) receiving training in the design of nonconventional water treatment plants, water system construction, O&M techniques, use of water testing equipment, and community participation.

4.7.2 Training of Trainers

DISABAR training methodology has focused on the "multiplier effect," (i.e., training of trainers) that has been applied to the four designated training levels; for example, DISABAR trains one group of engineers who then train sanitation technicians and other engineers. Training needs for Levels I, II, and III have been met. Training for Level IV has been organized but not executed. For budgetary and other reasons, Administrative Juntas and water users have not received the training necessary to ensure water system sustainability.

In 1985, DISABAR instituted a separate fund for supervisors (generally sanitation technicians) to make on-site inspections that would include training activities. (In 1989, when GOP counterpart funds had to be used for this purpose, there were no funds available for supervision visits.) Using the multiplier-effect approach, foremen were to provide training to communities. But because they work on a short-term basis and leave the community when their work is finished, the training they provide is irregular. Consequently, at the close of the project no training courses had been provided to Administrative Juntas, and the level of training they received from sanitation engineers/ technicians/foremen was inadequate.

4.7.3 Community Training

Of particular concern is the fact that juntas have received no systematic training in basic accounting and bookkeeping to improve their management of system operating costs. Because arithmetic and accounting skills are low, some juntas in Piura give the DISABAR promoter their tariff collection and maintenance receipts so that she can prepare their record books *(Libros de Actas)* and monthly financial reports. Other juntas may hire someone to keep their books. A substantial portion of the promoter's time is taken up with such activities, when it would be more efficient to hold bookkeeping courses for the juntas. Training courses for juntas should have been conducted throughout the life of the project for at least three reasons: (1) the few, irregular community visits by DISABAR personnel and their own limited training in community-participation methodology and health education; (2) the variety of tasks the junta must perform (accounting, bookkeeping, monthly reporting, system operation and maintenance, tariff collection, problem-solving); and (3) the history of community-level operation and maintenance as the weakest link in rural water systems (acknowledged in the PP). The project's lack of training for juntas reflects a failure from the start to define a community participation methodology as part of the overall training program.

Training events that included community participation were not held until 1987, seven years after project start-up. In January 1987, a well-designed community-participation methodology was presented at a refresher course for sanitation technicians and auxiliaries. Later, in conjunction with the MOH Office of Community Assistance, DISABAR held three two-week regional workshops ("Working with the Community") for regional engineers and sanitary technicians, and included community participants in Cuzco (July 1987), Piura (June 1988), and Chimbote (March 1989). The workshops, focusing on how to improve community

participation by using existing community-based organizations and leaders to provide health and sanitary education, were very well-received.

Other issues relevant to the training program concern the failure to implement the special latrine study to which community training activities were to be linked and the lack of coordination between sanitation and health activities.

The DISABAR training plan for 1990, however, significantly advances and expands training activities for Level IV. Sanitation technicians, auxiliaries, and promoters will continue their training activities in community participation/promotion and sanitation education. Three-day training courses will be given to Administrative Juntas, water users, schoolteachers, and community organizations. These courses will be conducted by DISABAR field office personnel and staff from the departmental health units (UDES) and territorial health units (UTES) to integrate health services with rural water services at the community level. Courses are scheduled for all field offices.

4.7.4 Decentralization

The issue of decentralization touches upon training in the sense that most courses and materials were developed in Lima and may not have arrived in regional offices in a timely fashion. Moreover, the central office has had very limited resources to develop training materials. During the life of the project, a slide presentation on the use of Millipore equipment was prepared, as were video presentations on water and health (financed by USAID) and the evaluation of treatment plants (financed by USAID with technical assistance from CEPIS). The necessary equipment to make use of these materials is not found in many regional offices. A forthcoming DISABAR publication, *Manual del Promotor*, is designed to address community-level training needs.

In sum, training received very little attention through late 1986, when the first major effort (needs identification, course and materials development, annual planning) was initiated. This effort has been very successful in meeting the training needs for Levels I, II, and III. It is noted that regional field staff have also benefited from training courses offered in connection with other projects and programs. In this regard, DISABAR enjoys a close working relationship with the Pan American Health Organization and the World Health Organization (PAHO/WHO).

A significant feature of the 1990 plan is the decentralization of some training activities. Regional offices will develop their own courses (including budgets) according to local needs, and the central office will provide assistance. Some regional offices have taken the initiative to develop and offer courses with financing sought elsewhere. For example, since 1984 Piura has conducted a variety of courses ranging from refresher courses for sanitation technicians to training on Hach water testing equipment. Regional offices have already begun to seek assistance from Lima in developing courses, e.g., Cuzco, where the sanitation technicians have proposed a training course for Administrative Juntas.

Finally, with respect to training for health service workers and schoolteachers, in October 1983 DISABAR sponsored eight four-day courses on rural water supply management and operation and maintenance for 226 sanitation technicians and health auxiliaries from seven health regions. This was the **single** training event during the lifetime of the project that brought together sanitation and health service workers for the purpose of coordinating their work. No evidence was found of any project training for schoolteachers to date.

4.8 Technical Assistance

As originally planned, the project called for 35 months of technical assistance in the following areas:

- planning and administration—24 months
- maintenance—5 months
- environmental sanitation education—6 months

The amendment signed in August 1982 added 15 months of technical assistance:

- develop simplified water system design and job descriptions for paraprofessionals—6 months
- evaluate per capita costs of water systems—3 months
- develop training materials and techniques for community-level workers—3 months
- develop curriculum materials and training programs for MOE staff—3 months

In January 1982, a WASH advisory team recommended restructuring the original 35 months of technical assistance to include the following:

- a regional office development advisor with experience in management of rural water and sanitation programs—24 months
- an HRD advisor to establish a locally based O&M program and a scheme to recruit and train semiprofessional regional staff that would carry out community development and participation activities—5 months
- an O&M advisor to train semiprofessional technicians and unskilled systems operators—6 months

In September 1984, a second WASH team conducted a progress evaluation of the project. At that time, approximately six months of short-term TA focused on project planning and start-up had been provided. During a two-month consultancy, the HRD advisor had designed an organization and implementation plan for a DISABAR HRD unit that included these elements:

- short-, medium-, and long-term training schedule

- model curriculum design
- plan for coordinating DISABAR's training and community promotion activities with the IPH

Also, the management information system (MIS) advisor was working with DISABAR to computerize its management information system. The long-term planning and administration advisor had arrived in September 1983 and was assisting DISABAR in project implementation activities.

The WASH progress evaluation team recommended further changes in the TA component, increasing it by ten months. This new package included replacing the health-education promotion advisor (6 months), the communications advisor (3 months) and the training advisor (3 months) with a long-term (24-month) advisor experienced in all three areas. The O&M advisor's term of service would be cut to 3 months, and the economist advisor (evaluating per capita costs of water systems) would be replaced by a personnel planning and evaluation advisor (3 months).

Despite the several plans and recommended changes, the actual TA provided under the project consisted of the long-term sanitary engineer (who was identified in the PP to advise in planning and administration), the HRD advisor, and the MIS advisor.

The engineering advisor prepared a brief pre-departure memorandum describing the status of several specific implementation issues and recommendations on actions to be taken; however, no periodic progress reports were found.

During project implementation, the problem of adjusting salary scales between permanent and contract employees went through several phases. At one point the salaries for permanent engineers were so much lower than for contract engineers that several resigned their permanent positions to be immediately rehired in the same job as contract engineers at a higher salary. At present, permanent-staff salaries are higher than those of contract personnel due to salary adjustments made by the GOP.

A major achievement in project administration was the autonomy that the MOH granted to DISABAR and its regional offices in allocating and disbursing funds. This decision allowed regional offices to procure local construction materials (cement, reinforcing steel, fittings, lumber) without applying to Lima for approval. Local purchases could now be completed in a day or two instead of weeks.

Regarding the outcome of the HRD advisor's work, DISABAR created an HRD unit within its Lima headquarters office in mid-1985. This unit began planning and designing training programs for project staff and community officials. In late 1987, DISABAR hired a new chief, who then restructured the HRD unit into a training and applied research office.

In 1989, DISABAR planned to purchase one of the computers recommended by the MIS advisor; however, this budget item was never funded. Therefore, no progress has been made on computerizing DISABAR's management information system to date.

4.9 Special Studies

The project paper listed five special studies to be conducted during the course of project implementation:

- a latrine study to determine defecation habits and attitudes toward latrine use and maintenance, and to recommend future project direction;
- a water-use study on consumer perceptions regarding the relationship between water use and disease;
- a system efficacy study to determine the impact of providing potable water and latrines as measured by reductions in diarrhea among beneficiaries;
- a study of simplified water-treatment mechanisms to determine alternative treatment methods that use local materials; and
- a study of alternative methods of supplying water from wells.

The Project Amendment provided additional funds for special studies but did not describe any new studies other than to state that "a series of studies to complement those programmed under the on-going project will be financed by this component."

In their April 1982 report, the WASH advisory team suggested that USAID study the feasibility of developing the local manufacture of handpumps. DISABAR proposed adding two additional studies—one on the efficiency of treatment systems, another on developing a computerized management information system.

Of the eight studies proposed, four were carried out. DISABAR studied rural water consumption patterns and produced a detailed report on the subject titled, *Estudio de Variaciones de Consumo en Poblaciones del Medio Rural* (1987). This study showed that per capita consumption was 50 liters per day (lpcd) instead of the 80 lpcd used in designs for the sierra. DISABAR also conducted studies on the design and operation of simplified water treatment systems using local materials; however, the final report has not yet been published.

A two-person team of engineers from Georgia Institute of Technology spent two weeks in Lima to assess the feasibility of manufacturing handpumps locally. There is no record of any follow-up action as a result of this consultancy.

Finally, the MIS advisor prepared an analysis of DISABAR's existing information systems and a computerized system design (see Section 4.8.)

Of the four remaining studies, the latrine study could have contributed significantly to the development of alternative latrines more acceptable to beneficiaries. The low levels of latrine usage attained in the project reflect the continuing need for such a study.

4.10 Role of Women

Women's role as participants in system construction has been equal to that of men because of the tradition of communal labor. Moreover, during construction women provide room and board to workers, in addition to their own labor and economic contributions. However, the role of women in the decision-making process, i.e., membership in the Administrative Junta, has been minimal. Because women are present in the community on a year-round basis[1], bear responsibility for family health and well-being, and are the principal domestic water users, women and women's organizations such as mothers' clubs should have been targeted for special attention—hygiene education and preventive health care, for example. The fact that they were not is a significant shortcoming of the project. The OPS-sponsored seminar on this subject (August 1989) demonstrated that women's role can be expanded in rural water projects.

The project's impact on women as beneficiaries (constituting half the target population of 367,068) has been substantial in terms of time saved relative to food preparation, cooking, cleaning, child care, small animal husbandry, and horticulture. In Cerritos (Piura), for example, before system construction the nearest water source was 2 km. from the community, a daily walk for women and children.

Family health has improved. Women report decreased incidence of pediatric diarrheal disease relative to the installation of household connections (although this and other health benefits cannot be verified in the absence of baseline data.) Similarly, sanitary habits may have changed with water in the household because some communities observe that their children "look cleaner."

4.11 End of Project Status (EOPS)

The original project paper set forth the following EOPS:

(a) decentralized regional environmental sanitation offices upgraded and operating in six regional health offices;

(b) the Directorate of Sanitary Engineering (DSE) upgraded such that it can develop, implement, and maintain rural potable water and sanitary systems, through increased human, financial, and material resources available as a result of the project;

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[1] Men migrate in search of casual labor, following the agricultural cycle.

(e) health conditions and general well-being in the project area improved as a result of increased potable water.

The project achieved the first three EOPS, except for the maintenance component in (b) and (c). Latrine use was increased but never equalled the number of household water connections made. Some villagers reported that their children had fewer diarrhea attacks; however, the household faucets have created a drainage problem at most houses.

4.12 System Sustainability

As noted in Section 4.2, spring-fed gravity systems require the least attention; they will almost run themselves if a few O&M procedures and actions are practiced.

The water source must be protected from contamination by preventing animals and people from defecating above or near the springs. The spring catchment inlets as well as the reservoirs and pressure-reduction boxes need to be kept free of debris and obstacles. Pipeline leaks need to be repaired and the washers in leaking faucets replaced. Tariffs need to be set at realistic rates and collected regularly.

None of these tasks is overly difficult to carry out; villagers can perform each of them. With adequate training and motivation, villagers should be able to operate and maintain these water systems for the 20-year period of their design life.

4.13 Financial Aspects

4.13.1 Capital Costs of RWSES

The PP analyzes the capital cost per capita of a gravity system with household connections (Annex II, Exhibit H.2). The cost per capita (with administration figured at 35 percent of capital cost) was $40.

Using gross project budget and disbursement figures, the following calculation can be made:

Source	Disbursements
Loan	$ 7,160,000
Grant	740,000
GOP	2,755,000
Total Cost of Project	$10,655,000

Number of beneficiaries: 367,000

$$\frac{\text{Capital Cost of Project}}{\text{No. of Beneficiaries}} = \frac{\$10,655,000}{367,000} = \$29 \text{ per capita}$$

This compares favorably with the costs figured in the project papers.

4.13.2 Production Costs

The computation shown in Annex II, Exhibit K, pages 1 and 2 of the Project Paper, has been redone based on updated information collected during the final evaluation.

1. Location: 15 systems

2. Departments: Piura, Puno, Cuzco, Cajamarca

3. Type of system: Gravity with household connections

4. Population data: 350 inhabitants (average); 60 household connections

5. Monthly consumption per household

$$\frac{350 \text{ capita}}{60 \text{ households}} \times 80 \text{ lpcd} \times 30 \text{ days} = 14.0 \text{ m}^3\text{/month}$$

6. Total monthly consumption (60 households) - 840.0 m^3/month

7. Monthly production costs (in U.S. $)

A. Administration		
Manager's salary	$0.00	
Office supplies	2.00	
Miscellaneous	2.50	
Subtotal		$4.50

B. Operation

Operator's salary	$15.00	
Chemical purchase	0.00	
Gas and oil	0.00	
Miscellaneous	3.00	
Subtotal		$18.00

C. Maintenance

Skilled wages	$ 0.00	
Spare parts	10.00	
Subtotal		$10.00

Total Monthly O&M costs per system $32.50

D. Depreciation (MOH reckons 16% of straight line value)

Total capital cost per system
($10,655,000 ÷ 986 systems): $10,800.00

Life of project: 20 years (240 months)

Monthly straight line depreciation $\frac{\$10,800}{240} = \$ 45.00$

16% of $45.00 $7.20

Total monthly production cost = $32.50 + $7.20 = $39.70

8. Cost of water per m^3:

$$\frac{\$39.70/\text{month}}{840\ m^3/\text{month}} = \$0.047/m^3$$

9. Estimated cost per household per month:

$\$0.047/m^3 \times 14\ m^3/\text{month} = \$0.66/\text{month}$

10. Consumption cost per home per year:

$\$0.66/\text{month} \times 12\ \text{months} = \$7.92/\text{year}$

An indicative benefit-cost ratio is found in Appendix F.

Chapter 5

PROJECT SUPPORT AND MANAGEMENT

5.1 DISABAR

DISABAR and its predecessor agencies have a decades-long history of planning and managing rural water supply and sanitation programs. In the past, practically all decision-making responsibility rested with the central office in Lima. All field surveys and water system designs were performed by engineers and topographers who traveled into the countryside from Lima. The engineers stationed in the departmental capitals were used mainly as construction engineers and supervisors. Even the purchasing and warehousing of construction materials were concentrated in Lima. Under the project's operational design, this pattern of concentrated authority and central control of goods and services was to undergo a drastic change.

Upon signing the Project Agreement, the official representative of the GOP agreed to the PP's decentralization concept, but the DISABAR senior staff did not foresee nor support the extent to which decentralization was to occur. However, since project funds meant a significant buildup in DISABAR's overall program, the staff had no alternative but to accept an administrative change that required they relinquish some control and delegate authority and responsibility to regional staff.

Over the years regional offices assumed greater and greater responsibility and at last approached the degree envisioned in the project design, which called for overall project planning, design, and implementation to be done by regional personnel. In the later years of the project, the regional staff began to prepare annual operational plans and budgets. However, DISABAR/Lima retained review and approval authority on annual operational plans and budgets, which is a prudent and necessary step in an operation such as this. The review and approval of individual water system designs is unnecessary except where special structures such as elevated tanks and treatment plants are planned.

DISABAR/Lima manages and monitors the project through four channels:

- allocation and distribution of funds
- selection, hiring, training, and assignment of personnel
- review and evaluation of data submitted monthly by regional offices
- periodic field inspection visits.

DISABAR/Lima also plans, organizes, and executes training activities.

During 1989, the lack of travel funds brought field inspection visits virtually to a halt. The hiring and training of new personnel have also been drastically reduced. DISABAR/Lima now presides over the allocation and distribution of a greatly reduced investment budget. Therefore, DISABAR/Lima's main management

tool is the review and evaluation of data contained in the regional monthly activity reports.

DISABAR's management information system is based largely on monthly progress reports sent in from its regional offices. This information is supplemented by memos, cables, and telephone contacts. Monthly progress reports focused primarily on the previous month's accomplishments, i.e., numbers, location, and other demographic data concerning surveys conducted, designs completed, construction activities, and financial status of the project. The reports generally did not include a prognosis for funding of future procurement, travel, commodities, or other expenses. Nor did DISABAR/Lima allocate resources on the basis of past performance. Some regions that performed poorly one year received unusually large budget increases the following year.

A comparison of data provided by DISABAR/Lima with that of the four regional offices visited, together with observations made at 15 project sites, indicates that DISABAR/Lima is not fully up-to-date on field activities. DISABAR/Lima's most reliable information was on water system construction. Significant inconsistencies emerged regarding personnel status and latrine installation: in many cases the same amounts appeared for the number of latrines fabricated and installed. However, sampling of latrine installations in the 15 project communities visited indicates that actual installation may be from 25 to 50 percent less than reported. Therefore, it is apparent that without having the resources to make field inspection and supervision visits, DISABAR/Lima is unable to adequately manage and monitor field activities.

During the life of the project, DISABAR responded actively to major recommendations regarding implementation issues. These were some of the more important actions taken:

- successfully recruited, hired, trained, and assigned new professional, technical, and support staff to regional offices, as the key element of the decentralization effort;
- planned and conducted numerous training courses, seminars, and observation visits;
- initiated and completed local procurement as stop-gap measures to maintain an adequate flow of key construction commodities;
- delegated authority to the regional offices for project implementation, from preparing annual operational plans and budgets, to designing and building water systems, to supervising their operation and maintenance;
- improved its management information system by instituting standardized monthly progress reporting and inventory control systems; and
- designated a project manager to coordinate activities and act as the official liaison with other agencies and USAID.

Some important recommendations such as the latrine study, improved community participation, health-education integration with IPH, and O&M training for junta members were not carried out. All parties concerned gave insufficient attention to these project components.

For each target community, the regional offices maintained separate files containing a chronological record of each significant project event-- from the first community meeting, through design and construction, to system turnover and supervisory visits. Project status was reported monthly.

5.2 Ministry of Health

The MOH retained control of GOP counterpart funding for the project, and controls selection, hiring, training, and assignment of permanent employees. Through its regional health offices, the MOH gives the regional sanitation teams some administrative and logistic support, usually in the form of part-time assignment of accounting, procurement, and warehousing staff to handle project actions.

The Vice Minister of the MOH was designated as the person responsible for coordinating the water supply and sanitation program with the now-completed IPH. However, very little initiative was taken to coordinate IPH field activities with those of the water supply and sanitation project. Since the project no longer operates, coordination is a moot issue.

The MOH's project-management role is one of oversight and monitoring rather than direct control. The ministry also monitors and evaluates project activities through monthly submissions from its regional health offices.

5.3 USAID

USAID/Peru has primary responsibility for managing, supporting, and monitoring the project in behalf of the USG. Three project managers were assigned to RWSES throughout its life. In addition, the long-term sanitation engineering advisor worked with DISABAR daily for just under three years to address and resolve problems and issues that arose.

Although lapses occurred in project management due to personnel turnover followed by periods of familiarization with project operations, the project managers worked closely with DISABAR/Lima staff to provide guidance and support. They participated in several joint evaluation and planning seminars, and also visited regional offices and project sites periodically to observe field activities at first hand. Through these channels, the USAID project managers were able to help DISABAR meet and address new situations as they occurred. The project's high level of accomplishment reflects the degree of attention that USAID managers paid to the project.

As noted in Section 4.3, the achievements in decentralization/institution building and in the construction of potable water systems were the project's most outstanding accomplishments. USAID project managers deserve substantial

credit for their commitment and attention to these project components. The managers were less successful in motivating MOH and DISABAR to vigorously pursue the project's collateral goals of integration with IPH, latrine promotion and utilization, health education, and sustained community participation in the post-construction phase of water system operation and maintenance. Considerable achievements were attained in training, technical assistance, and special studies, although the lack of a latrine study negatively affected the latrine promotion, installation, and utilization component.

USAID/Peru took corrective actions on the major recommendations of the three main evaluative reports made during project implementation:

- WASH Field Report No. 38, *Recommendations for the Rural Water and Environmental Sanitation Project in Peru*, April 1982.
- GAO report, *A Troubled Project: Rural Water Systems and Environmental Sanitation in Peru*, June 1983
- WASH Field Report No. 134, *Progress Evaluation of the Rural Water Systems and Environmental Sanitation Project—Peru*, March 1985.

These accomplishments resulted:

1. The project successfully obtained GOP support at the presidential level to resolve the problem of salaries too low to attract and retain engineers.

2. MOH and DISABAR demonstrated commitment to decentralizing project operations.

3. A long-term advisor provided direct assistance to DISABAR in addressing issues and resolving project problems.

4. Several short-term advisors, including an HRD advisor and an MIS advisor, provided services to the project.

5.4 Regional Offices and Agencies

The regional health offices provided direct administrative and logistical support to the regional DISABAR offices. As noted in Section 5.2, this support came about through the general oversight functions of the regional health office director and the part-time assignment of several staff to address various project affairs, especially in the areas of procurement and accounting.

As the project progressed, the regional DISABAR office became fully responsible for day-to-day project operations. Except for DISABAR/Lima's control of annual operations plans/budgets and allocation of project funds/commodities (pipes and accessories), the regional DISABAR offices directly managed all project activities: assignment of all regional staff; procurement, allocation, and distribution of local project commodities; supervision of field activities in target communities; and coordination of project-related goods and services. In

target communities; and coordination of project-related goods and services. In addition, the regional DISABAR offices continued to execute non-project-funded national programs—building latrines, rehabilitating water systems, installing community sewerage systems, and executing the IDB-supported water supply and sanitation program for communities of under 2,000. Of the four regional offices visited, DISABAR/Puno has demonstrated the best level of project execution.

During the past two years, some regional DISABAR offices have made temporary arrangements with Departmental Development Corporation (DDC) offices to acquire key construction commodities, such as cement, reinforcing steel, piping, and accessories, to comply with construction commitments made to target communities.

Chapter 6

RECOMMENDATIONS

6.1 Key Recommendation: Future Project

1. USAID should find some way to continue funding the DISABAR rural water supply and sanitation program.

Background. This project's most significant achievement was the successful decentralization of DISABAR's rural water supply and sanitation programs. While decentralizing the USAID-sponsored RWSES project, DISABAR/Lima found that its other national programs could also be managed directly by the newly developed regional offices. As the USAID-funded project came to an end, the 18 regional DISABAR offices were operating at a high level of efficiency and productivity.

In 1980, when the project was being planned, both the USAID Mission and the GOP had reason to believe that Peru's economic situation would improve over the years of project implementation. This optimistic outlook was reflected in the planned phasing-down of USAID disbursements while GOP disbursements were to increase each year.

Had the ensuing years provided Peru with a period of more normal socioeconomic times, the GOP would have been able to sustain and even expand the DISABAR program today.

Since project funding has stopped, most project-related activities have also stopped. As noted in Section 4.3, the hard-won gains in building a decentralized, regionally operated program have already begun to fall apart. Because of the GOP's bleak economic situation, there is little hope of obtaining enough additional budget allocations to keep the regional DISABAR staffs on the payroll and able to operate near their previous levels of productivity. Therefore, unless outside funding can be obtained soon (in three to six months), the whole decentralized regional DISABAR structure will collapse.

Proposed Project. Possibilities for extending RWSES have been researched and found to be exhausted. The normal USAID project-paper process for a new project requires upward of a year. This leaves the USAID/Peru mission with only one likely method of saving the decentralized DISABAR program from collapse: adding a potable water supply and sanitation component to the ongoing Child Survival Action (CSA) project, whose goal is to reduce infant mortality from 88.2/1000 live births to 72/1000 and child (ages 1 to 4) mortality from 14/1000 to 10/1000. The need for child-survival interventions is greatest in rural areas where infant mortality rates are reported to be three times those of urban areas.

As presently designed, the CSA has two major components: expanding child survival services and strengthening decentralized support systems for sustainable child-survival services delivery. CSA includes five major child-survival interventions: diarrheal disease control, nutrition, immunizations,

family planning, and control of acute respiratory infections. All of these services are to be provided at or through the hospitals and health posts of the MOH and *Instituto Peruano de Seguridad Social* (IPSS).

One of the project's fundamental assumptions is that its clients will be able to sustain the health benefits gained from services provided to control diarrheal disease and improve nutrition. In reality, most rural clients have no convenient access to a reliable potable water supply or a safe excreta-disposal facility. Without these basic services and without good personal hygiene practices, these health benefits cannot be sustained.

Another key assumption is that the physical plants (hospitals, health centers, medical posts) through which CSA services are to be provided will present a positive model and an environment that demonstrates desirable health and sanitation conditions and practices. (See Map E, Health Facilities in Regions Visited.)

As part of the field visits made during this evaluation, hospitals, health centers, and medical posts were visited. At the hospital in Juli, the one toilet observed had no water for flushing. Of the five health centers and posts visited, only one had 24-hour water service—supplied by a water system built under the USAID-sponsored RWSES project. In sum, none of the health facilities through which CSA services are to be provided presented a positive health and sanitation model for its clients. Unless these facilities are upgraded to demonstrate acceptable health and sanitation conditions, the health message being delivered through the various CSA services will be lost.

While DISABAR's several rural water supply and sanitation programs do not include communities where hospitals and many health centers are located because of their larger population (over 2,000), it does reach many communities where medical and health posts are located. It therefore makes eminent sense to amend CSA to include a rural water supply and sanitation component that focuses especially on those villages under 2,000 with an existing or planned health/medical post, thus providing model water supply and sanitation facilities to these posts in conjunction with child survival services.

A similar arrangement could be made with SENAPA to upgrade existing water supply and sanitation facilities in the larger health installations, such as hospitals and health centers.

As a backup position, USAID should initiate the PID and project paper process to have a rural water supply and sanitation project ready to be approved and funded or, if funds are not immediately available, as a "shelf" project for possible end-of-year funding.

2. USAID should reopen the dialogue with DISABAR to explore the possibility of involving a private-sector PVO in its RWSES program. Since DISABAR has proven highly effective at accomplishing the "hardware" water systems and latrine sanitation elements of the program, it may be mutually advantageous to delegate the "software" components (health education, community participation, junta and O&M training) to a PVO with a history of successful involvement in these activities.

6.2 Engineering and Physical Infrastructure

1. DISABAR should concentrate future RWSES activities in areas with good security.

Granted that it would go against GOP and USAID policy, future RWSES activities would be more cost effective if they were focused primarily in zones having good security. Rather than attempting to continue full program operations in all 18 regions, it would be more efficient and effective to concentrate field activities in those areas where the movement and presence of program personnel and commodities are not harassed by terrorist actions. All of the present 18 regional offices should remain open and operational; however in regions having security problems, the regional offices should operate at a level consistent with security and reduced staffs. Staff from these regions should be temporarily transferred to regions with good security to step up the tempo of program activities.

6.2.1 Water Supply

1. Water quality tests, especially bacteriological, should be performed at least twice yearly on all water supplies. Samples should be taken from the source and from household faucets. Corrective actions such as protection of spring catchment areas and, as a last resort, chlorination, should be taken where needed.

2. As long as adequate spring-fed water sources can be found within reasonable distances of target communities, DISABAR's RWSES program should continue to focus on installing spring-fed gravity systems.

3. The present practices for surveying, designing, and constructing water systems should be continued despite some areas of over-sophistication.

6.2.2 Latrines

1. The special latrine study to determine villagers excreta-disposal habits and latrine design preferences should be carried out.

2. Based on the results of the study, appropriate alternative latrine designs and models should be made available to villagers.

3. Engineers and sanitation technicians should be trained in proper latrine siting and pit construction.

6.3 Decentralization/Institution Building

1. USAID/Peru should make an all-out effort to obtain new funding for DISABAR's rural water supply and sanitation program in order to save its decentralized organization and allow it to continue carrying out its national mandate.

6.4 Community Participation and Organization

1. USAID/Peru and DISABAR should prepare a scope of work for a community development/health education advisor to assist DISABAR in planning, testing, and implementing a community-based methodology for this project component.

6.5 Integration with the Primary Health Project and Health Education

1. USAID/Peru should meet with pertinent MOH, IPSS, and DISABAR officials to consider developing mechanisms to coordinate DISABAR's rural water supply and sanitation program with the ongoing CSA.

2. Based on the results of these meetings, the MOH, IPSS, DISABAR, and USAID/Peru should identify specific technical assistance needs and plan a technical assistance activity to address them.

6.6 Training

1. DISABAR should give priority to training community junta members in managing the operation and maintenance of water systems.

2. DISABAR should train all professional and technical-level staff in community participation and organization methodologies and practices.

6.7 Technical Assistance

1. USAID/Peru and DISABAR should assess DISABAR's need for continued technical assistance.

2. Based on the results of this assessment, USAID/Peru and DISABAR should prepare a comprehensive technical assistance package designed to respond to the needs identified.

6.8 Special Studies

1. DISABAR should conduct the latrine study to determine villagers excreta-disposal habits and latrine design preferences. Based on these findings, alternative latrine designs and models should be made available to villagers in target communities.

6.9 Role of Women

1. Together with community women and men, DISABAR should develop a plan to actively involve more women in decision making and planning.

Chapter 7

LESSONS LEARNED

1. Under Peru's present economic conditions, programs that build decentralized institutions need to receive continued funding to avoid collapse of those institutions.

2. Unless detailed description of community participation, health education, latrine promotion, and water system O&M programs and methodologies are included in their designs, rural water supply and sanitation projects will not achieve their goals.

3. Unless the executing agency is fully involved in the design process and takes the necessary actions to meet the conditions precedent during the design process, project implementation will experience excessive delays.

4. Water and sanitation projects need staff trained in social science methodology, health education, and community development to prepare the detailed methodologies and program activities necessary for project goals to be achieved in these crucial areas. This observation is borne out by RWSES's tremendous difficulties and long delays in developing and implementing a training plan, and the additional problems associated with community participation in system operation and maintenance and latrine installation and use—attributable in large part to the technical focus of project activities.

PHOTOGRAPHS

Photo 1:

Drainage Problem at Santa Rosa de Pichicho

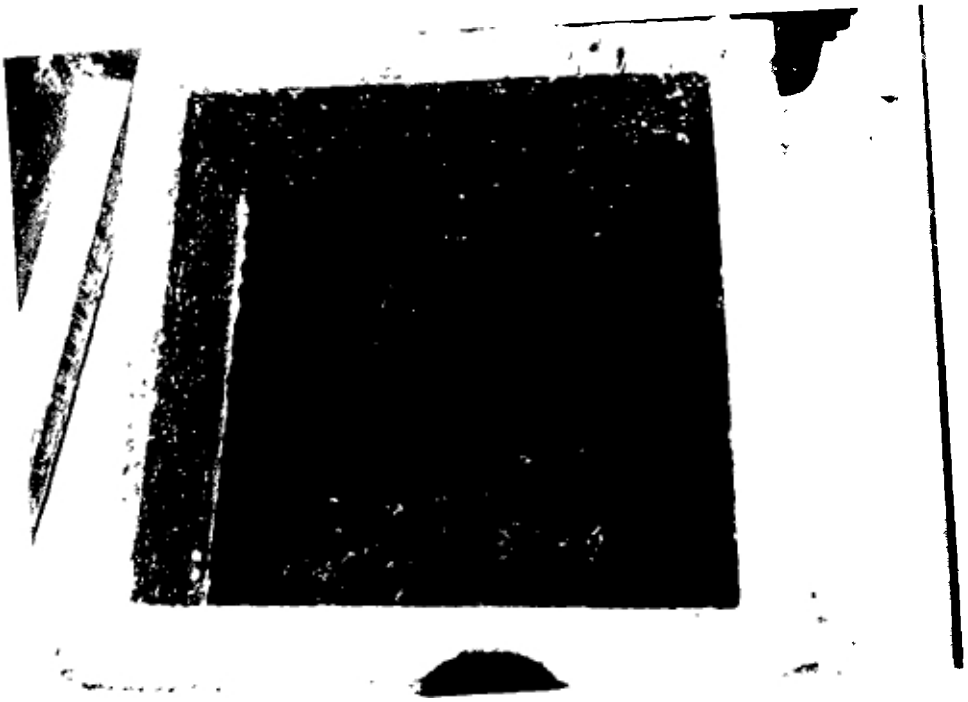


Photo 2:

Clear Water in Reservoir at La Banda

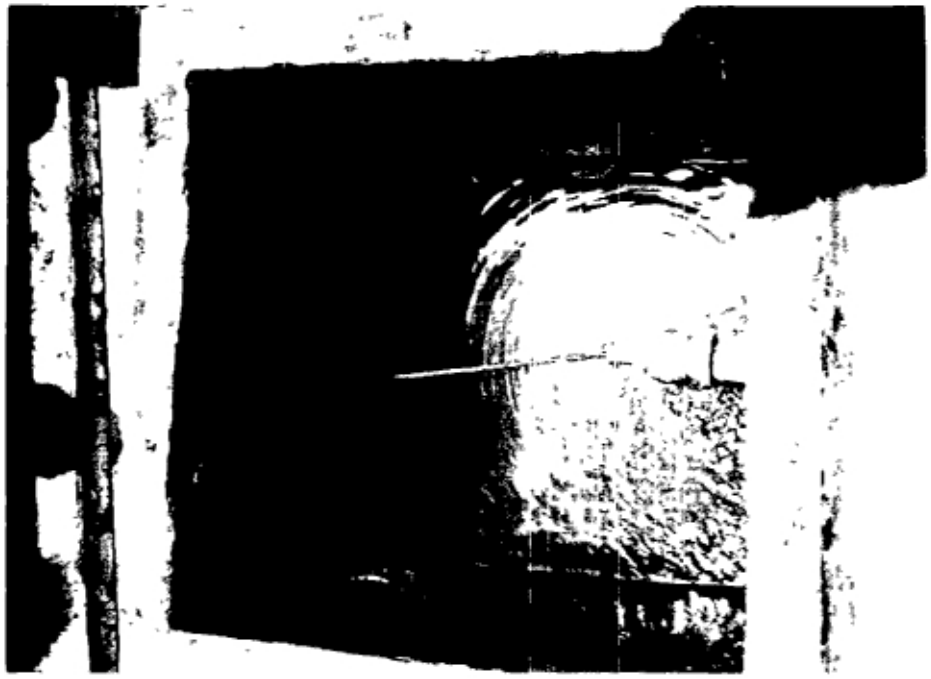


Photo 3

Pressure-reducing valve and box at Bajo Otuzco, Cajamarca

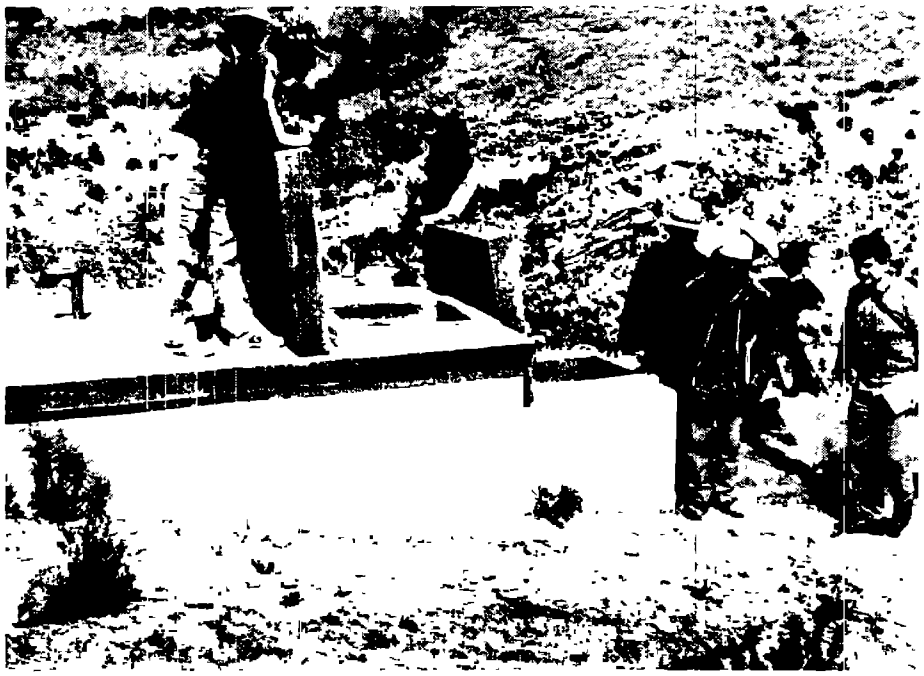


Photo 4: Storage Reservoir at Suancata, Puno

Photo 5: Junta Members with tools purchase by the Junta, Suancata, Puno

Photo 6: Community Meeting with Ecuadorian Team, Suancata, Puno

Photo 7: Junta Treasurer with handtools supplied by the project and office supplies bought by the Junta--La Banda, Cajamarca

Photo 8: Typical latrine superstructure at La Banda, Cajamarca

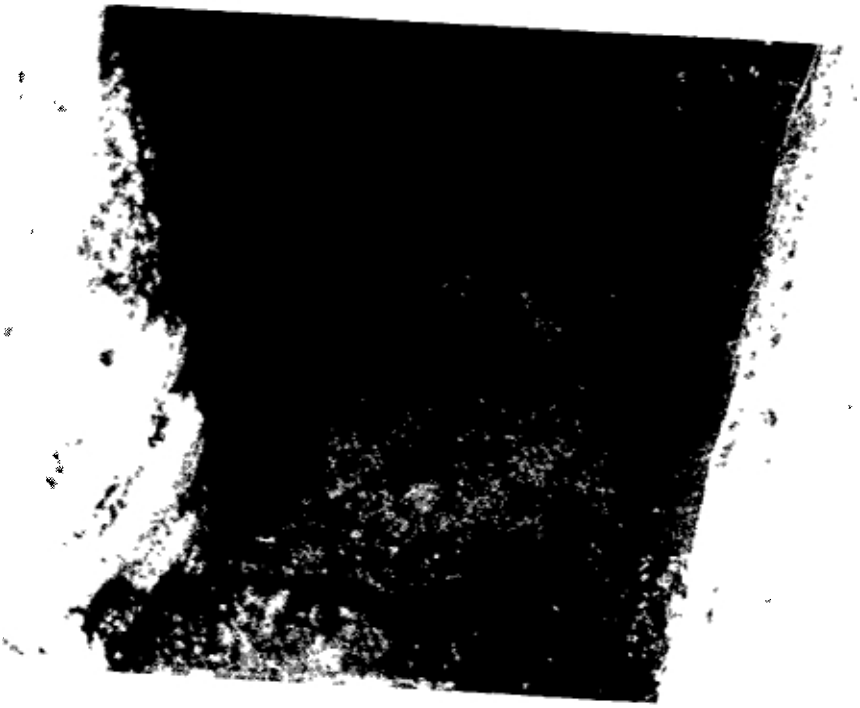


Photo 9:

Typical latrine slab installation at La Banda, Cajamarca

Photo 10:

Regional Office and Staff at Puno

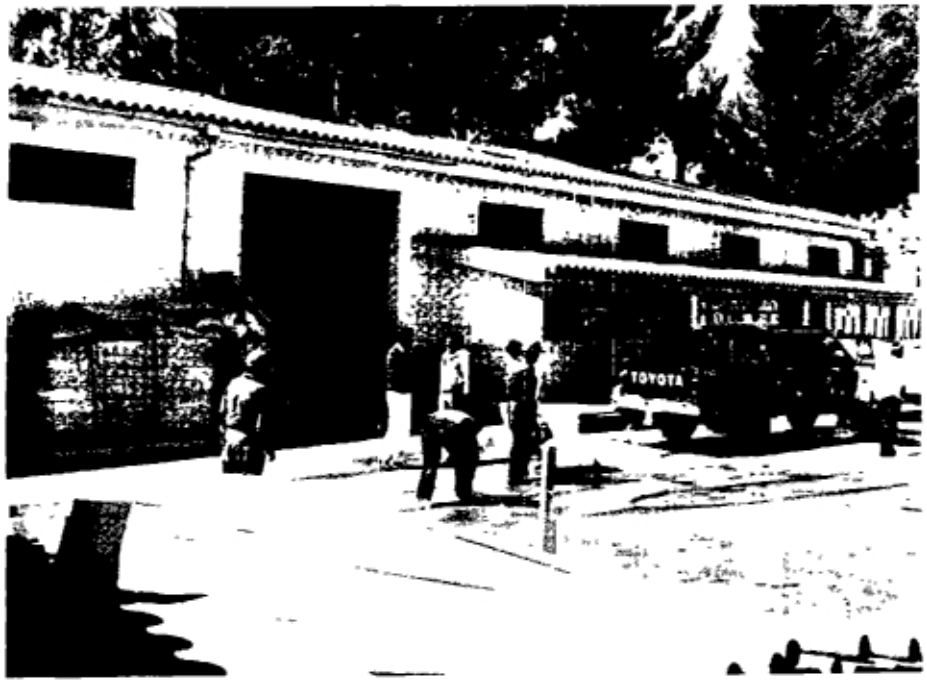


Photo 11:

Warehouse offices and corporation yard at Puno

Photo 12:

Warehouse at Cuzco

Photo 13: Junta Members at Santa Rosa de Pichicho, Puno

Photo 14: Junta Members at Saccacatani, Puno

Photo 15: Junta and Community Members at Tisihua, Puno

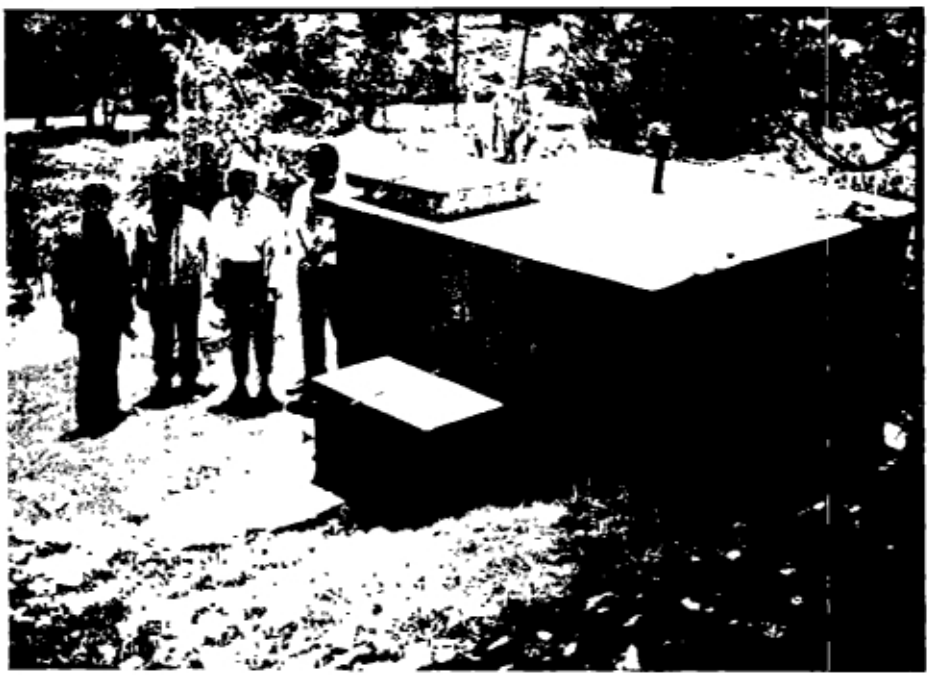


Photo 16:

Storage Reservoir at La Banda, Cajamarca

Photo 17:

Reservoir Supply and Drain Piping—La Banda, Cajamarca

Photo 18: Prototype treatment plant using local filter media at Huambocancha Baja, Cajamarca

APPENDIX A

Charts and Maps

Charts

1. Typical Regional Staffing
2. Data and Rating of Water Systems Visited
3. Status of the Rural Water Systems and Environmental Sanitation (RWSES) Project
4. Regional Infrastructures and Major Commodities
5. Total Annual DISABAR Disbursements
6. Disbursements for Construction in the Four Regions Visited
7. DISABAR Personnel
8. DISABAR Organigram
9. Basic Rural Sanitation and Physical Infrastructure Executive Office: Structural Organization Chart

Maps

1. Piura
2. Puno
3. Cusco
4. Cajamarca
5. Existing Hospitals in Regions Visited

Chart 1

Typical Regional Staffing

1 **Sanitation Engineer (head of team)**

1 **Sanitation Engineer for Studies and Designs**

1 **Topography Specialist**

1 **Engineering Draftsmen**

5 **Sanitation Technicians**

2 **Secretaries**

3 **Chauffeurs**

2 **Skilled Laborers**

2 **Unskilled laborers**

1 **Storekeeper**

1 **Accounting of Administrative Auxiliary**

2 **Watch people**

Chart 2

Data and Rating of Water Systems Visited

	REGIONAL OFFICE & POPULATION	CONSTRUCTION DATE START	CONSTRUCTION DATE FINISH	PROJECT TYPE	WATER SOURCE	INTAKE TYPE	INTAKE FLOW (lps)	STORAGE TANK CAP	HOUSE CONNECTIONS NUMBER	HOUSE CONNECTIONS FLOW (lps)	LATRINES UTILIZED	WATER QUALITY RATING	OPERATION & MAINTENANCE RATING
	PIURA Visit: Oct.19												
1	Cerritos 455	82-88	84-88	Expansion	Well	Strg.Tk	----	80 m3	82	----	38 %	----	Fair
2	Alto Hechatos 487	86-86	87-87	Expansion	Well	Strg.Tk	----	30 m3.	72	0.39	58 %	Poor	Bad
	PUNO Visit: Oct.23 & 24												
3	Suancata 375	88-88	89-88	New	Spring	2 x C2	0.30	5 m3.	78	0 17 *	98 %	Good	Fair
4	Santa Rosa Pichicho 852	82-86	87-86	New	Spring	1 x C1	0.23	6 m3	158	0.32	90 %	Good	Good
5	Saccamatani 530	82-86	87-86	New	Spring	1 x C1	1.29	5 m3.	110	0.17	70 %	Fair	Good
6	Challapampa 500	11-84	85-85	New	Spring	1 x C1	N/M	6 m3	89	0.17	58 %	Fair	Fair
7	Tisihua 520	84-89	87-89	New	Spring	1 x C2A	N/M	5 m3	85	0.28 *	90 %	Good	Good
	COSCO Visit: Oct.25 & 26												
8	Chocco 312	87-89	89-89	New	Spring	1 x C1	0.36	8 m3	50	0.16 *	70 %	Fair	Good
9	Cuper Bajo 290	85-88	89-88	New	Spring	1 x C1	N/M	5 m3.	64	0 06	90 %	Fair	Good
10	Querapata 288	82-85	87-85	New	Spring	1 x C1	N/M	3 m3.	44	N/M	70 %	Bad	Fair
11	Ccorimarca 220	09-87	87-88	New	Spring	1 x C1	0.76	2.5 m3.	35	0 11 *	70 %	Fair	Fair
	CAJAMARCA Visit: Oct.29 & 30												
12	Ventanillas Otuzco 294	02-87	06-87	New	Spring	1 x C4	N/M	5 m3	38	0 38	70 %	Bad	Good
13	Bajo Otuzco 685	04 87	88-87	New	Spring	1 x C4	N/M	5 m3	93	N/M	90 %	Fair	Fair
14	La Banda 360	10-88	03-89	New	Spring	2 x C2	0 48	5 m3	41	0 35	90 %	Good	Good
15	Huambocancha Baja 396	10-84	02-85	Rehabilit	Surface	Tm Plant	N/M	20 m3.	120	N/M	70 %	Poor	Bad

NOTES

(1) * Discharge flow measured (liters per second) with next adjacent tap open

(2) N/M Not measured

(3) C1 Spring box, large size
C2 Spring box, medium size
C2A Spring box, small size
C4 Spring box and reservoir

(4) The percentage of latrines utilized is referred to the number of household connections installed

(5) The system of Huambocancha Baja was been rehabilitated in 1987 Originally, it was a spring fed gravity system and actually is a surface fed with water treatment plant system

(6) Visited systems are functioning 24 hours per day, except the ones of Piura which are functioning only from 2 to 4 hours per day

Chart 3

Status of the Rural Water Systems and Environmental Sanitation (RWSES) Project as of June 1989

DEPARTMENT	REGIONAL OFFICE	SYSTEMS COMPLETED 1982	1983	1984	1985	1986	1987	1988	1989	TOTAL	UNDER CONSTRUCTION	DESIGNS COMPLETED	LATRINES INSTALLED	POPULATION SERVED
ANCASH	Huaraz	1	5	8	10	13	13	9	3	62	8	12	1,746	22,835
	Huari		1	4	1	10	3	2	1	21	6	11	490	8,977
	Chimbote		1		5	5	8	6	3	32	3	3	1,148	10,143
APURIMAC	Abancay						6	6	2	14	3	5	564	6,315
AREQUIPA	Arequipa					3	11	12	1	27	8	1	913	12,044
AYACUCHO	Ayacucho			1	8	8	13	12	3	45	2	6	961	13,720
	Puquio			1	7	5	3	6	1	23	7	3	607	10,203
CAJAMARCA	Cajamarca		8	13	8	14	14	15	3	74	4	6	2,321	25,496
	Chota		2	1	8	4	7	10	2	35	5	6	1,452	14,572
	Jaen				1	4	12	17	2	36	8	9	1,780	12,700
CUZCO	Cuzco			11	25	17	12	17	3	85	16	9	988	34,533
HUANCAVELICA	Huancavelica				1	1	12	7	1	22	14	2	1,361	12,354
ICA	Ica				4	5	9	6	6	30	7	13	612	10,617
JUNIN	Huancayo		2	16	22	18	25	10	4	89	4	7	3,099	34,424
	Tarma	4		9	16	19	7	18	5	78	20	0	2,378	28,975
LA LIBERTAD	Trujillo			3	13	11	9	5		41	5	6	870	12,224
	Huamachuco			7	2	5	13	7		34	5	5	691	12,300
LAMBAYEQUE	Chiclayo					4	6	13	2	25	2	4	790	7,806
PIURA	Piura			1	13	19	19	9	2	63	16	18	2,497	27,899
PUNO	Puno			6	25	23	14	35	2	105	5	7	3,707	48,431
TOTALES		5	17	81	171	181	217	224	45	941	139	138	30,975	367,068

NOTES

(1) Reference : Progress Report - DISABAR - 06/30/89
(2) Systems under construction are equivalent to 97 systems completed
(3) Designs completed systems are expected to initiate construction in 1990

Chart 4

Regional Infrastructures and Major Commodities

DEPARTMENT	REGIONAL OFFICE	OFFICES(O) AND WAREHOUSES(W) OPERATING	SINCE	OBSERVATIONS	VEHICLES JEEP WAGONER (1983)	ADDIO VISUAL (1984)	PICKUP 3 T N. (1983)	PICKUP 1 5 T.N (1985)	PICKUP 4 X 4 (1987)	TOTAL	WATER TESTING EQUIPMENT HACH	MILLIPORE
ANCASH	Huaraz	O + W	1982		---	---	1	1	1	3	2	2
	Huari	---		Operating from Huaraz	---	---	---	---	(1)	---	(1)	(1)
	Chimbote	W	1983	O. Operating in Hospital	---	---	---	1	1	2	2	2
APURIMAC	Abancay	O + W	1988		---	---	---	---	2	2	3	3
AREQUIPA	Arequipa	O + W	1985		---	---	---	1	1	2	3	3
AYACUCHO	Ayacucho	O	1986	W Under construction	---	---	---	1	1	2	2	2
	Puquio	---		Operating in Hospital	---	---	---	1	1	2	1	1
CAJAMARCA	Cajamarca	O + W	1982		---	---	1	---	1	2	3	3
	Chota	---		Operating in Hospital	---	---	---	1	1	2	1	1
	Jaen	O	1987	W Rented space	---	---	---	---	2	2	1	1
CUSCO	Cusco	O + W	1987		---	---	1	1	1	3	(4)	4
HUANCAVELICA	Huancavelica	---		Rented space	---	---	---	1	1	2	2	2
ICA	Ica	O + W	1985		---	---	1	---	1	2	2	2
JUNIN	Huancayo	O + W	1984		---	---	1	---	1	2	2	2
	Tarma	O + W	1985		---	---	---	1	1	2	2	2
LA LIBERTAD	Trujillo	O + W	1984		---	---	1	1	1	3	3	3
	Huamachuco	---		O/W: Under construction Operating from Trujillo	---	---	---	---	(1)	---	(2)	(2)
LAMBAYEQUE	Chiclayo	O + W	1985		---	---	---	1	1	2	2	2
PIURA	Piura	O + W	1985		---	---	---	1	1	2	3	3
PUNO	Puno	O + W	1985		---	---	1	1	1	3	2	2
LIMA	Lima	---			2	1	---	---	3	6 + (2)	8	9
TOTALES					2	1	7	13	25	48	51	51

NOTES:

(1) Vehicles and equipment indicated with parenthesis, remain in Lima
(2) Regional offices have surveying and drafting equipment.

Chart 5

Total Annual DISABAR Disbursements

(in dollars)

	FUNDING SOURCE		
YEAR	NATIONAL	INTERNATIONAL	TOTAL
1981	1,327,000	110,000	1,437,000
1982	1,720,000	312,000	2,032,000
1983	1,471,000	992,000	2,463,000
1984	1,644,000	1,419,000	3,063,000
1985	1,087,000	815,000	1,902 000
1986	4,314,000	1,494,000	5,808,000
1987	5,734,000	2,173,000	7 907 000
1988	3,279,000	458,000	3,737,000
1989 (2)	650,000	130,000	780,000
TOTAL	21,226,000	7,903,000	29,129,000

NOTES :

(1) Includes all DISABAR national and international funded programs
(2) Funds disbursed as of 10/30/89.

Chart 6

Disbursements for Construction in the Four Regions Visited

(in U.S Dollars)*

REGIONAL OFFICE		1987	1988	1989 **
PIURA				
	GOP	35,160	19,200	2,180
	AID LOAN	24,690	10,440	8,290
	AID GRANT	880	730	
		60,930	30,370	10,470
PUNO				
	GOP	56,130	24,680	3,730
	AID LOAN	32,360	23,400	9,170
	AID GRANT	3,460	50	
		91,950	48,130	12,900
CUSCO				
	GOP	52,100	22,700	2,070
	AID LOAN	20,150	13,370	8,660
	AID GRANT	6,160	135	
		78,410	36,205	10,930
CAJAMARCA				
	GOP	25,810	18,620	1,810
	AID LOAN	24,760	9,180	3,470
	AID GRANT	820	190	620
		51,390	27,970	5,900

* Reference : DISABAR'S records in Intis, converted with the following average rates of exchange :

1987 : US $ 1.00 = 31 Intis
1988 : US $ 1.00 = 297 Intis
1989 : US $ 1.00 = 1,930 Intis

** Disbursements through 6/30/89

Chart 7

DISABAR Personnel

1982 - 1989

CATEGORIAS	1982	1987	1989
	Nivel Central		
INGENIEROS	32	24	23
OTROS PROFESIONALES	7	10	10
TECNICOS EN INGENIERIA	20	12	12
OTROS TECNICOS	76	50	45
AUXILIARES	22	36	36
	157	132	126
	Nivel Regional		
INGENIEROS	18	43	40
OTROS PROFESIONALES	-	4	4
TECNICOS EN INGENIERIA	23	59	55
OTROS TECNICOS	18	60	50
AUXILIARES	11	139	61
	70	305	210
TOTAL :	227	437	336

Chart 8

DISABAR Organigram

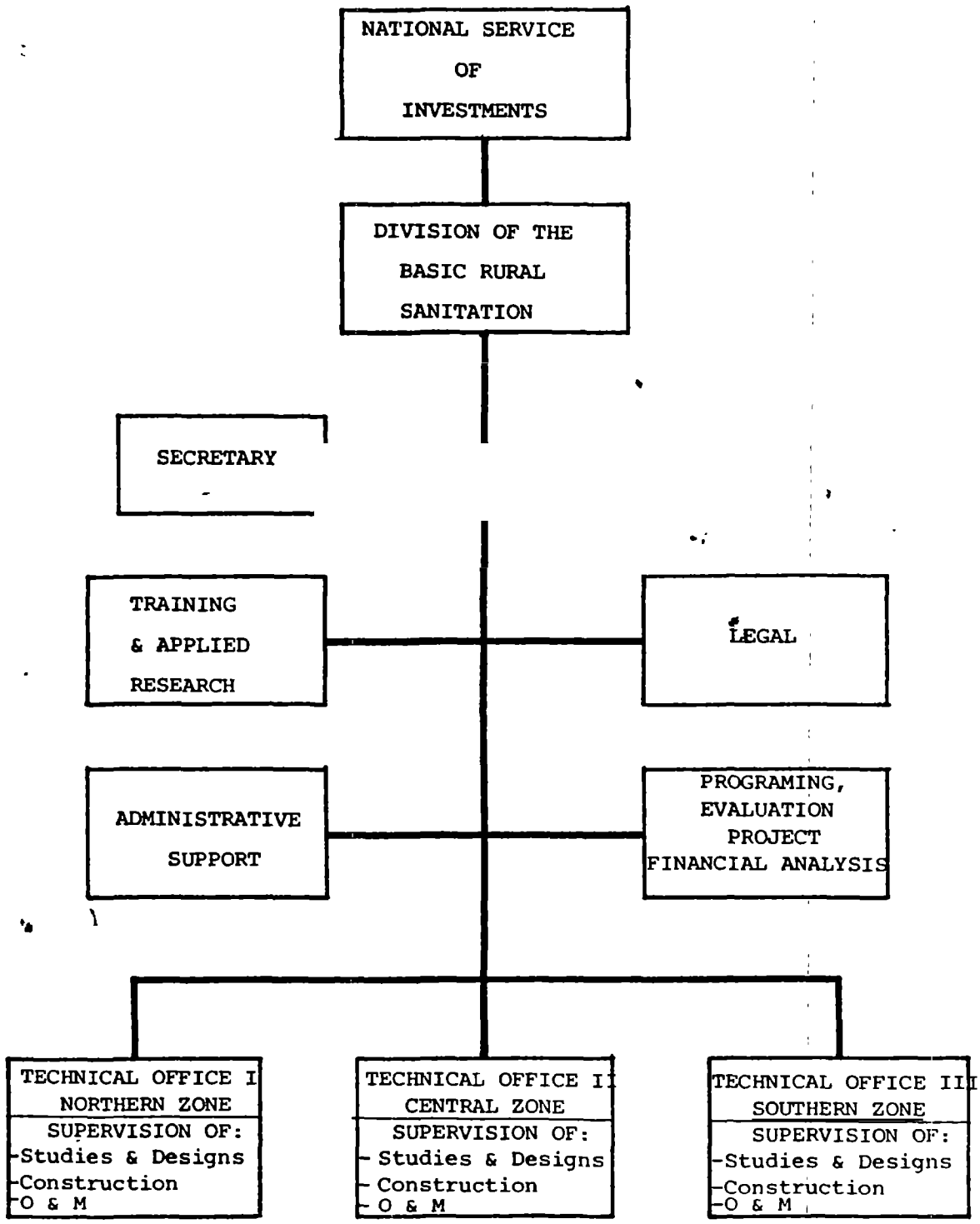
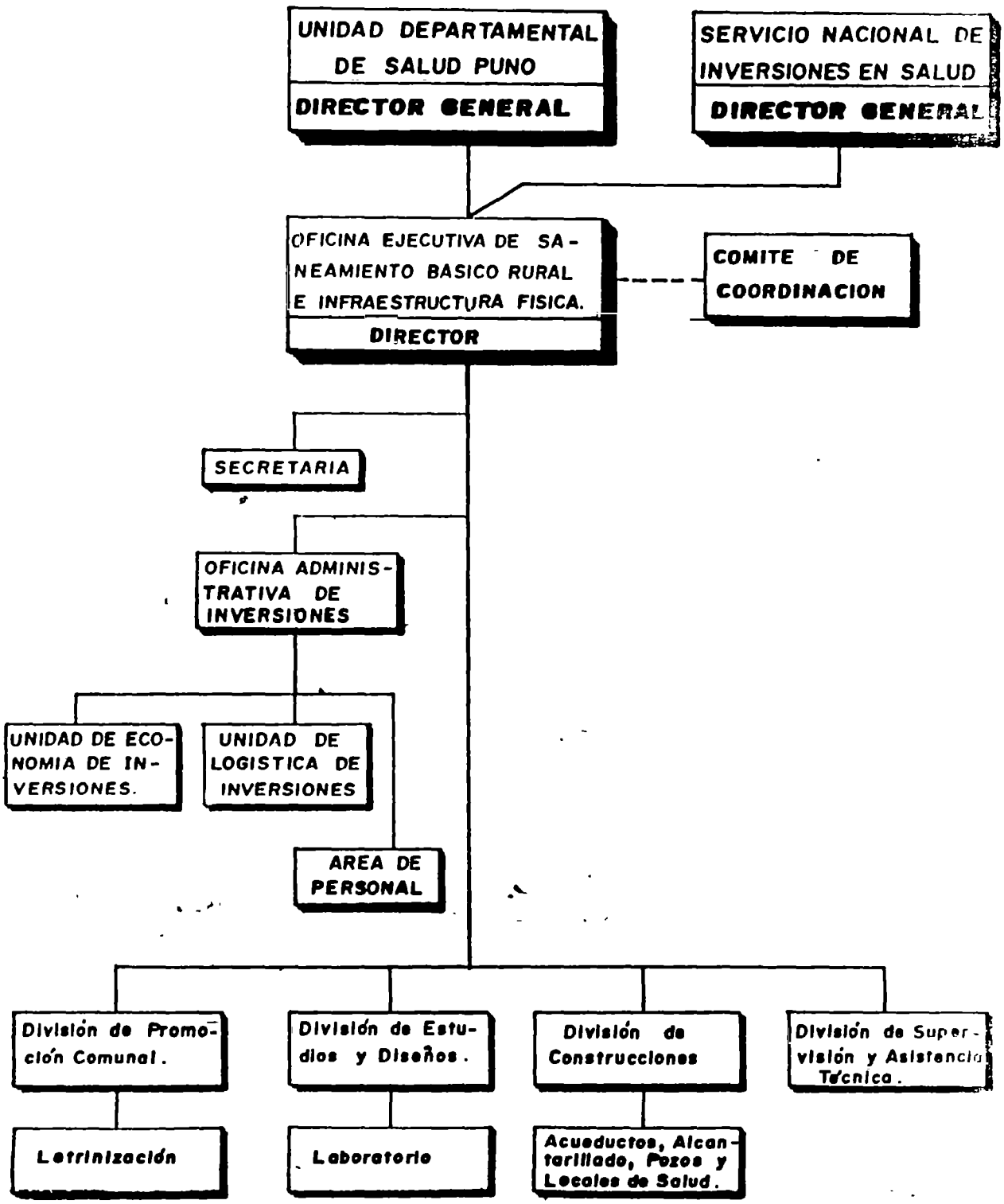


Chart 9

Basic Rural Sanitation and Physical Infrastructure Executive Office:

Structural Organization Chart



OBRAS TERMINADAS A.I.D.

PIURA

MAP 1

SETIEMBRE 1,989

* SYSTEMS VISITED

MORROPON

1 Maray
2 Lajas
3 San Francisco
4 La Victoria
5 La Pilca
6 Sabila
7 Chungayo
8 Simirís
9 La Maravilla
10 Piedra Herrada
11 Solumbre
12 San Jacinto
13 Rio Seco Alto
14 Caraveli
15 Loma de Yamango
16 Palo Colorado
17 Rinconada
18 Coca
19 Piscan Alto - Bajo
20 Culebreros
21 Dotor

HUANCABAMBA

1 La Capilla
2 El Higueron
3 Tunal
4 Mayland
5 Papayo
6 Santa Rosa
7 Loma Larga Baja
8 Puente de Piedra
9 Maray
10 La Laguna
11 Loma de Agua Azul
El Tambo
. Sapse
14 Los Ranchos
15 Vilma
16 . San Martin de la Pacchа
17 . Pampa de Cilia
18 Cuchupampa
19 San Isidro
Cedro
Papayal Bajo
Guayabo
Cashacoto
Sapalache
. Ingano Grande
Rodeopampa
. Loma de Huarmaca
Trigal
. San Francisco Con - choque
Ñangali
. Succha
Maray Chico
Nuevo Hualapampa
San Cristobal
Huabal
. Loma Larga Alta
. Paccha Alta

PIURA

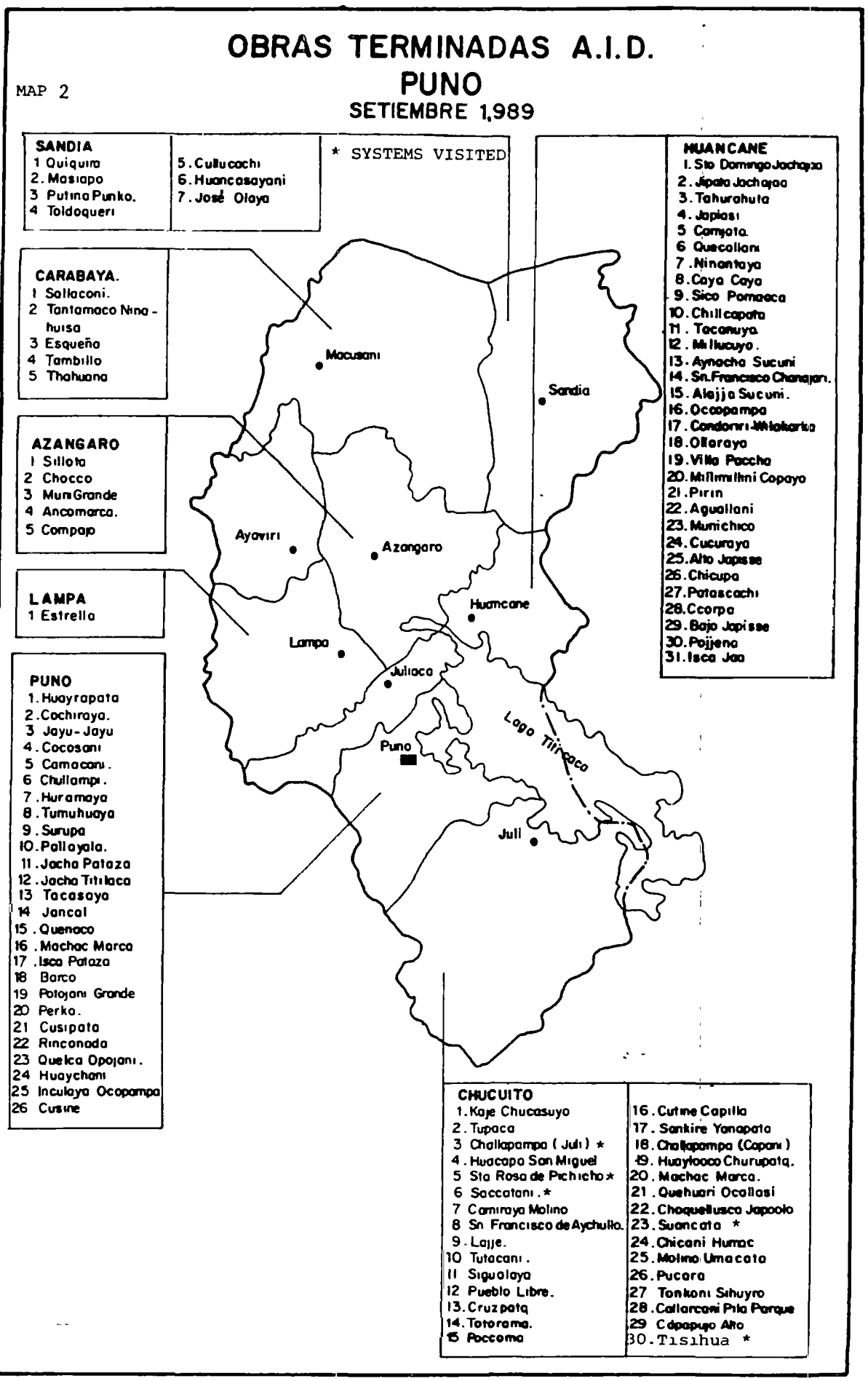
1 Alto de los Mechatos *
2 Cerrios *

OBRAS TERMINADAS A.I.D.

PUNO

SETIEMBRE 1,989

MAP 2



SANDIA
1 Quiquira
2. Masiapo
3 Putina Punko.
4 Toldoqueri
5. Cullucachi
6. Huancasayani
7. José Olaya

CARABAYA.
1 Sallaconi.
2 Tantamaco Nina-huisa
3 Esqueña
4 Tambillo
5 Thahuana

AZANGARO
1 Sillota
2 Chocco
3 Muni Grande
4 Ancomarca.
5 Compajo

LAMPA
1 Estrella

PUNO
1. Huayrapata
2. Cochiraya.
3 Jayu-Jayu
4. Cocosani
5 Camacani.
6 Chullampi.
7. Huramaya
8. Tumuhuaya
9. Surupa
10. Pallayala.
11. Jacha Pataza
12. Jacha Titilaca
13 Tacasaya
14 Jancal
15. Quenaco
16. Machac Marca
17. Isco Pataza
18 Barco
19 Potojani Grande
20 Perka.
21 Cusipata
22 Rinconada
23 Quelca Opojani.
24 Huaychani
25 Inculaya Ocopampa
26 Cusine

HUANCANE
1. Sto Domingo Jachaja
2. Japata Jachaja
3. Tahurahuta
4. Japiasi
5 Comata.
6 Quecollani
7. Ninantaya
8. Caya Caya
9. Sico Pomaeca
10. Chillcapata
11. Tacanuya.
12. Milucuyo.
13. Aynacha Sucuni
14. Sn. Francisco Chanajani.
15. Alajja Sucuni.
16. Ocopampa
17. Condorni-Wiakarita
18. Olleraya
19. Villa Paccha
20. Millmillini Copaya
21. Pirin
22. Aguallani
23. Munichico
24. Cucuraya
25. Alto Japisse
26. Chicupa
27. Patascachi
28. Ccorpa
29. Bajo Japisse
30. Pojjena
31. Isca Jaa

CHUCUITO
1. Kaje Chucasuyo
2. Tupaca
3 Challapampa (Juli) *
4. Huacapa San Miguel
5 Sta Rosa de Pichicho *
6 Saccatani. *
7 Camiraya Molino
8 Sn Francisco de Aychullo.
9. Lajje.
10 Tutacani.
11 Sigualaya
12 Pueblo Libre.
13. Cruzpata
14. Totorama.
15 Paccoma
16. Cutine Capilla
17. Sankire Yanapata
18. Challapampa (Capani)
19. Huaylooco Churupata.
20. Machac Marca.
21. Quehuari Ocallasi
22. Choquellusca Japoolo
23. Suancata *
24. Chicani Humac
25. Molino Umacata
26. Pucara
27 Tonkoni Sihuyro
28. Callarcani Pila Parque
29 Cdapapujo Alto
30. Tisihua *

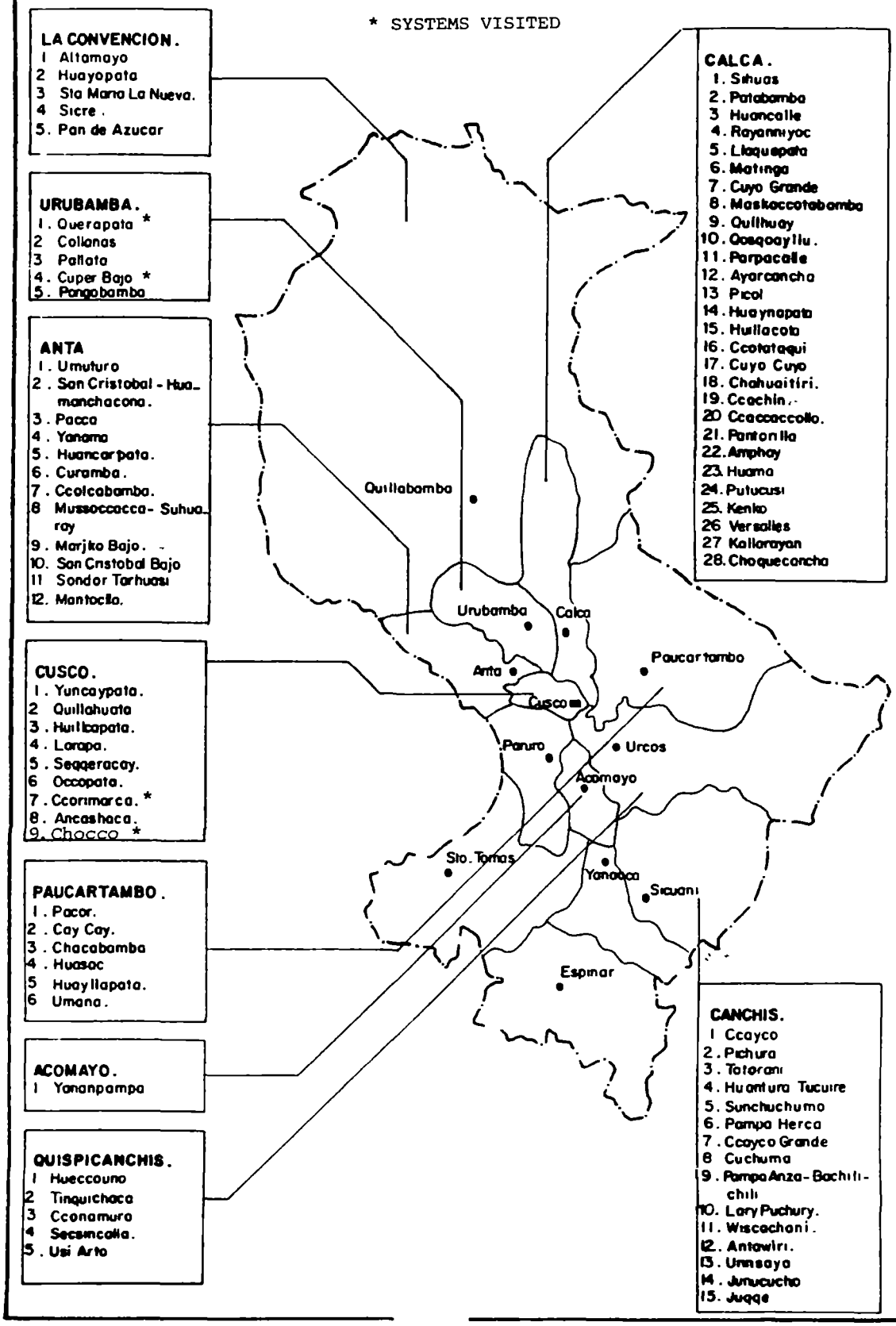
OBRAS TERMINADAS A.I.D

CUSCO

MAP 3

Setiembre 1,989

* SYSTEMS VISITED



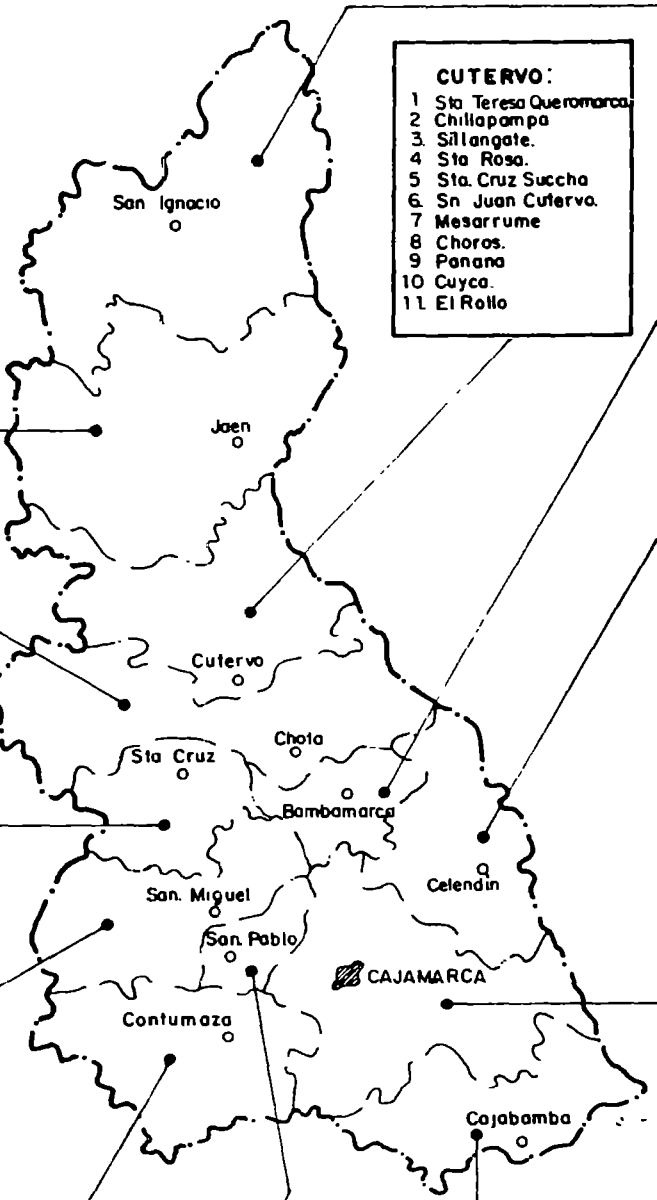
MAP 4

OBRAS TERMINADAS AID

CAJAMARCA

SET. 1989

* SYSTEMS VISITED



JAEN
1 Rumibamba
2 Chambamontera
3 Granadillas
4 Tabacal
5 La Palma Central
6 Puente Techin
7 Las Delicias
8 San Francisco
9 Yanayacu
10 Chunchuca
11 Curioco
12 Los Cedros
13 La Virginia
14 El Diamante
15 Pachapiriana
16 Vista Alegre

CHOTA:
1 Conga Chalomarca.
2 Ajipampa.
3 Limoncarro
4 Colpatuapampa
5 El Verde
6 Retama.
7 Llanduma
8 La Pucara
9 Chigulrip
10 Choropampa.
11 Pacobamba
12 Chucmar
13 Callacpoma
14 Quiden
15 Huascarcocha.
16 Maychil
17 Pion_Sta Rosa

SANTA CRUZ:
1 Chancay Baños.
2 Saucepampa
3 Andabamba
4 Pulan.

SAN MIGUEL:
1 Curahuasi
2 Sn Jose Nanchoc.
3 Pampacuyo.
4 Jangala
5 Tongo.
6 Sn Antonio de Ojos
7 Lomaspampa
8 Rodeopampa
9 La Selva
10 Catilluc
11 El Prado
12 Chuad
13 Sn Mateo de Quilcate

CONTUMAZA:
1 Sta Catalina_ Barrio Pampa
2 Portada de Jaguey
3 Ayambla
4 Santa Ana
5 Catan
6 Totorillas.
7 Santiago
8 Tambo Molino.
9 Cholot Alto.
10 Pampa Larga.

SAN PABLO:
1 Cerro Blanco
2 Sta Rosa Unanca

CAJABAMBA:
1 Farrat
2 Higospampa
3 Tamberia.
4 San Francisco

SAN IGNACIO
1 Portachuela.
2 Rumipite Bajo
3 Vergel
4 La Lima
5 Mandinga
6 Los Naranjos
7 El Pindo
8 Pacaypite
9 Cañas Bravas
10 La Nueva Esperanza

CUTERVO:
1 Sta Teresa Queromarca
2 Chillapampa
3 Sillangate.
4 Sta Rosa.
5 Sta. Cruz Succha
6 Sn Juan Cutervo.
7 Mesarrume
8 Choros.
9 Panana
10 Cuyca.
11 El Rollo

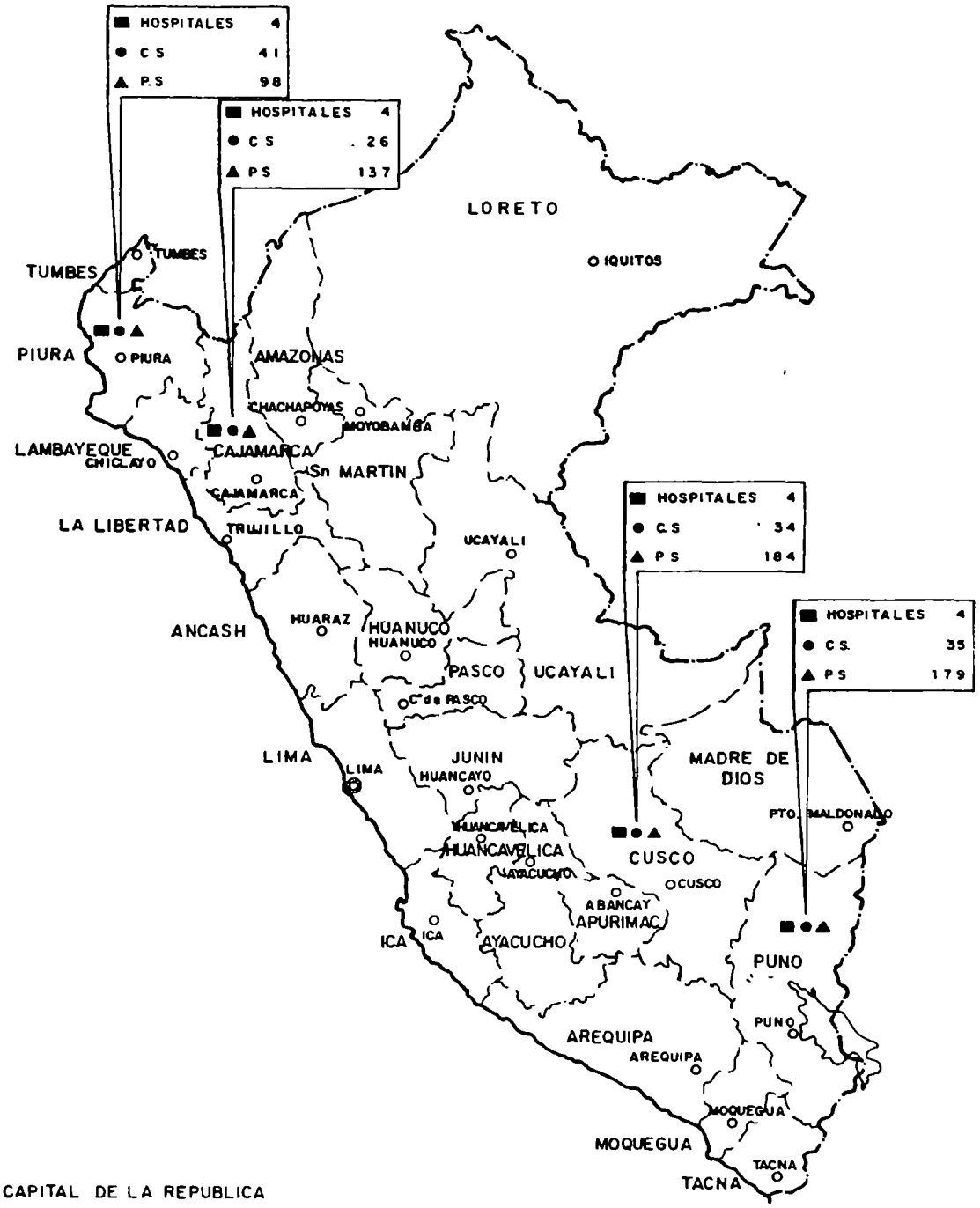
BAMBAMARCA:
1 El Porvenir
2 Alto Perú
3 Maygasbamba
4 Lucmacucho
5 El Porvenir II
6 Monterredondo
7 Lucmacucho 2
8 Lucmacucho 1
9 Sn. Antonio Bajo.

CELENDIN:
1 La Victoria
2 Galacat
3 Calcanga
4 Sn JUAN TINCAT
5 Quihuilla

CAJAMARCA:
1 Puylucana
2 Nahuaypampa
3 Sogoron Bajo.
4 Manzanilla
5 Choropampa
6 Tambomayo
7 Cebadin
8 Amillos.
9 Cumbico
10 Huambocancha Baja*
11 Chonta Alto
12 Chinchipata
13 Rancho Grande_ La Florida.
14 Agospampa Alto
15 Hualqui
16 Yanacancha Baja
17 Cerrillo
18 Rinconada de Otuzco
19 Sn Miguel Matarita
20 Bajo Otuzco. *
21 Ventanilla Otuzco.*
22 Quimapata
23 Pueblo Nuevo
24 Sunchubamba
25 Yurocpirca.
26 Chilacat
27 Pampas de Capan
28 La Granada
29 Manzanamayo_ Alto Miraflores
30 Sapuc
31 Capilla Unanca
32 Montecillo
33 Granja Porcon.
34 Alto Otuzco
35 Quinrayquero Bajo.
36 Campo Alegre
37 Colpan
38 Huayobamba
39 La Laguna
40 El Azufre
41 Shitamalca
42 La Banda *

INFRAESTRUCTURA HOSPITALARIA EXISTENTE
MISION EVALUACION A.I.D.

MAP 5 IN REGIONS VISITED



APPENDIX B

Persons Contacted

APPENDIX B

Persons Contacted

LIMA

Ministry of Health (MOH)

Dr. Alberto Huarachi, Director, Maternal-Child Office
Ms. Pilar Sifuentes de Silva, Maternal-Child Office
Dr. Eduardo Zapata, Maternal-Child Office

Division of Rural Basic Sanitation (DISABAR)

Eng. Nestor Esquivel, Director
Eng. Luis Valencia, Project Coordinator
Dr. Carmen Vargas, Chief, Training and Research Office

USAID

Ms. Barbara Kennedy, Chief, Human Resources Office
Mr. Charles Mantione, Chief, Health Division
Mr. Edward Scholl, Health Projects Coordinator
Mr. Gerardo Arabe, Health Projects Coordinator
Ms. Rita Fairbanks, Health Projects Coordinator

PIURA

Departmental Unit of Health (UDES)

Dr. Oscar Alvarez, Regional Director
Dr. Rodolfo Soto, Child-Survival Project Coordinator

DISABAR

Eng. Luis Quispe, Regional Director
Eng. Ramón Medina, Regional Office
Eng. Augusto Correa, Regional Office
Ms. Marilyn Catano, Promotor
Ms. Soledad Peña, Accounting

PUNO

Departmental Unit of Health (UDES)

Dr. Ismael Cornejo Rosello, Regional Director
Dr. Percy Miranda, Deputy Regional Director
Dr. Eduardo Chavez, Director, Ilave Hospital
Ms. Maximina Velásquez, Health Post of Challapampa
Mr. Adolfo Cervantes, Health Post of Challapampa

ISABAR

Eng. Edgar Zecenarro, Regional Director
Mr. Humberto Nina, Promotor

CUZCO

Departmental Unit of Health (UDES)

Dr. César Nisiama, Regional Director
Dr. Leoncio Susuki, Child-Survival Project Coordinator
Ms. Inocencia Loayza, Director, Health Post of Anta-Ischucha

DISABAR

Eng. Jesús Calatayud, Regional Director
Eng. Nazario Arias, Regional Office
Mr. Eduardo Chávez, Sanitation Technician
Mr. Rubén Goncora, Sanitation Technician
Mr. Jesés Villafuerte, Promotor
Mr. Federico Astete, Promotor

CAJAMARCA

Departmental Unit of Health (UDES)

Dr. Jorge Moreno, Regional Director
Ms. Mariella Rodríguez, Health Post of Llacanora
Ms. Dolores Marroquín, Health Post of Huambocancha

DISABAR

Eng. Hugo Tirado, Regional Director
Mr. Víctor Vásquez, Sanitation Technician
Mr. Manuel Llerena, Sanitation Technician

APPENDIX C

Communities Visited

APPENDIX C

Communities Visited

Department of Piura

Cerritos
Alto de los Mechatos

Department of Puno

Suancata
Santa Rosa de Pichicho
Saccacatani
Challapampa
Tisihua

Department of Cuzco

Chocco
Cuper Bajo
Querapata
Ccorimarca

Department of Cajamarca

Ventanillas de Otuzco
Bajo Otuzco
La Banda
Huambocancha Baja

APPENDIX D

DISABAR Training Activities 1981-89

APPENDIX D

DISABAR Training Activities 1981-89

Course	Mo./Yr.	Level/Number Place	Participants
Rural Water Systems	10/81	Paraguay	I-3
Instruction in Basic Sanitation	07/83	Panama	I-1
Training for Sanitation Technicians and Health Auxiliaries in Rural Water Supply Management, Operations & Maintenance	10/83 32 days	Lima	II-226
Training for New Engineers	09/83	Lima	I-8
Training for Sanitation Technicians	10/83	Chimbote and Ica	II-50
Information Seminar on International Potable Water Decade	12/83	Colombia	I-1
Training for Construction Supervisors and System Operators	04/84	Cajamarca	III-30
Training for New Engineers	07/84	Lima	I-10
Training for Construction Supervisors and System Operators	08/84	Cajamarca	III-30
Third-Country Training	10/84	USA & Guatemala	I-7
Training for New Engineers	07/86	Lima	I-15
Training for Engineers on Wastewater Treatment and Water Quality Control	08/86	Piura	I-2

Course for Engineers on Use of Nonconventional Technologies	09/86	Lima	I-10
Seminar for Engineers on Pressure Reduction and Air Relief Valves	10/86	Lima	I-15
Symposium on Potable Water Supply and Environmental Sanitation as a Primary Attention Health Care Strategy	11/86	Guatemala	I-8
Refresher Course for Southern Zone Technicians	12/86	Arequipa	II-37
Refresher Course for Northern Zone Technicians	01/87	La Libertad (Trujillo)	II-41
Training for Engineers on Treatment Plant Design	03/87	Lima	I-18
Training for Civil Construction Workers (Cajamarca and Chota) on Rural Potable Water System Construction Techniques	04/87	Cajamarca	III-25
Training for Civil Construction Workers (La Libertad) on Rural Potable Water System Construction Techniques	04/87	La Libertad	III-25
Training for Civil Construction Workers (Cuzco) on Rural Potable Water System Construction Techniques	04/87	Cuzco	III-21
Training for Civil Construction Workers (Apurimac) on Rural Potable Water System Construction Techniques	04/87	Apurimac	III-15

Refresher Course for Southern Zone Technicians on Use of Portable Millipore Equipment for Bacteriological Water Analysis	05/87	Ica	II-36
Refresher Course for Central Zone Technicians on Use of Portable Millipore Equipment for Bacteriological Water Analysis	06/87	Huaraz	II-42
Course for Southern Zone Engineers, Technicians & Promoters on Community Promotion	07/87	Cuzco	I & II-29
Course for Engineers on Water Treatment Plant Design	08/87	Lima	I-25
Course for Northern Zone Technicians on Use of Portable Millipore Equipment	10/87	La Libertad (Trujillo)	II-36
Course for Southern Zone Technicians on Use of Portable Millipore Equipment	11/87	Puno	II-52
Subregional Andean Meeting on Evaluation of the Actual Situation of Operation, Maintenance, and Rehabilitation of Potable Water Installations and Sanitation	03/88	Bolivia	I-6
Course on Working with the Community	06/88	Piura	I & II-52
Course on Use of Portable Equipment for Physio-Chemical Water Analysis	06/88	Lima	I-26

International Seminar on the Impact of Urban Development on Underground Water	02/89	Lima	I-3
Course on Working with the Community	03/89	Chimbote	I & II-32
Course on Operation and Maintenance of Rural Aqueducts	04/89	Cajamarca	I-31
Course on Accounting and Public Administration	05/89	Chimbote	II-60

Total Courses	Total Participants
35	708

Legend:

- Level I - Engineers, Chemists, Biologists, Administrators
- Level II - Sanitation Technicians & Sanitation Auxiliaries
- Level III - Construction Foremen
- Level IV - Administrative Juntas, Caretakers/Operators, and Water Users

APPENDIX E

Reference Documents

APPENDIX E

Reference Documents

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AID, Project Paper Amendment, Rural Water Systems and Environmental Sanitation, 527-0221, 1982

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DISABAR, Informe de progreso al 30.06.89, Lima, Peru, Junio 1989

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" " " Amendment No. 2, June 1982
" " " Amendment No. 3, September 1982
" " " Amendment No. 4, April 1985

WASH, Socio-Cultural and Economic Characteristics of Conditions in Anchash and La Libertad, Peru, WASH Field Report No. 1, 1980

WASH, Report on the Peru Water Systems and Environmental Sanitation Project, WASH Field Report No. 6, 1981

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WASH, Water and Sanitation-Related Health Constraints on Women's Contribution to the Economic Development of Communities, WASH Technical Report No. 11, 1982

WASH, Linking Water & Sanitation Programs to Child Survival, October 1989

WASH, Expanding the Role of Community Participation in Water Supply and Sanitation Projects, 1988

Wellin, E., Village Water Systems in Selected Coastal and Highland Areas of Peru, 1982

APPENDIX F

Indicative Benefit Cost Ratio

APPENDIX F

Indicative Benefit Cost Ratio

A. Present value of water consumption during 20-year design life of project systems, assuming a 10% discount rate.

- Per capita consumption = 80 liters/day
- Annual consumption = 80 x 365 = 29,200 liters/cap/year
  = $29.2m^3$/cap/year
- Annual consumption per water system = $29.2m^3$/cap/year x 350 cap = $10,220m^3$/year
- Total consumption per year (for 986 project systems = $10,220m^3$/year x 986 systems
  = $10,057,200m^3$/year
- Value of water = US $0.10/$m^3$ (based on tariff rates (January-September 1989) for Lima households
- Assumptions: Water consumption remains constant.
  Value of water remains constant.

From present value tables (20 years at 10%)

- Present value of water consumption during next 20 years (at 10% discount rate). $10,057,200m^3$ x 8,5136 x $0.10[1] = U.S. $8,562,298

B. Present value of labor saved during design life

- Average minimum wage (September-November 1989) = U.S. $42.50/month
- Hourly minimum wage = U.S. $42.50/176 hours/month = US $0.24/hour. Assume
  = US$.12/hour (factored at .5 to allow for underemployment)
- Average labor saved per household = 1 hour/day x 365 days/year = 365 hours/year
- Average labor saved per year = 1 hour/day (estimated)
- Average labor saved per water system per year = 365 hours/yr x 60 households/system = 21,900 hours/year

---

1. From present value tables (20 years at 10%)

- Total labor saved per year = 21,900 hours/yr x 986 systems = 21,593,400 hours

- Value of labor saved per year = 21,593,400 hours x US $0.12/hour = US $2,591,208

- Assumption: Minimum wage remains constant

- Present value of labor saved during next 20 years (at 10% discount rate) = US $2,591,208 x 8.5136 = $22,060,508

C. Present Value of Total Benefits

Present value of water consumption	US $ 8,562,298
Present value of labor saved	22,060,509
Total Benefits	US $30,622,806

D. Capital Cost of Project

Loan	US$ 7,160,852
Grant	739,532
GOP	2,754,295
Total Cost	US$ 10,654,679

E. Present Value of O&M costs
(21.50/system/month)(2 months)(986 systems) = $384,540 per year

Present Value of O&M = ($384,540) (8.5136) = $3,273,820 over 20 years at 10% discount ratio

F. Benefit-Cost Ratio (over 20 years at 10% discount rate)

$$\frac{\text{Present Value of Benefits}}{\text{Capital Costs + Present Value of O\&M}}$$

$$\frac{\$30,622,806}{\$10,654,679 + \$3,273,820} = 2.2$$


WASH