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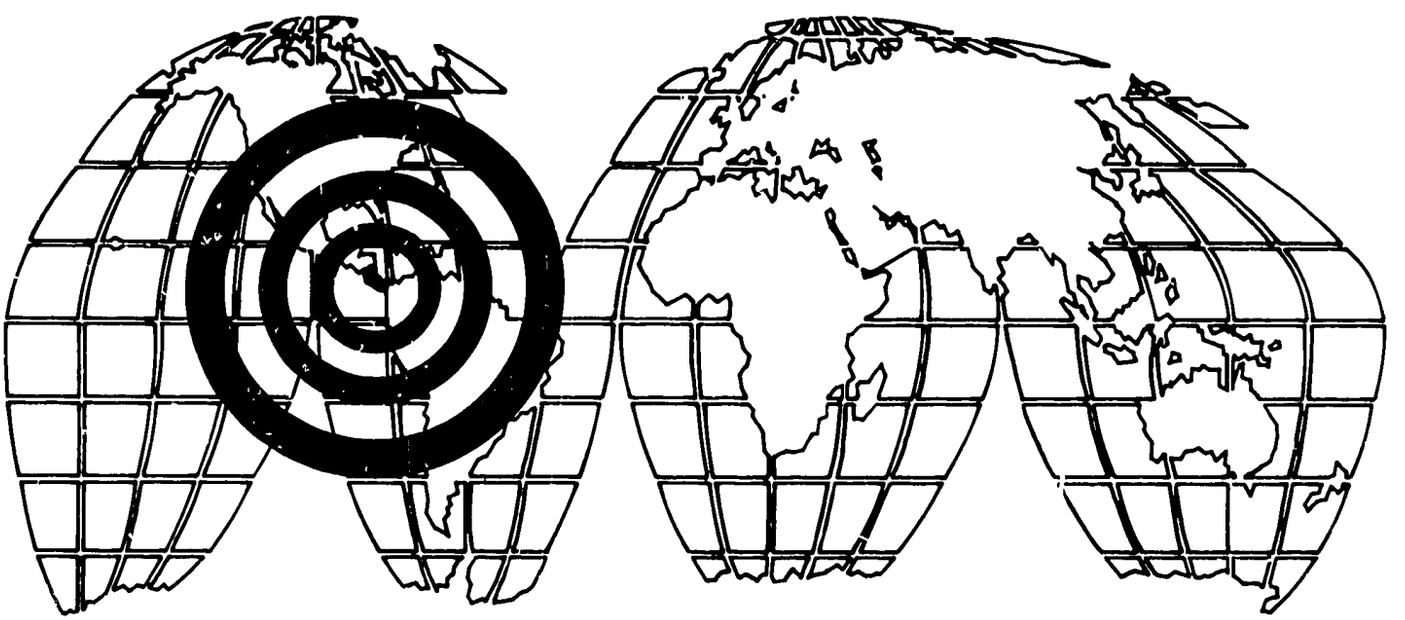
A.I.D. Project Impact Evaluation Report No. 32

Panama: Rural Water



May 1982

U.S. Agency for International Development (AID)

PN-AAJ-609

PANAMA: RURAL WATER

PROJECT IMPACT EVALUATION NO. 32

by

Robert Meehan, Team Leader
(Bureau for Science and Technology)

Anamaria Viveros-Long, Sociologist
(Bureau for Program and Policy Coordination)

With the assistance of

Jose Manuel Hernandez, Political Scientist

Sonia de Heckadon, Anthropologist

U.S. Agency for International Development

May 1982

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FOREWORD

In October 1979, the Administrator of the Agency for International Development initiated an Agency-wide ex-post evaluation system focusing on the impact of AID-funded projects. These impact evaluations are concentrated in particular substantive areas as determined by A.I.D.'s most senior executives. The evaluations are to be performed largely by Agency personnel and result in a series of studies which, by virtue of their comparability in scope, will ensure cumulative findings o_ use to the Agency and the larger development community. This study of the impact of A.I.D. Panama: Rural Water was conducted in August 1980 as part of this effort. A final evaluation report will summarize and analyze the results of all the studies in this sector, and relate them to program, policy and design requirements.

SUMMARY

In 1968, the government of Panama initiated a new development strategy designed to improve conditions in rural areas of the country. In the area of public health, the strategy called for coordinated efforts in health, nutrition and environmental sanitation, including the provision of piped water systems to villages with 250 to 500 residents. Piped water systems had previously been available only to larger communities. The new strategy recognized that public water service could be practical in small communities if villagers accepted responsibility for operation and maintenance.

In 1972 and 1976, the Agency for International Development (AID) approved rural health loans to the government of Panama. Of the $13.3 million provided under these loans, almost $6 million was allocated for improving environmental health, primarily through the construction of piped water systems. Many systems were originally operated by diesel or gasoline pumps, but were converted to gravity systems as fuel costs escalated. By 1980, about half were gravity systems. The installation of piped water systems was carefully planned to enlist the participation of community residents and their commitment to maintain the systems.

By 1980, original expectations concerning project outputs had been exceeded and 562 piped water systems were completed. The AID evaluation team visited 26 randomly selected communities with piped water systems, all of which had been in operation during 1980. Sixteen of the systems had good records of operation, with effective management, adequate maintenance and regular collection of fees. The other ten systems in the random sample were experiencing problems. Communities with strong local organizations had a good prospect of resolving their technical and/or economic problems in the near future. A viable solution did not seem as likely, however, in villages where motivation and leadership was lacking.

After an initial shakedown period, the reliability of water systems seemed to be high. All communities visited had trained personnel who could operate and maintain the equipment and handle simple repairs.

Monthly charges for piped water ranged from twenty-five cents per household in gravity systems to as much as three dollars per household in diesel operated systems. Collection problems were most prevalent in systems operated by diesel or electricity. Several villages had converted to gravity systems.

Access to piped water systems was almost universal in all villages visited. Some families were without taps because they did not participate in the construction of the systems, their houses were located at too high an altitude and could not be served by a system that depended on gravity, or they had moved into the village after the system was constructed and lacked resources to extend the pipes to their houses. In a few communities, new residents did not gain access to the water supply because rapid population growth had already overtaxed the system.

In most villages, residents reported using the water for drinking, cooking, bathing, washing dishes and clothes, and for household cleaning. The water was reported to be clear, sweet and odorless. Most households had good access to the piped water system from a tap in the house or next to it. By bringing water closer to rural households, the new water systems made life easier for women.

The experience of building, operating and maintaining a piped water system enabled communities to take initiatives and resolve their own problems. The process of implementation thus encouraged self-reliance. Effective local leadership was important to the successful operation of piped water systems.

ACKNOWLEDGEMENTS

We wish to acknowledge the cooperation and support provided by the USAID Mission Director and members of his staff, Herbert Caudill and Pedro Martiz. Their preparatory work allowed us a headstart that was invaluable to the evaluation.

Appreciation is also extended to Antonio Sucre's staff in the Department of Environmental Health for their enthusiastic assistance. They facilitated the development of a field itinerary that allowed us to visit many sites in a relatively short period of time. Special thanks go to Elizabeth Halpen Polo who provided cheerful support for every step of the evaluation.

To the many Panamanians who shared their insights and experiences, we are especially grateful. We hope our efforts will serve a useful purpose on their behalf.

PROJECT DATA SHEET

1. Country: Panama

2. Project Titles: Rural Community Health and Nutrition Rural Health Delivery System

3. Project Numbers: 5250170 (Loan 525-V-040)
   5250181 (Loan 525-L-045)

4. Project Implementation: FY 1972 - FY 1976 (Loan 040)
   FY 1976 - FY 1981 (Loan 045)

5. Project Completion - Final Disbursement:
   FY 1976 (Loan 040)
   FY 1981 (Loan 045)

6. Project Funding:

		Total Project	Environmental Component
Loan 040:	AID	$3.8 million	$1.7 million
	Panama	$5.3 million	$3.6 million
	UNICEF	$ .4 million	0
Loan 045:	AID	$9.5 million	$4.2 million
	Panama	$8.7 million	$3.9 million
		$27.7 million	$13.5 million

Loan Terms: 40 years repayment from the date of the first disbursement, including 10 year grace period. Interest rate of 2 percent per annum for 10 years after the first disbursement and at a rate of 3 percent per annum thereafter.

7. Mode of Implementation: Project agreements between AID and the government of Panama. The Ministry of Health was responsible for project implementation. The environmental component was implemented by the Department of Environmental Health.

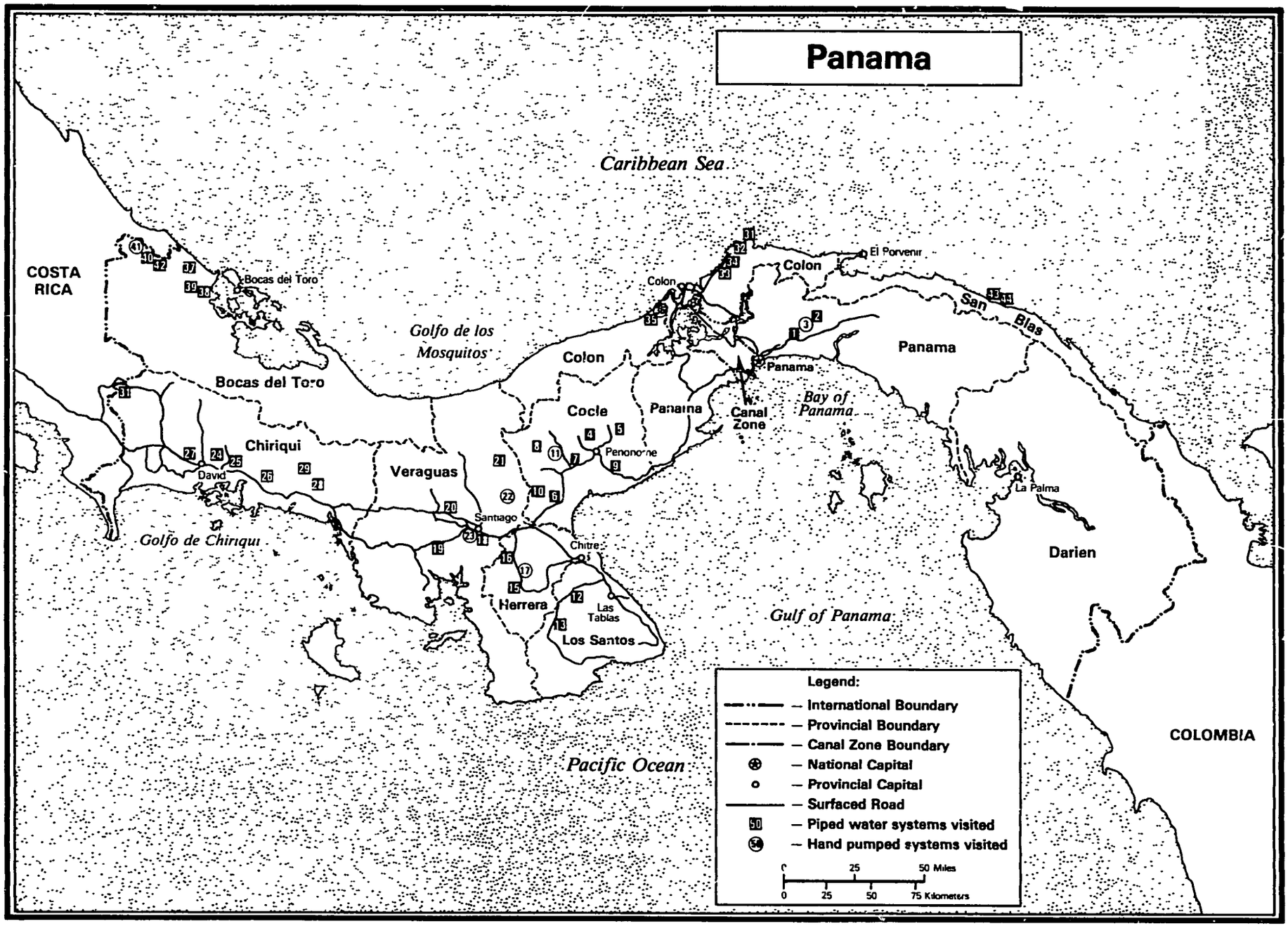
8. Evaluations:
   PES No. 79-5 September 1978
   Audit Report No. 1-525-79-11 April 1979

9. Responsible Mission Officials During Life of Project:

Mission Directors:	Alexander Firfer Irving G. Tragan Adelmo Ruiz
Project Manager:	Herbert Caudill
Finance Officer:	C. Schoux

GLOSSARY

AID	Agency for International Development
DEH	Department of Environmental Health
FAR	Fixed Amount Reimbursement - method of disbursement of AID project funds
IDAAN	National Water and Sewerage Institute
MOH	Ministry of Health


Panama
Caribbean Sea
COSTA RICA
Bocas del Toro
Golfo de los Mosquitos
Colon
El Porvenir
Panama
San Blas
Bay of Panama
Canal Zone
Cocle
Penonome
Chiriqui
David
Veraguas
Santiago
Golfo de Chiriqui
Chitre
Herrera
Las Tablas
Los Santos
La Palma
Darien
Gulf of Panama
Pacific Ocean
COLOMBIA
Legend:
— International Boundary
— Provincial Boundary
— Canal Zone Boundary
— National Capital
— Provincial Capital
— Surfaced Road
— Piped water systems visited
— Hand pumped systems visited
0 25 50 Miles
0 25 50 75 Kilometers

I. INTRODUCTION

In 1968, the government of Panama committed itself to improve conditions in the rural areas. The new development strategy called for agrarian reform as well as improvements in roads, schools and health. With the goal of attaining "health for all by the year 2000," the Ministry of Health became responsible for expanding health services, increasing nutritional levels and improving sanitation facilities. Included in its public health efforts were plans to construct wells with handpumps and piped water systems with individual connections in small villages throughout the country.

In 1972, the Agency for International Development (AID) approved a loan for $3.8 million in support of this program. In 1976, an additional loan of $9.5 million was authorized. Forty-four percent of these loan funds were allocated for improving environmental health, primarily through the construction of water systems in rural villages. An AID evaluation team visited Panama in August 1980 to assess the impact of these water systems.

II. BACKGROUND

In 1968, when the government of Panama initiated new strategies to aid the rural population of the country, differences between rural and urban dwellers were pronounced. Almost all urban dwellers had access to a safe water supply, but only one-third of the rural population had this service. Infant mortality in rural areas was nearly 70 percent higher and mortality rates for children aged one through four were about 180 percent higher in rural areas than in urban areas. Low agricultural production and high rural unemployment were encouraging substantial rural to urban migration.

The public health strategy called for the Ministry of Health (MOH) to expand preventive and curative health services, to increase nutritional levels and to improve sanitation facilities. The MOH also assumed responsibility for providing piped water systems to villages of 500 or fewer inhabitants. Previously, IDAAN, The National Water and Sewerage Institute, had built and operated piped water systems only for larger communities and MOH had constructed wells with handpumps for smaller communities. The new strategy recognized that piped water systems could be practical in small communities if villagers accepted responsibility for operation and maintenance.

MOH programs were developed with very strong self-help components. Community Health Committees were established by law, providing villagers with the right to participate in the planning and execution of MOH services.

The country was divided into 505 administrative units, each of which elected a representative to the National People's Congress. The Congress provided a direct link between the central government and local areas. Small communities, for example, could request new or improved services through their representative.

Starting in 1970, the Department of Environmental Health (DEH), within MOH, undertook the construction of piped water systems with individual connections in villages of 500 or fewer inhabitants. With the assistance of the World Health Organization and CARE, 132 piped water systems were built in small communities between 1970 and 1972. During this initial period, DEH trained staff, developed a standardized system design and acquired substantial managerial experience. The DEH was ready to undertake an expanded effort.

III. PROJECT DESCRIPTION

In 1972 and 1976, AID approved rural health loans to the government of Panama. The environmental component of the loans was directed toward the construction of piped water systems, hand pumped wells and simple latrines. The loans were also intended to increase nutritional levels through the establishment of community gardens and to strengthen and expand public health services through the construction of new facilities and the training of additional health personnel. Through coordinated efforts in health, nutrition and environmental sanitation, the government of Panama hoped to prevent diarrhea, reduce the incidence of water-borne diseases and improve the health of the rural population. The government also hoped that improvements in the quality of rural life would reduce rural to urban migration.

AID assistance totalled $13.3 million under both loans. Of this, $5.9 million was allocated to the environmental health component, primarily for piped water systems in small communities. The Department of Environmental Health (DEH) in Panama's Ministry of Health (MOH) planned to construct 500 piped water systems in villages of 250 to 500 people and 1,300 wells with handpumps in smaller villages. These rural water supply systems were designed to provide safe water for domestic use. They were not intended to serve factories, farms, hotels or other commercial establishments, or to be used for irrigation.

Both AID loans financed equipment and materials. In addition, the 1976 agreement allocated funds for the training of 20 rural sanitarians to facilitate implementation at the community level. The 1976 loan originally included funds for the construction of 13,000 latrines. In April 1979, the AID Auditor General found problems in maintaining adequate supervision of latrine construction and ensuring that design specifications were met. As a result, latrine construction was terminated after approximately 900 latrines had been built.

Approximately 80 percent of the loan funds were allocated for piped water systems. In most cases, water was obtained from a spring or drilled well and did not require chemical treatment. Systems were designed to serve twice the community population at the time of construction, with consumption estimated to be 30 gallons per person per day.

Most piped water systems were originally designed to obtain water from a well, using pumps operated by gasoline, diesel or electricity.

Pumps and storage tanks were large enough to provide a day's supply of water with only six to eight hours of pumping. They were protected by a shed. The first loan called for prefabricated steel storage tanks, but tanks were later constructed of blocks and concrete. The distribution network consisted of plastic pipe, most of which could be purchased in Panama.

As a result of the escalating cost of fuel, about half of the systems were later converted to gravity systems. They were similar in design, except that they tapped a spring as the source of water. The spring was capped with a concrete box with pressure release valves in areas where springs were highly pressurized. Plastic pipe connected springs as far as 20 kilometers away with the community's storage tank.

AID reviewed plans, provided technical assistance, checked the adequacy of designs to differing conditions, and supervised compliance with the required conditions for reimbursement. Using the fixed amount reimbursement (FAR) method, AID made a pre-agreed payment for each water system when construction was completed and an AID inspection certified that it had been completed according to specifications.

The Department of Environmental Health developed cost estimates and technical specifications for the water systems (Appendix B). Program planning, development of standard designs and the purchase of materials and equipment were handled by the headquarters office in Panama City. Provincial offices implemented construction, but monthly progress was recorded at headquarters for each province. This permitted regular assessment of trends and problems.

Communities could request a public water system through their elected representatives, but DEH also approached communities directly. In order to participate in the water program, villagers had to organize Community Health Committees. Through these committees, community members assisted with the building of the water system. Contributions usually included labor, local materials, and cash. Villagers also committed themselves to operate and maintain the system when it was completed.

After the Community Health Committee was formed, the Department of Environmental Health determined the technical feasibility of building a system with an adequate source of water. The rural sanitarian worked in the community to collect data for the feasibility study, resolve right of way problems, draft initial designs, supervise construction, and provide training to community members in the operation and maintenance of the system whenever local leadership or community commitment faltered.

AID funds financed 40 to 50 percent of the cost of each piped water system. In most communities, the government of Panama contributed 30 to 40 percent of the initial cost and recipient communities paid approximately 20 percent. (See Appendix B, Table B-10.) To obtain the necessary $3,500 to $5,000, including $25 to $50 per household for the purchase of cement, plastic pipe, gasoline and other materials, communities usually

held one or two fiestas. Such fund raising activities are a tradition in many parts of Panama. The balance of the contribution represented the value of village labor and the community's provision of room and board for the DEH work crew during construction.

The AID project manager visited community sites before construction to determine whether the proposed system met project eligibility and design criteria, and during the construction phase to examine progress. When the public water system was completed, the project manager returned to the community to certify that the water system met the standards for reimbursement and that the quality of the water was satisfactory. This last visit often coincided with a public ceremony in which the Ministry of Health vested title of the water system to the community. After this ceremony, the community was responsible for operation and maintenance of the system and the Ministry of Health retained only supervisory functions. (See Appendix C for regulations for managing rural water supply systems.)

IV. PROJECT EFFECTIVENESS AND IMPACT

To assess the effectiveness and impact of rural public water service, evaluation team members visited 26 randomly selected communities with piped water systems. The team examined the reliability of the water systems, their usage, and their effects on beneficiaries. Although it was not possible to isolate changes caused by the new water systems from other potential influences, the team attempted to assess the perceived impacts of the water service on recipient communities. The evaluation methodology is discussed in detail in Appendix A.

A. Rural Public Water Service

In August 1980, 562 piped water systems were completed (Appendix E). Another 83 were scheduled for completion early in 1981. Original plans called for the construction of 500 water systems with AID loan funds. This goal was exceeded because construction costs were less than expected, as DEH increasingly installed gravity systems rather than more expensive diesel operated systems. The team estimated that the 645 systems, when completed, would provide water service to about 200,000 people.

Nearly half of the piped water systems constructed were gravity systems. Others had electric or diesel pumps and a few still used gasoline.

Funds from the two AID loans were also used to install 1,600 wells with handpumps. Although the team's evaluation focused primarily on the impact of piped water systems, some observations on handpumps are presented in section VI.

In visits to a randomly selected sample of 26 communities (13 gravity systems, 6 diesel systems, 6 electric systems, and 1 gasoline system), the team found that all of the systems had been in operation during 1980. Sixteen of the systems had good records of operation and appeared to have good prospects for maintaining such a record. Villagers in these sites

were able to manage the water service quite effectively. Fees were collected, and the systems were adequately maintained. Two gravity systems had problems of insufficient spring flow during the dry season, but this problem had been successfully resolved by finding another spring source.

The other ten systems in the random sample were experiencing serious problems, but most were capable of resolving them within a year. Major problems were bursting pipes (three systems), insufficient water flow during the dry season (four systems), and lack of funds to buy diesel fuel (three systems). In addition, two of the sites had a water supply system that was insufficient for all villagers in the community because population growth had exceeded system design.

In the past eight years, technical problems experienced by nearly all of these systems were successfully resolved by the villagers with the assistance of the DEH. For example, the villagers were able to collect enough funds, either from the villagers or the political representative, to cap a new spring that would supply water year-round, or to buy a new pump to satisfy increasing demand for water. Increased demand resulted from population growth or from increased water usage when toilets or showers were installed.

Two thirds of the systems built in 1979/80 had or were experiencing technical problems. These systems were still in the initial shakedown period. In an effort to satisfy the increasing demand for piped water, DEH had devised systems that required greater technical expertise than was available at that time. One of the new options, for example, was to construct multi-village gravity systems. Sanitarians were apparently not prepared to cope with these more complex systems.

Among older systems visited, only one third were experiencing technical problems. This finding suggests that DEH follow-up support was successful and that the overall quality of design was satisfactory.

The villagers in all types of piped systems had trained personnel who could operate and maintain the equipment and handle simple repairs. In a majority of households, someone had learned to repair leaking faucets. Pipe, glue, and faucet supplies were usually available locally. Problems of maintenance existed primarily in diesel systems.

Monthly charges for piped water ranged from twenty-five cents per household in gravity systems to as much as three dollars in diesel operated systems. Collection problems were most prevalent among diesel and electric systems. However, there were very few villages (4 out of 26) that had problems of covering operating costs. Nine of the twenty-six systems had accumulated considerable savings to deal with major system failures. These differences occur because some villages had found alternative ways to cover costs, mainly by "fiestas," by establishing a graded system of fees according to capacity to pay, or through grants or subsidies from the political respresentative or other local groups. All gravity and

electric systems visited were using these financing arrangements. The diesel systems, however, have not been able to successfully cope with the rising prices of fuel. Four of the six systems in the sample had experienced several service interruptions through the year.

An alternative solution to the problem of increasing operating costs was to change the source of energy for the system. Of the twenty-six communities visited, four had changed their system for economic reasons. One of these had changed from gasoline to diesel to gravity.

In general, villagers were able to manage the water service quite effectively. Communities had organized this management function in different ways. Most of the systems had an effective organization as required in the management guidelines developed by the DEH. Some villages were assisted by outsiders such as the political representative, the primary school teacher, the medical doctor assigned to the local health center, or the regional sanitarian. Local organizational capacity of the villages seemed to be important to the successful operation of the water service. Some villages had coped with technical problems and collected over $1,000 to buy new equipment. All of the five communities that had the most problems in the operation of their water service were also experiencing severe organizational problems. The lack of motivation and leadership in these communities seemed to be related to a combination of factors, such as poverty, inaccessibility, and major internal conflicts. Most of their problems could probably be resolved with some community assistance.

A detailed description of the operational status and viability of systems visited is presented in Appendix D.

In the communities visited, access to piped water systems was almost universal. Most households had a tap in the house or next to it. Some very poor villagers had erected makeshift outdoor showers, using perforated plastic bottles as shower heads. Other villagers installed additional taps inside their homes for kitchen use and for washing and bathing indoors.

Lack of access was not due to discrimination. Some families were without taps because they refused to participate in the building of the water system. A few happened to live on high land and could not be served by a system that depended on gravity for distribution. Others moved into the community after the piped water system was built and lacked the resources to extend the pipes to their houses. In other communities, new residents did not gain access to the water supply because rapid population growth had already overtaxed the system.

Most villagers interviewed liked the water from the piped water system and reported that it was clear, sweet, and odorless. The only appearance problem mentioned was muddiness in water from two gravity systems during torrential downpours. Villagers found the muddy water undesirable but did not associate it with any health problems.

In all communities, residents reported that they used the water for drinking, cooking, bathing, washing dishes and clothes, and for household cleaning. These purposes were authorized by the Ministry of Health. The team also observed unauthorized uses, including children splashing each other with hoses, a taxi driver washing his cab, and gardens watered from a faucet.

B. Impact on Health

During the decade of the seventies, as piped water systems were being installed in small Panamanian communities, other health-related programs were also being implemented. Although the impact of piped water systems on health cannot be separated from the impact of these other programs, it seems likely that clean safe supplies of water contributed significantly to the reported improvements in the health status of the rural population. In 1970, infant mortality rates in rural areas of Panama averaged 59 per 1,000. In 1980, local health statistics reported that rural infant mortality had dropped to about 35 per 1,000.

A baseline survey of communities was not completed early enough to provide before and after data for communities receiving piped water systems. However, provincial health directors indicated that infant diarrhea was no longer a public health problem. One physician had come to his province as an intern in 1970 when there was a high incidence of diarrhea in the rural population. In his opinion, the provision of safe, clean water in piped water systems was largely responsible for the current absence of diarrhea as a public health problem.

After the completion of the piped water systems, teachers reported substantial reductions in absenteeism due to diarrhea. Also, in a majority of the communities where water systems were functioning well, villagers mentioned to the team that they had noticed less sickness among local residents, especially less diarrhea in children. There was a widespread belief that good household water supplies brought improved health to the community. The team found this belief to be prevalent among health personnel, teachers, community leaders and housewives.

C. Impact on Community Self-Reliance

In order to obtain a piped water system, villagers had to form Community Health Committees and commit themselves to operate and maintain the system when it was completed. The experience of building, operating, and maintaining a piped water system tended to transform voluntary participation into a more corporate sense of community responsibility in the following ways.

Several of the communities visited had struggled with issues that threatened the piped water system. Problems included conflicts over higher energy costs as well as the failure of some households to pay the monthly water charges. The team noted that communities in the piped water program often took initiatives to resolve their own problems. One response was

to raise monthly water charges slightly in order to provide free water for those who could not afford to pay. Another response was to select new leaders to run the system more efficiently. According to Panamanian officials and local leaders, these self-reliant responses were less common in other development programs.

D. Impact on Women

In each of the 26 communities visited, team members interviewed two or three mothers of young children. The women reported that piped water had made a major difference in their lives. They appreciated the convenience of having sufficient water for personal and household needs and they expressed satisfaction to be participating in the amenities of modern life.

The feeling of relief was often profound. In one case, a village successfully petitioned for a piped water system soon after a seven year old girl was killed while crossing the Panamerican Highway on an errand to fetch water. In another, the women no longer had to spend five or six hours a day hauling water through steep and rough terrain or rowing several miles to get water to their island from the mainland.

Men also expressed feelings of relief. One old man said: "This program has been extremely humane for us." Another joked that the women's heads would no longer be flat from carrying heavy loads of water.

Women were asked what they did with the time saved. Most indicated that they used some time to rest. Many mentioned household chores or taking care of children. One woman remarked, "Now I have time to read to my children." A few women mentioned using their extra time in income-producing activities. For example, Cuna Indian women indicated that they were now sewing five to seven pieces of multi-layered fabrics (molas) per month instead of two or three. Also, women in Cocle province and in the Azuero region had increased their production of hats.

The management of the water system provided women with opportunities to participate actively in community affairs. Each of the 26 communities visited had at least one woman on the water subcommittee of the Community Health Committee. In many communities, women had initiated efforts to obtain the piped water system. They contributed during construction by carrying heavy loads of sand and by preparing food for laborers. They also had important roles in maintaining the water systems. In several communities that were having problems collecting water fees, women emerged as local leaders and successfully managed the collection process.

E. Impact on Economic Activities

The piped water systems were designed and constructed to provide water for household consumption. In an effort to ensure the availability of water for household use, the Ministry of Health established regulations to discourage unauthorized uses. Although utilizing water from piped systems for profit-making activities was unauthorized, many communities reported using water in this way.

During the dry season, the piped water systems provided essential water for small livestock and for vegetable gardens. In the milk districts of Chiriqui province, piped water from the mountains permitted high standards of cleanliness in dairy operations. In the tourist areas of Colon province, the number of vacation cottages with showers and flush toilets increased. This unauthorized use was associated with water shortages in two villages visited.

By providing public services, including water, to potential growth centers, the government of Panama hoped to reduce rural migration into Panama City. The team was unable to assess the impact of the water service on migration to Panama City. However, villages with both electricity and running water that were close to provincial job markets, were expanding rapidly. Thus the water service appeared to be associated with the development of growth centers in the provinces.

V. THE FUTURE

A. A Sustainable Investment

Overall, the performance record of the piped water systems was impressive. As far as the team could tell from its field experience and from interviews with MOH and AID officials, none of the 562 piped water systems had been abandoned during the eight year period since construction began. Many of the factors that contributed to this record also increase the likelihood that it will be sustained in the future.

1. Effective Administration

The effort to provide piped household water to small and dispersed communities was effectively administered by Antonio Sucre, an engineer and Director of the Department of Environmental Health (DEH). Applying knowledge gained during years of experience in implementing water projects, he developed simple and practical administrative procedures that facilitated implementation. To carry out construction activities simultaneously in all provinces, he created a special Water Task Force with personnel provided by various divisions of the Ministry of Health. Operational staff members moved to the provinces where they had direct responsibility for their programs and communications were handled largely by telephone. The Director retained control of program resources, however, to shorten the chain of command and avoid administrative delays. Thus headquarters was able to participate meaningfully in provincial work plans and to ensure delivery of materials on a timely basis. These administrative procedures enabled DEH to respond quickly to a community's request for a piped water system.

Monthly progress in planning and construction was recorded on a chart in the Director's office. These records enabled headquarters to analyze trends and identify problems in each province. Provinces that lagged behind in their schedules risked losing their resource allocations to

more aggressive provinces. At the same time, strict adherence to established criteria was encouraged by AID's use of the fixed amount reimbursement method because reimbursement was not made to water systems that failed to meet established criteria.

Proper training of staff was emphasized and the Water Task Force held periodic workshops where key staff shared experiences, identified common problems and developed solutions.

In addition, DEH continued to provide technical support and other assistance after the piped water systems were constructed. Without this assistance, many communities might have been unable to sustain their initial investment.

Through effective administration, DEH met and exceeded its targets for providing rural public water service. In July 1980, Antonio Sucre, Director of DEH, was appointed to administer the construction of health posts, a component of the AID Health loan that was lagging behind schedule. He is expected to apply the successful approaches of the piped water efforts to this component.

2. Simple Reliable Technology

The piped water systems constructed by DEH were simple to design. Nearly half were gravity systems that were relatively easy to maintain. The others were primarily diesel and electric systems and used standardized equipment that appeared to be highly reliable. The team did not learn of any patterns of defective parts or premature replacement.

Usual repair and maintenance problems could be handled within the community by trained residents. Most households, for example, included persons who could repair breaks to the pipe that occurred on their property. Supplies needed to repair breaks were readily available in the local markets.

Water systems were designed to provide 30 gallons of water per person per day to twice the population of the community being served. The systems provided much more water than had been available and at the same time eliminated any need for water carrying. As a result the villagers valued the systems highly and were willing to pay and work for continuous operation and maintenance.

3. Community Participation

The Department of Environmental Health employed procedures that recognized the importance of community participation to the long-term operation of the public water systems. The DEH informed the community of its obligations under the program and made sure the community understood these obligations. Commitments of both the DEH and the community were incorporated into a contract. When the system was installed, title was publicly vested in the community and the Minister of Health wrote directly to the community leader in charge of the piped water system.

Thus, the DEH required that community participation be formally institutionalized. Some installations were deferred several months until conditions for participation were met. The approach seems to have paid off. Communities generally have a positive attitude toward extending their systems to newcomers if there is sufficient water. In cases where population now exceeds design capacity or where there are problems with the source of water, communities have instituted rationing. Generally, work gangs are organized to repair broken pipes or handle any major maintenance problems such as cleaning and repairing the storage tank.

Community participation was facilitated by representatives to the National People's Congress. As locally elected officials, they voiced the villagers' demands for improved water systems and often ensured economic support for the maintenance of the systems.

4. Other Facilitating Factors

There is plenty of water in Panama. North of the ridge of mountains that traverses the country there are 2,500 millimeters of rain per year. South of the mountains, there are 1,500 millimeters. Most of this water runs off in rivers and streams throughout the country. Since most communities are located within 20 miles of a watershed, scarcity of water is not a problem.

In the rural population of Panama, there is a high level of environmental health awareness. Water and sanitation programs have existed in Panama for 30 years, and many of the communities receiving piped water systems already had handpumps. The demand for household piped water remains strong, and the promise of more water systems is a standard component of all political speeches.

In Panama, the estimated income required to provide for a rural family's basic needs is $304 per person. Although 57 percent of Panama's rural families live below this level, rural per capita income was sufficiently high to enable villages to raise funds to operate and maintain water systems. The use of the U.S. dollar as local currency expedited purchasing procedures. The implementation of public rural water service was also facilitated by government investments in rural roads and communications. During the seventies, access to rural communities was greatly improved.

B. Potential Problems

1. Priorities and Budget Cuts

Currently, DEH's mandate overextends its limited resources. It is committed to install between 300 and 400 handpumps a year, principally in remote communities, and it has requests from nearly 500 communities for piped water systems. In recent years, the DEH has given priority to the installation of new facilities, but it also retains a supervisory role over the hundreds of handpumps and piped water systems that have

already been installed. One of its other functions, the monitoring and surveillance of water quality, has been neglected. In fact, personnel and laboratory facilities for this purpose are grossly inadequate.

The DEH mandate was recently increased to include communities of up to 1,000 people. Previously, all communities with more than 500 people had been under the mandate of IDAAN, the National Water and Sewerage Institute. Nevertheless, DEH had developed piped water systems that combined villages whose total populations exceeded 1,500. Although these systems were clearly within the IDAAN mandate, the communities preferred to stay under the supervision of DEH.

The draft report of a water and sanitation sector study prepared by the World Health Organization in 1979, recommended that IDAAN assume responsibility for constructing and supervising all piped water systems and that DEH concentrate on installing handpumps and monitoring water quality. The study also called for the transfer of 300 DEH piped water systems to IDAAN supervision because of their large service populations.

The sector study's recommendations have been resisted for a number of reasons. First, DEH appears to have a better reputation for service and responsiveness among smaller communities. Second, there are major differences between a DEH and an IDAAN piped water system. Under IDAAN, communities pay for metered water and IDAAN has responsibility to operate, maintain, repair and expand systems. Therefore, shifting from DEH to IDAAN supervision implies a shifting of ownership from the community to IDAAN. Third, in terms of health benefits, it may be more useful for DEH to concentrate on larger communities within its mandate rather than on the provision of handpumps to very small villages.

In 1980, the government of Panama reduced DEH's budget for personnel and operating expenses. As a result, periodic visits to communities with piped water systems have been sharply curtailed and mechanics generally cannot visit completed systems unless communities offer to pay for the gasoline. The DEH is thus less able to provide technical support to new systems, even during the initial period when they are most likely to encounter problems.

The DEH is facing difficult decisions. New arrangements must be worked out with IDAAN and with communities that have piped water systems. Priorities must be established to resolve competing demands on staff time and financial resources.

2. Rising Energy Costs

As energy costs escalated during the seventies, so did the costs of operating the piped water systems. About half of the water systems depend on diesel or electricity. DEH personnel expressed optimism that rising energy costs can be minimized by converting diesel to electricity or to gravity systems.

If energy prices exceed the limits of monthly fees, many villages will find it difficult to raise $800 to $1,000 to buy a submersible electric turbine, or $10,000 to install two miles of plastic pipe for a gravity system. At one time, villages paid 20 percent of their monthly collections into a revolving fund maintained by the Department of Environmental Health. This fund was used to provide credit for repairs, expansion or conversion, but was bankrupted by numerous conversions as energy costs rose. Communities now rely on funds raised through special fiestas or on help from their local representative to the National People's Congress. Representatives receive $500 to $2,000 annually to support local development projects and the rural water program has been a priority recipient of these funds.

3. Conservation and Watershed Management

Piped water systems installed by DEH were designed for household consumption only. However, in all provinces, villagers violate the rules and use piped water for vegetable gardens and animals. During the initial years of properly designed systems, these unauthorized uses did not generally cause water shortages. As legitimate demands on piped water systems increase, many communities may be faced with the necessity to restrict improper use of water in order to have sufficient supplies for household use. This problem will be especially prevalent in small gravity systems where the amount of water flowing from the spring each day is limited. In other systems, conservation may be necessary to reduce pump use and associated costs for fuel and operators.

Watershed management is critical for the continued good performance of gravity systems. The DEH emphasizes this to villages with gravity systems, but village-level watershed management within Panama has traditionally been poor. Over the last 20 years, for example, a rain forest in the Azuero region was virtually eliminated through lumbering and the need for firewood. Mining and slash-and-burn cultivation have also caused serious erosion and loss of water retention. There is presently no formal arrangement for supervising and protecting watershed areas.

VI. OBSERVATIONS ON HANDPUMP SYSTEMS

Between 1972 and 1980, the Ministry of Health installed approximately 2,400 wells with handpumps, 1,600 of which were partially financed by AID loans. Usually, installation involved drilling a well, pouring a concrete cap around the top of it and installing the handpump. Most handpumps were constructed in communities that were too small to qualify for piped water systems. The selection of these communities often seemed to be based as much on political considerations as on need. One handpump was designed to serve 10 households or 50 people. Recipient communities were not required to maintain the installation or to pay for repairs.

The team observed handpumps in eight villages that were located en route to the randomly selected 26 communities with piped water systems.

The experience of these villages was not necessarily representative but does provide some insight concerning the operation of handpumps. In the eight villages, the team found that residents used the handpumps when they were the most convenient source of water. They were used more frequently during the dry season than during the wet season. Also, village residents living near the handpump were more likely to use it than those located further away. Since villages often stretched out along a road or path, some residents were 300 meters from the handpump. These households often preferred nearby brooks or traditional excavated shallow wells to the more distant handpump.

In the villages visited, three of the eight handpumps were not functioning. A fourth was working, but did not provide enough water for the village. These findings correspond with DEH estimates that 40 to 50 percent of the handpumps in the country may not be operating at any one time. In contrast to the piped water systems, communities retain no responsibility for maintaining or repairing handpumps. Furthermore, the type of handpump used cannot be repaired locally because special tools are required. Without better handpumps and community commitments to maintain them, handpumps cannot provide reliable service.

Even in communities with piped water systems, handpumps fall into disrepair. According to the DEH, villagers do not understand that pumps have to be used periodically to keep them in condition. Even though handpumps were considered a backup system in case of interruptions, DEH officials reported that communities with piped water systems did not maintain their handpumps.

The average cost of handpump installation was $1,200 or about $24 per person. The estimated cost of a piped water system was $25,000 or approximately $50 per person. Since piped water systems were designed to serve twice the population of the community, new residents could usually be added to the piped system for minimal additional expense. Although handpump systems were cheaper initially, piped water systems may not cost significantly more per person in the long run, if repair and expansion costs are taken into consideration.

Information on handpumps installed by MOH is presented in Appendix F.

VII. CONCLUSIONS, RECOMMENDATIONS, LESSONS LEARNED

1. The implementation of this national effort to construct piped water systems in hundreds of rural communities was facilitated by the prior experience of the Department of Environmental Health. From 1970 to 1972, the DEH built piped water systems in more than 100 small communities and developed a standardized system design. It also acquired substantial managerial experience that was applied in the planning and organization of the national effort. The organization of a national program is more likely to be successful if it is based on the prior experience of a pilot program.

2. Carefully planned efforts to secure the involvement and commitment of community residents contributed to the success of the piped water systems in Panama. This experience suggests that rural piped water systems are more likely to succeed when a number of conditions with respect to community participation are met. First, there must be community demand for household water. Second, the implementing agency should follow carefully planned procedures to secure the involvement and commitment of community residents and to incorporate the commitments of both parties into a written contract between them. Third, the contract should call for equal access to the water and equitable sharing of the burden of keeping the water system running. If possible, local political leaders should be involved. Finally, village personnel should be trained to operate and maintain equipment and to know when to call in technical assistance.

3. Small rural water systems require periodic monitoring and technical support to remain operational and safe. The DEH should take steps to eliminate the high rate of design problems in recently completed systems. In addition, water quality should be monitored periodically. Regular inspections would also provide an opportunity to assess the effectiveness of community leadership and commitment and to work with residents to resolve difficulties before they threaten the operation of the water system.

4. Some communities undertook major expansion to meet the needs of increased populations. Many others converted to gravity systems as energy costs escalated. Conversion, expansion and major repairs require funds that communities can seldom raise alone. To sustain piped water systems, some mechanism for raising funds in an emergency must be available. One possibility is the establishment of a loan guarantee program that would enable communities to finance the costs of major repairs, conversions and expansions of their piped water systems.

5. If ground water is already clear and potable, small community piped water systems may be able to deliver safe household water for years without the need for chemical treatment or filtration. The operation of two multi-village systems, each serving 1,300 to 1,600 people and including a provincial health center, provide some evidence that untreated systems may be practical for significantly larger systems than those contemplated under AID loans.

6. Rural sanitarians were trained to work in communities during construction and to teach local residents how to operate and maintain equipment. When an alternate energy source is adopted or major expansion is undertaken, training should be updated and the division of labor between engineers and village personnel reviewed. In addition, field manuals should be reviewed and revised to remain relevant.

7. Wells with handpumps were installed in villages that were too small to sustain a piped water system. They could contribute signficantly to the quality of life, especially where traditional sources of water were unacceptable, but the allocation of handpumps appeared to serve as much

as a symbol of government outreach as an investment to meet a real need. Their service was unreliable because of high repair rates and the lack of community commitments to maintain them. The criteria and technology of the handpump program should be reevaluated. By establishing community responsibility for some maintenance and repair, ascertaining community demand for the service, and by selecting alternative technologies, handpump service could become more reliable.

APPENDIX A

LOGICAL FRAMEWORK*

* This logframe corresponds to all the components of loan 045. This evaluation only focussed on the water component of loan 045 and loan 040. There is no logframe for loan 040 because it was designed before this requirement was mandatory.

AID 1020-26 (1-73)
SUPPLEMENT 1

PROJECT DESIGN SUMMARY
LOGICAL FRAMEWORK

(INSTRUCTION: THIS IS AN OPTIONAL FORM WHICH CAN BE USED AS AN AID TO ORGANIZING DATA FOR THE PAR REPORT. IT NEED NOT BE RETAINED OR SUBMITTED.)

Life of Project: From FY 77 to FY 81
Total U.S. Funding: $9,500
Date Prepared: May 1976

Project Title & Number: Rural Health Delivery System 525-22-530-181

NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	MEANS OF VERIFICATION	IMPORTANT ASSUMPTIONS
A. Program or Sector Goal: The broader objective to which this project contributes: (A-1)	Measures of Goal Achievement: (A-2)	(A-3)	Assumptions for achieving goal targets: (A-4)
Raise the health level of the Panamanian marginal population 1/ to acceptable standards.	For the marginal populations by 1985: 2/		
	1. Increase life expectancy from 50 years to 55 years.	1. Decennial census.	Vital statistics are reasonably accurate.
	2. Reduce infant mortality from 37.2 per thousand to 30 per thousand.	2. Special surveys and studies conducted periodically by the MOH and Statistics and Census Bureau of the Contraloria General de la Republica.	
	3. Reduce general mortality from 6.0 per thousand to 5.3 per thousand.		
	4. Reduce incidence of diarrheal diseases 30%; i.e., from 29,000 cases in 1974 to 20,000.		

1/ The "marginal population" refers to those people lacking some or all of the basic public services - electricity, potable water, sewerage, access to secondary schools, paved streets, etc.

AID 1020-28 (11-73)
SUPPLEMENT

PROJECT DESIGN SUMMARY
LOGICAL FRAMEWORK

Project Title & Number: Rural Health Delivery System 525-22-530-181

Life of Project: From FY 77 to FY 81
Total U.S. Funding $9,500
Date Prepared: May 1976

NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	MEANS OF VERIFICATION	IMPORTANT ASSUMPTIONS
B. Project Purpose: (B-1)	Conditions that will indicate purpose has been achieved: End-of-Project status. (B-2)	(B-3)	Assumptions for achieving purpose: (B-4)
To institutionalize an improved integrated low cost public health delivery system providing preventive and curative health care services and adequate environmental sanitation conditions to the marginal population residing in rural areas.	By 1981:	Data collected annually by the Statistical Department of the MOH and Statistics and Census Bureau of the Contraloria General de la Republica.	
a. Health services will be accessible. 1/	a.1 Increase accessibility of the marginal population to basic health facilities from 25% to nearly 50%.		
	a.2 Increase the population with access to potable water from 54% in 1975 to 70%.		
	a.3 Increase the population with access to excreta disposal systems from 76% in 1975 to 83%.		

1/ Accessibility is defined as any public health facility within two hours using normal routes and transportation means.

AID 1020-20 (11-72)
SUPPLEMENT 1

PROJECT DESIGN SUMMARY
LOGICAL FRAMEWORK

Life of Project: From FY 77 to FY 81
Total U.S. Funding $9,500
Date Prepared: May 1976

Project Title & Number: Rural Health Delivery System 525-22-530-181

NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	MEANS OF VERIFICATION	IMPORTANT ASSUMPTIONS
Project Purpose: (B-1) (continued) b. Health services will be effectively delivered.	Conditions that will indicate purpose has been achieved: End-of-Project status. (B-2) By 1981: b.1 Increase professional services during childbirth from 47.6% in 1975 to 60% for the target population, b.2 Increase immunization for the marginal population from 50% to 60%.	(B-3)	Assumptions for achieving purpose: (B-4)

AID 1020-28 (11-74)
SUPPLEMENT 1

PROJECT DESIGN SUMMARY
LOGICAL FRAMEWORK

Project Title & Number: Rural Health Delivery System 525-22-530-181

Life of Project: From FY 77 to FY 81
Total U.S. Funding $9,500
Date Prepared May 1976

NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	MEANS OF VERIFICATION	IMPORTANT ASSUMPTIONS
C. Project Outputs: (C-1)	Magnitude of Outputs: (C-2)	(C-3)	Assumptions for achieving outputs: (C-4)
1. Increased efficiency of health services within the context of an integrated public health care system.	The improvement of MOH and CSS health care systems will be achieved to the extent that by 1981 health objectives, policies and functions will have been uniformly established and administered at both the national and provincial levels.	As part of the continuous evaluation of the program, periodic reviews will be conducted by the GOP to monitor the progressive integration of the various administrative elements - management, purchasing, transportation, laboratory analysis, budgeting, accounting, data gathering, maintenance, and medical services.	GOP policy will continue to favor integration of MOH and CSS health care systems.
2. An enlarged and strengthened capacity within the public health sector for training and utilizing health assistants.	By 1981, 225 health posts will have health assistants with intensive health care training in basic community health subjects, including vaccinations, first aid, childbirth, family planning and other basic MCH care and environmental sanitation.	Data collected annually by the Statistical Department of the MOH.	
3. Providing rural communities, representing approximately 25% of the marginal population, with access to basic health care services and facilities and a mechanism of referral through the health care delivery system	a. By 1981, 4 rural health centers will have been constructed, staffed and equipped.	Observation	Land titles will be obtained in a timely manner.

AID 1020-28 (11-72)
SUPPLEMENT 1

PROJECT DESIGN SUMMARY
LOGICAL FRAMEWORK

Life of Project:
From FY 77 to FY 81
Total U.S. Funding 9,500
Date Prepared May 1976

Project Title & Number: Rural Health Delivery System 525-22-530-181

NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	MEANS OF VERIFICATION	IMPORTANT ASSUMPTIONS
Project Outputs: (C-1) as appropriate to the individual's health needs.	Magnitude of Outputs: (C-2) b. By 1981, 14 health sub-centers will have been constructed, staffed and equipped. c. By 1981, 225 rural health posts will have been established, equipped and staffed. d. By 1981, 300 rural aqueducts and 400 hand pumped wells will have been installed. e. By 1981, 13,800 latrines will have been constructed. f. Over the period 1977-1979, 48 community gardens will be established. By 1980 there will be a total of at least 200 functioning community gardens in the rural sector. g. Over the period 1977 - 1979, 75 small animal projects will be established. h. By 1981, 50 health centers and/or sub-centers will have been remodeled.	(C-3) Annual surveys by the Department of Training and Investigation of the MOH.	Assumptions for achieving outputs: (C-4)

D. INPUTS

See financial plan for details on funding.

APPENDIX B

EVALUATION METHODOLOGY

Evaluation Methodology

In August 1980, a three person team spent three weeks in Panama evaluating the impact of the rural water program. The team leader was an economist and program officer. A second AID team member was a sociologist. These two AID staff members from Washington were assisted by a Panamanian political scientist with field experience at the local level. After the community visits were completed, a Panamanian anthropologist helped the team with data analysis.

Before arriving in Panama, the team obtained a listing of the 562 communities with completed piped water systems that had been supported by the two AID loans. Communities in one province, Darien, were excluded from the study to reduce travel time. This province contained only 3 percent of the total number of completed piped water systems.

In order to avoid selectivity bias, the team randomly selected 26 communities (approximately 5 percent of the total, excluding Darien) for visits. Sample size is certainly too small to attempt statistical generalizability of findings; however, the randomness of observations allows the drawing of informed judgements about the program. As routes to these 26 communities were being planned, 8 villages in which wells with handpumps had been installed were selected for evaluation. In addition, the team added eight communities where piped water systems had special problems or conditions. Three were in Bocas de Toro, the most inaccessible province in the country. Two sites in San Blas were included at the request of the AID Mission Director because they offered insights into the process of local participation. Puerto Lindo, in Colon, was visited at the request of the Ministry of Health. Finally, to learn more about the implementation process, the team visited two piped water systems that were under construction. A listing of villagers visited, by type of systems and province, is included in Table B-1.

Arrangements for field visits were made with the headquarters office of the Department of Environmental Health. Regional offices were notified in advance so they could allocate two staff members and one vehicle for the site visits. In order to visit 42 sites in 13 days, team members separated into two groups. Each evening, experiences were shared at regional headquarters.

At each community visited, two questionnaires were administered. One questionnaire was directed to community leaders, water or health committee members and water system operators. They were asked to comment on how well the water system was working, whether it was being used, how the community participated, and the impacts they had observed. The second questionnaire obtained information from women whose families included at least one child under five years of age. In all, about 70 women answered questions on how water was being used, and what difference it made to health, time savings, and convenience.

The team also interviewed central and regional authorities of the Ministry of Health in all areas visited. Included were medical doctors, sanitarians, and health assistants. They provided general background information on the communities visited and the implementation of the program.

When field visits were completed, the team returned to Panama City to tabulate and analyze the information. A preliminary report was written in Spanish and discussed with both AID personnel and the staff of the Department of Environmental Health.

Table B-1. Listing of Villages Visited by Type of System and Province

Type of System and Site Name	Province
Piped Water Systems:	
DIESEL	
San Jose*	Herrera
La Candelaria*	Herrera
Los Leones*	Veraguas
El Centeno*	Veraguas
Santa Rosa*	Los Santos
El Silencio*	Bocas del Toro
GASOLINE	
Los Castillos*	Chiriqui
ELECTRIC	
Paso Blanco*	Panama
Chorrerita*	Cocle
Dos Rios*	Chiriqui
El Tejar*	Chiriqui
Bagala Abajo*	Chiriqui
Palmas Bellas*	Colon
Finca 4	Bocas del Toro
GRAVITY	
San Miguel*	Panama
Sagreja*	Cocle
Machuca*	Cocle
El Espave Poblito*	Cocle
Trinidad*	Cocle
Sta. Rita*	Cocle
Bombacho*	Los Santos
Paso Real*	Veraguas
La Yeguada*	Veraguas
Quebrada Huabo*	Chiriqui
Rio Sereno*	Chiriqui
Barranco Adentro	Bocas del Toro
Ojo de Agua	Bocas del Toro
Isla Grande*	Colon
Puerto Lindo	Colon
Escucha*	Colon
Rio Tigre	San Blas
Ticantiqui	San Blas
Acequias	Chiriqui
Nuevo Tonosi	Colon

Table B-1. Listing of Villages Visited by Type of System and Province (Continued)

Type of System and Site Name	Province
Hand Pumped Wells:	
Santa Maria	Cocle
Cienaga Larga	Cocle
Las Lajas	Los Santos
Lagunilla	Veraguas
Marinez	Veraguas
Tiger Hill	Bocas de Toro
Punta Grande	Colon
Las Margaritas	Herrera

* Site was randomly selected.

APPENDIX C

STANDARDIZED SYSTEM DESIGNS

Standardized System Designs

Requirements for Reimbursement

Information on standardized system designs is presented in this Appendix. Cost estimates and requirements for reimbursement were prepared by DEH Chief Engineer A. Sucre, Engineer N. Camarano, Mr. Abdiel Zarata, and AID engineers H. Caudill and J. Saiz in March of 1979. Cost estimates were determined for four different community sizes ranging from 5-100 households. This represents a change from the original plans to serve communities from 250-500 people.

Initially, Table B-1 presents design specifications for water systems with individual connections. Subsequent tables show:

-- Costs of materials and labor by agency and type of water system (Tables C-2, C-3, C-4, and C-5);

-- Cost for gravity sources by type of aqueduct for water systems A, B, C, and D (Tables C-6 and C-7);

-- Cost of pumped systems including pump shelter (Table C-8);

-- Total (summary) costs by agency for each type of water system (Table C-9);

-- Planned distribution of costs per unit for wells and aqueducts under loan 040 and loan 045 (Table C-10).

Cost for source installation and costs for storage and distribution systems have been determined separately. Requests for reimbursement for water systems would be submitted under two figures based on the type of source and on the number of connections. For example, for type C water system, the request for reimbursement would equal $10,218.00 plus $4,547.00 if it is a pumped system. In the case of a gravity system, the request for reimbursement would equal $10,218,00 and $2,879.00, respectively.

Table C-1. Design Specifications For Water Systems With Individual Connections

	Type A	Type B	Type C	Type D
Number of Connections	5 to 14	15 to 39	40 to 99	over 100
Max. Number of Inhabitants According to Design Spec. (N)	70	195	495	1,000
Minimum Tank Capacity (C)	630 gal.	1,755 gal.	4,455 gal.	9,000 gal.
Minimum Water Pressure During Dry Season For Source (P_b) For Pumped Systems	3 gpm	8 gpm	20 gpm	42 gpm
Minimum Water Pressure During Dry Season For Gravity Systems (P_f)	1 gpm	2-2/3 gpm	6-2/3 gpm	14 gpm

C = 30 gal. x N pers. x 0.3 daily = 9 N

$\boxed{C = 9\ N}$

P_b = 30 gal. x N pers. x 1,440 min. x 2 = .042 N

$\boxed{P_b = .042\ N}$

$\boxed{P_f = 0.014\ N}$

gpm = gallons per minute

Table C-2. Costs For Materials and Labor By Agency and Type of Water System
(Does Not Include Source or Well)

			Water System Type A		
	Quantity	Cost Per/ Unit	AID	GOP *	Community
Storage Tank 3,500 Gal.					
Blocks	300	0.37			111.00
Cement	45 sacks	2.58			116.00
Steel 3/8" Ø x 30'	18 bars	2.99			54.00
Steel 1/2" Ø x 30'	30 bars	4.84			145.00
Sand and Stones	16 yd^3	6.60			106.00
Wood For Framing	160 sq. ft.	0.50			80.00
Spare Parts			95.00		
Labor					
Specialized Labor	60 days	21.00		1,260.00	
Non Specialized Labor	170 days	5.00			850.00
Per Diem	80 days	4.40		352.00	
Coordination and Supervision	20 days	36.00		720.00	
Distribution System (5-14)					
P.V.C. 1" Ø	328 sections	3.16	1,036.00		
Household Connections	10	20.67	207.00		
Spare Parts and Tools			200.00		
Transportation				500.00	
Right of Way					300.00
Audiovisual Equipment and Miscellaneous				30.00	
	Total		1,538.00	2,862.00	1,682.00

*GOP - Government of Panama

Table C-3. Costs For Materials and Labor By Agency and Type of Water System
(Does Not Include Source or Well)

			Water System Type B		
	Quantity	Cost Per/ Unit	AID	GOP*	Community
Storage Tank 3,500 Gal					
Blocks 6"	300	0.37			111.00
Cement	45 sacks	2.58			116.00
Steel 3/8" x 30'	18 bars	2.99			54.00
Steel 1/2" x 30	30 bars	4.84			145.00
Sand and Stones	16 yd^3	6.60			106.00
Wood For Framing	160 sq. ft.	0.50			80.00
Spare Parts			95.00		
Labor					
Specialized Labor	80 days	21.00		1,680.00	
Non Specialized Labor	357 days	5.00			1,785.00
Per Diem	160 days	4.40		466.00	
Coordination and Supervision	26 days	36.00		936.00	
Distribution System					
P.V.C. 1-1/2" Ø	328 sections	5.29	1,735.00		
P.V.C. 1" Ø	328 sections	3.16	1,036.00		
Household connections	27	20.67	558.00		
Spare Parts and Tools			300.00		
Transportation				650.00	
Right of Way					400.00
Audiovisual Equipment and Miscellaneous				40.00	
	Total		3,724.00	3,772.00	2,797.00

*GOP - Government of Panama

Table C-4. Costs For Materials and Labor By Agency and Type of Water System
(Does Not Include Source or Well)

				Water System Type C	
	Quantity	Cost Per/ Unit	AID	GOP*	Community
Storage Tank 5,000 Gal.					
Blocks 6"	400	0.37			148.00
Cement	60 sacks	2.58			155.00
Steel 3/8" Ø x 30'	25 bars	2.99			75.00
Steel 1/2" Ø x 30'	38 bars	4.84			184.00
Sand and Stones	16 yd^3	6.60			106.00
Wood For Framing	160 sq. ft.	0.50			80.00
Spare Parts			95.00		
Labor					
Specialized Labor	120 days	21.00		2,520.00	
Non Specialized Labor	830 days	5.00			4,150.00
Per Diem	158 days	4.40		695.00	
Coordination and Supervision	38 days	36.00		1,368.00	
Distribution System (40-99)					
P.V.C. 3" Ø	164 sections	17.37	2,849.00		
P.V.C. 2" Ø	492 sections	8.28	4,074.00		
P.V.C. 1-1/2" Ø	164 sections	5.29	868.00		
P.V.C. 1" Ø	164 sections	3.16	518.00		
Household Connections	70	20.67	1,447.00		
Spare Parts and Tools			367.00		
Transportation				1,000.00	
Right of Way					500.00
Audiovisual Equipment and Miscellaneous				50.00	
	Total		10,218.00	5,633.00	5,398.00

*GOP - Government of Panama

Table C-5. Costs For Materials and Labor By Agency and Type of Water System
(Does Not Include Source or Well)

			Water System Type D		
	Quantity	Cost Per/ Unit	AID	GOP *	Community
Storage Tank					
Blocks 8"	620	0.47			291.00
Cement	100 sacks	2.58			258.00
Steel 5/8" Ø x 30'	38 bars	7.36			280.00
Steel 1/2" Ø x 30'	44 bars	4.84			213.00
Sand and Stones	20 yd^3	6.60			132.00
Wood For Framing	200 sq. ft.	0.50			100.00
Spare Parts			125.00		
Labor					
Specialized Labor	160 days	21.00		3,360.00	
Non Specialized Labor	1710 days	5.00			8,550.00
Per Diem	210 days	4.40		924.00	
Coordination and Supervision	50 days	36.00		1,800.00	
Distribution System (40-99)					
P.V.C. 3" Ø	328 sections	17.37	5,697.00		
P.V.C. 2" Ø	656 sections	8.28	5,432.00		
P.V.C. 1-1/2" Ø	328 sections	5.29	1,735.00		
Household Connections	150	20.67	3,100.00		
Spare Parts and Tools			400.00		
Transportation				1,200.00	
Right of Way					700.00
Audiovisual Equipment and Miscellaneous				60.00	
	Total		16,489.00	7,344.00	10,424.00

*GOP - Government of Panama

Table C-6. Cost For Gravity Source By Type of Aqueduct

	AID	GOP *	Community	Total
Water System Type A				
Materials for Capping Water Source	36.00			
P.V.C. 1" Ø, 328 Sections	1,036.00			
Spare Parts	37.00			
Surveying		250.00		
Specialized Labor Force		105.00		
Non Specialized Labor Force			100.00	
Per Diem		66.00		
Total	1,109.00	421.00	100.00	1,630.00
Water System Type B				
Materials for Capping Water Source	36.00			
P.V.C. 1-1/2" Ø, 328 Sections	1,735.00			
Spare Parts	77.00			
Surveying		250.00		
Specialized Labor Force		105.00		
Nonspecialized Labor Force			100.00	
Per Diem		66.00		
Total	1,848.00	421.00	100.00	2,369.00

*GOP - Government of Panama

Table C-7. Cost For Gravity Source By Type of Aqueduct (Cont'd)

	AID	GOP *	Community	Total
Water System Type C				
Materials for Capping Water Source	36.00			
P.V.C. 2" Ø, 328 Sections	2,716.00			
Spare Parts	127.00			
Surveying		250.00		
Specialized Labor Force		105.00		
Non Specialized Labor Force			100.00	
Per Diem		66.00		
Total	2,879.00	421.00	100.00	3,400.00
Water System Type D				
Materials for Capping Water Source	36.00			
P.V.C. 3" Ø, 328 Sections	5,697.00			
Spare Parts	326.00			
Surveying		250.00		
Specialized Labor Force		105.00		
Non Specialized Labor Force			100.00	
Per Diem		66.00		
Total	6,059.00	421.00	100.00	6,580.00

*GOP - Government of Panama

Table C-8. Costs of Source For Pumped Systems and Well Drilling

	Quantity	Cost Per/ Unit	Aid	GOP*	Community
Cost of Well					
8" Ø (20% of the wells)	20 feet	21.45	86.00		
6" Ø (8" in some cases)	120 feet	9.90	1,188.00		
6" stainless steel	10 feet	33.00	330.00		
1-1/2 galvanized pipe	120 feet	1.06	127.00		
2" galvanized pipe	120 feet	1.66	199.00		
Spare parts (security valve, sanitary seal)			208.00		
Well Drilling Operator	15 d ys	21.00		315.00	
Well Drilling Assistant	15 days	14.40		216.00	
Per Diem	30 days	4.40		132.00	
Supervisor	2 days	50.00		100.00	
Work Team and Well Testing	3 days	65.00		195.00	
Rocks, babit, welding, etc.				90.00	
	Subtotal Well		2,138.00	1,048.00	
Cost of Pump Shelter					
Pump			2,409.00		
Materials (zinc roof, cement)				345.00	
Rocks, Sand	5 yd^3	6.60			33.00
Cement Blocks	200	0.37			74.00
Miscellaneous Materials					50.00
Labor	50 days	5.00			250.00
	Subtotal		2,409.00	345.00	407.00
	Total		4,547.00	1,393.00	407.00

*GOP - Government of Panama

Table C-9. Summary Costs By Agency For Different Types of Water Systems

(Exlcuding Costs For Source or Well)

	Type A			Type B			Type C			Type D		
	AID	GOP *	COM **	AID	GOP	COM	AID	GOP	COM	AID	GOP	COM
Materials For Storage Tank	$95		$612	$95		$612	$95		$748	$125		$1,274
Materials Distribution System	$1,443			$3,629			$10,123			$16,364		
Labor		$2,332	$850		$3,082	$1,785		$4,583	$4,150		$6,084	$8,550
Audio Visual Team		$30			$40			$50			$60	
Transportation		$500			$650			$1,000			$1,200	
Right of Way			$300			$400			$500			$700
Sub-Total	$1,538	$2,862	$1,682	$3,724	$3,772	$2,797	$10,218	$5,633	$5,398	$16,489	$7,344	$10,524

* Government of Panama

** Community

Table C-10. Planned Distribution of Costs Per Unit For Wells and Aqueducts Under Loan 040 and Loan 045

Planned Distribution	Loan 040	Loan 045*
Wells		
AID	38%	42%
MOH	48%	42%
Community	14%	16%
Total	100% $1,090	100% $1,270
Aqueducts		
AID	38%	52%
MOH	35%	23%
Community	27%	25%
Total	100% $18,070	100% $25,500

Source: Project papers for loan 040 and loan 045.

* Planned costs correspond to new requirements (March 1979) for reimbursement for type C systems.

APPENDIX D

REGULATIONS FOR MANAGING RURAL WATER SYSTEMS

Regulations For Managing Rural Water Supply Systems

The following is a translation from Spanish of the regulations for managing rural water supply systems, issued by the Ministry of Health in 1976.

Introduction

The Water Supply Program may be considered as one of the greatest challenges faced by the National Government. Its design and implementation has required and continues to require an aggressive effort on the part of many different sectors. The basic problem is that of the highly scattered nature of the country's 9,000 or so communities encompassing nearly 550,000 inhabitants and some 100,000 housing units with no safe water supply.

Working through the Health Ministry, the government and the people have brought about qualitative and quantitative changes in ways and means of meeting basic human needs. This modernization of our water supply systems also offers an appropriate solution to the problem of waste disposal, as well as to other human health problems.

Since 1969, we have constructed a total of 440 rural water supply systems serving a target population consisting of 91,229 households scattered throughout rural areas inhabited by men and women eager to improve their precarious health conditions and to surmount the hurdles of underdevelopment and poverty. Most of the moral and economic support received by the National Government in its effort to ensure the success of its Water Supply Program is rooted in this unquenchable thirst of its people to fight for what they believe in. There is one essential aspect of the program which cannot and will not be overlooked--namely the management of these water supply systems. It is essential to establish a code of regulations in mutual agreement with the community to ensure optimal use of the water supply system. The community must combine resources and join forces to make sound decisions resulting in the elimination of specific sources of disease. A positive attitude on the part of each community as a whole will encourage individual members of the community to work towards overcoming the contradictions representing an inherent cause of their underdevelopment and poverty. Through this responsible, ongoing joint effort by the government and the community, all Panamanians shall be given an opportunity to reap the rewards of hard work through the miracle of modern technology.

The regulations issued by the Administrative Council in charge of the rural water supply system and serving as guidelines for the effective delivery of this essential health service must be enforced by all communities without exception if they are to preserve their invaluable asset. The Ministry of Health is offering all communities throughout the country participating in the construction of their own village water supply system both its advice and its collaboration in recognition of their willingness to work towards improving the lives of all community members.

Dr. Abraham Saied
Minister of Health

Regulations For Managing Rural Water Supply Systems

The Community of_____, Township of_____ _____, acting in collaboration with the Ministry of Health, having completed construction of its water supply system, hereby agrees to issue formal regulations with respect to the management of this system which is expected to improve the standard of living of each and every household within the community.

2. The purpose of these regulations is as follows:

a) to establish basic rules and regulations with respect to the management, maintenance, operation, upgrading and expansion of the water supply system;

b) to protect the entire system, including the water source and its area of influence, in an effort to ensure a sufficient supply of safe water, thereby preserving and improving the health of the people;

c) to raise community consciousness and create a sense of responsibility vis-a-vis the rational use of the community water supply system, at the same time improving individual and community health and hygiene;

d) to establish specific measures designed to encourage the concentration of communities within the coverage area of the water supply system, making it possible to expand health service coverage and guarantee system efficiency and economy.

3. All system users will be held equally responsible for enforcing these regulations. The system belongs to the whole community and is the property of all present and future community residents.

However, the community will appoint a special council vested with responsibility for managing its water supply system through the local Health Committee or Community Council.

4. The responsibility for system operation and maintenance shall be entrusted to an Operator, to be selected by the group responsible for managing the water supply system. His duties will be as follows:

a) to ensure system operation and maintenance, acting on verbal and written instructions;

b) to promptly inform Health Committee officials or, in the absence of a Health Committee, the Community Council of any problem with or damage to the system;

c) to promptly issue written orders for all fuel, lubricating oils and other materials and equipment required for proper system operation and maintenance;

d) to maintain a permanent stock of extra fuel, oil and spare parts to prevent an interruption in the water supply;

e) to take full responsibility for all fuel, oil, tools, and equipment placed at his disposal;

f) to inform the Council as to the consumption of fuel and oil, the number of hours of pump operations, etc.;

g) to keep the shed freshly painted and the surrounding areas clean;

h) to coordinate his work with that of the members of community organizations and maintain good relations with the community;

i) to attend seminars and training courses sponsored by the health authorities;

j) to attend meetings of the Administrative Council.

5. System Users

a) Obligations of users involved in construction of the water supply system:

1. to help ensure smooth system operation and proper maintenance;

2. to pay a monthly water user charge by the fifth day of each month;

3. to repair any damage to the system occurring on their own property from the point of the shut-off valve;

4. to extinguish all debts pending from construction of the water supply systems;

5. to avoid wasting water;

6. to attend meetings and seminars organized by the Council.

b) Obligations of users who were not involved in construction of the water supply system:

In addition to the responsibilities, obligations, and rights described in the previous section devoted to users involved in construction of the water supply system, this latter group of system users will have the following duties and obligations:

1. They must provide all materials required for installing their water service, from the water main as far as their land or dwelling;

2. They will be responsible for all excavation work required for their connection to the system;

3. They must supply five (5) man-days of labor for upgrading the water supply system or the equivalent in cash based on the daily wage paid within the community;

4. Users faithfully fulfilling all commitments set forth in the present chapter will be exempt from payment of the regular connection charge.

6. Water Use

a) Authorized Uses

Rural water supply systems are designed and constructed to supply safe water for domestic human use for drinking, personal hygiene, laundering clothes, cooking, and washing housewares and utensils.

b) Unauthorized Uses

Water from rural water supply systems may not be used for present or future profit-making activities carried on within the community such as plants and factories, pigpens, milking stalls, field crops, truck-gardening, hotels, guest houses, public or private swimming pools, or any other type of commercial or residential building containing more than two lavatories.

Likewise, both the community and the Administrative Council responsible for the village water supply system are strictly forbidden to authorize the use of water from this system for existing and/or new housing development or land development schemes specifically designed to take advantage of the appreciation or increased value of the land as a direct result of the construction of the water supply system.

c) Conditional Use

In the case of a gravity-fed rural water supply system with design and flow such as to service a new real estate development, the land owner will be required to donate 10% of the sales value of each lot to the Administrative Council, to be used to supplement funds for future expansion and upgrading of the system.

d) Wasteful Use of Water

It is also forbidden to waste water from rural water supply systems. To ensure the repair of any and all damage resulting in additional waste of water, all property owners will be required to consult the local plumber and request that the latter make any corresponding repairs or adjustments.

The Administrative Council is authorized to take any and all desirable steps to limit water consumption.

7. User Charges

The water supply system belongs to the entire community as a facility created by the community and the Revolutionary Government through the Ministry of Health in an effort to improve health and well-being and to forge stronger ties among all members of the community.

In this context, the sole objective of an enlightened, dynamic community is to keep the system operating smoothly. To accomplish this, it is obvious that system users must cooperate by paying monthly user charges, to be used to defray expenses incurred in connection with the operation and upgrading of the system. The rates established by the community should adhere to the following guidelines insofar as possible:

a) Gravity-fed Systems

1. A minimum unit charge of 0.50 balboas per dwelling not equipped with its own lavatory, with the same minimum charge to apply to all users fetching water from public taps or hydrants;

2. A minimum of 1.50 balboas per dwelling equipped with its own lavatory;

3. A minimum of 2.00 balboas for buildings housing a small business establishment;

4. A minimum of 4.00 balboas for buildings housing a small business establishment and equipped with a maximum of two lavatories;

5. The Administrative Council will establish a special rate for large businesses categorized as placing no special strain on community water supplies.

b) Pump-activated Systems

1. A minimum of 1.50 balboas per dwelling connected to the system and 1 balboa for users fetching water from public taps or hydrants;

2. A minimum of 2.50 balboas per dwelling equipped with its own lavatory;

3. A minimum of 3 balboas for buildings housing a small business establishment;

4. A minimum of 5 balboas for buildings housing a small business establishment and equipped with a maximum of two lavatories;

5. The Administrative Council will establish a special rate for large businesses categorized as placing no special strain on community water supplies.

c) Delinquency, Surcharge, Reconnection

1. Users will pay a 10% surcharge on payments up to sixty days in arrears.

2. However, effective as of the beginning of month number three, they will be given a deadline of eight (8) days in which to pay off their debt, whereupon their water will be cut off subject to authorization from the Community Council.

3. Users wishing to have their service reconnected will be required to pay the cost of all necessary materials and equipment and settle all outstanding debts.

4. All users discovered wasting water from the system will be given two warnings. A third violation will result in their being turned in to the appropriate authorities.

5. All persons with unauthorized connections into the system will have their service disconnected and will be ordered by the authorities to pay a fine.

6. System users supplying water to another family will be required to pay double.

7. Any and all penalties imposed for other types of violations must be approved in advance by the local Health Board and/or by the Community Council and the community per se.

d) Under no condition may the community collect assessments for improvements on any property served or benefiting from the water supply system inasmuch as such procedure requires legal backing from the Executive branch of government.

8. System Funds

a) All funds obtained through operation of the water supply system will be used primarily for system maintenance and upgrading.

b) In special instances, the Council may earmark certain sums for use in promoting other community activities depending on the amount of funds available.

c) All such funds will be kept on deposit at the nearest branch of of the National Bank.

d) A sum of ten (10) balboas will be maintained in a petty cash fund for contingencies (or unforeseen expenses).

9. System Operation

All water supply systems are composed of different elements requiring varying degrees of supervision, inspection, and adjustment.

In the case of gravity-fed systems, someone from the community must maintain strict control over the water source and surrounding areas, the intake works, storage tank, water main and feeder lines, taps, and hydrants.

Obviously, the services of an operator are essential to the operation of pump-activated systems, with the latter responsible for activating the pumpset, for changing the oil as required and, in general, for caring for and protecting the entire, extremely costly and at the same time invaluable, water supply system, as well as for keeping the shed and surrounding areas clean and free from debris.

To ensure proper surveillance and operation of either type of system--whether gravity-fed or pump-activated--the community must recruit an operator, who will be expected to perform his duties with total dedication and integrity more as a provider of a public service to the community than as a typical private-sector employee.

In light of the above, we recommend that the operator of a gravity-fed water supply system be paid a maximum of 15 balboas per month and that the operator of a pump-activated system be paid a maximum of approximately 20 balboas per month with their actual wages depending on the income generated by the water supply system.

10. System Maintenance

All expenses incurred in connection with the upgrading, maintenance, and expansion of the water supply system must be defrayed by the community out of the funds generated by water charges and other operations.

Fully aware of the need to provide safe water to large numbers of communities still not served by a rural water supply system, the Ministry of Health will focus all its efforts on new target communities, while agreeing to provide previously equipped communities with the technical assistance services needed to ensure the smooth operation of existing water supply systems.

11. Violations and Penalties

The following are considered violations:

a) Nonpayment of water charges;

b) Waste of water;

c) Connection to the system without previous authorization from the Administrative Council;

d) Supplying water to neighbors without previously consulting the Administrative Council.

12. Reporting System

a) A monthly report must be submitted for review by the Community Council, the local Board of Health and the Ministry of Health/ Provincial Environmental Health Program management.

b) These reports will be submitted to the Municipal Assembly during sessions of the Community Council and/or Committee.

APPENDIX E

DATA ON SAMPLE SITES

Table E-1. Description of Sample Sites

Site	Year of Completion	Water Source	Energy Type	System Changes	Number of Connections	Number of Houses	Estimated Population Served	Estimated Total Population	Max. Population Per Original Design Specifications
1.	1975	Ground	Diesel	No	80	107	400	535	700
2.	1978	Ground	Diesel	No	59	59	295	295	560
3.	1976	Ground	Diesel	No	33	33	165	165	330
4.	1976	Ground	Diesel	No	44	44	220	220	470
5.	1978	Ground	Diesel	No	28	28	140	140	360
6.	1976	River	Diesel	No	38	50	190	250	800
7.	1979	Ground	Gas	No	5	7	25	35	70
8.	1979	Ground	Electric	No	57	60	285	300	600
9.	1976	Ground	Electric	No	67	85	335	425	814
10.	1977	Ground	Electric	Yes*	108	160	540	800	924
11.	1976	Ground	Electric	No	82	82	410	410	414
12.	1980	Ground	Electric	No	21	21	105	105	210
13.	1972	Ground	Electric	Yes*	270	300	1,350	1,500	986
14.	1976	Ground	Gravity	No	38	42	190	210	410
15.	1977	Ground	Gravity	No	47	80	235	400	534
16.	1974	Ground	Gravity	No	63	73	360	365	664
17.	1978	Ground	Gravity	No	43	44	215	220	470
18.	1979	Ground	Gravity	No	32	40	160	200	400
19.	1979	Ground	Gravity	Yes*	108	109	540	545	948
20.	1977	Ground	Gravity	No	28	29	140	145	280
21.	1980	Ground	Gravity	No	25	31	125	155	250
22.	1975	Ground	Gravity	No	75	80	375	400	400
23.	1979	Ground	Gravity	No	32	36	160	180	270
24.**	1979	Ground	Gravity	Yes*	260	320	1,300	1,300	2,600
25.***	1973	Ground	Gravity	No	77	87	175	225	224
26.**	1979	Ground	Gravity	No	31	31	155	155	310

* Systems 9 and 13 changed from gas to electric; system 19 changed from gas to diesel to gravity, and system 24 changed from gas to gravity.

** Multivillage system

*** System originally designed for 35 connections; 42 additional vacation cottages have been built by representative.

Table E-2. Viability of Dies
Technical, Ec

Site Number	*Summary Ratings	Technical Indicators					Economic I		
		*Reliability of Source	*System Design	*Service History	*Maintenance History	*Community Technical Expertise	Monthly Fee U.S. $	Collection Problems	Fees Cover Operating Costs
Diesel									
1.	B	G	F	B	B	F	2.00	Yes	No
2.**	G	G	E	G	G	G	1.50	No	No
3.	F	G	F	F	F	F	1.00	Yes	No
4.	F	G	G	F	F	F	2.00	Yes	No
5.	G	G	G	G	G	G	1.50	No	No
6.	B	E	G	B	B	F	3.00	Yes	No
Gasoline									
7.	G	G	G	E	E	G	2.00	No	Yes

N.A. = Not applicable
*Each indicator is evaluated Excellent (E), Good (G), Fair (F), a
**Community #2 will change to electricity soon.

iesel and Gasoline Piped Water Systems Visited,
Economic and Social Indicators

c Indicators			Social Indicators		
Operating Costs	Community Savings (U.S. $)	Community Covers Operating Costs	*Management of Water System	Source of Leadership	Other Social Characteristics
o	No	No	B	Local	Poor Village Internal Social Conflicts
o	400.00	Yes (Fiestas)	E	Local & Teacher	Richer Village
o	No	Yes	F	Teacher	Isolated
o	No	Yes	F	Local & Family	
o	No	Yes (Representative)	E	Local	Poor Village; Representative Resides in Village
o	No	No	B	None	Close to Banana Plantation Receiving Services Free
s	No	N.A.	G	Representative	No Formal Organization; Community Works Directly With Representative

and Bad (B) to facilitate comparison.

Table E-3. Viability of
Technical, Ec

Site Number	*Summary Ratings	Technical Indicators: *Reliability of Source	*System Design	*Service History	*Maintenance History	*Community Technical Expertise	Economic Ir: Monthly Fee U.S. $	Collection Problems	Fees Cover Operating Costs	
Electric										
8.	G	E	E	E	G	F	2.00	Some	Yes	
9.**	G	E	F	F	G	G	2.00	No	Fee Raised	5
10.**	G	E	F	F	G	G	1.00	No	No	5
11.	G	E	G	G	G	G	1.00	Some	Fee Raised	
12.	G	E	E	E	E	E	1.50 - 3.00	N.A.	Yes	
13.	F	G	F	F	G	G	***	Some	Yes	

N.A. = Not Applicable

*Each indicator is evaluated Excellent (E), Good (G), Fair (F), and

**Communities #9 and #11 will increase tank capacity.

***Monthly fee included in electric bill.

lectric Piped Water Systems Visited,
iomic and Social Indicators

icators		Social Indicators		
(U.S. $)	Community Covers Operating Costs	*Management of Water System	Source of Leadership	Other Social Characteristics
No	Yes (Village Council)	F	Local	Bedroom Community to Panama City, Easy Access to DEH Technical Assistance
).00	Yes (Representative)	G	Local	Representative Resides in Village, High Population Growth
).00	Yes (Representative)	E	Local	High Population Growth
No	Yes (With New Fees)	G	Local	Water Committee Recently Reorganized. Leader is a Woman
No	N.A.	F	Local	New System - Strengthening Water Organization
No	N.A.	F	Medical Doctor & Representative	High Population Growth

ad (B) to facilitate comparison.

Table E-4. Viability of Gravity Piped Wat
Technical, Economic and Social

Site Number	*Summary Ratings	Technical Indicators					Economic Indicators				
		*Reliability of Source	*System Design	*Service History	*Maintenance History	*Community Technical Expertise	Monthly Fee U.S. $	Collection Problems	Fees Cover Operating Costs	Community Savings (U.S. $)	Community Covers Operating Costs
Gravity											
14.	G	G	F**	G	G	G	.50	No	Yes	No	N.A.
15.	G	G	G	G	G	G	.50	No	Yes	250.00	N.A.
16.	B	F	F	F	B	F	.50	Yes	Yes	No	N.A.
17.	G	G	G	G	G	G	.75	No	Yes	298.00	N.A.
18.	G	F	G	F	G	G	None	N.A.	N.A.	pipes & materials	Yes (Vil Counci
19.	G	G	G	F	G	G	.50 - 2.00	No	Yes	111.00	N.A.
20.	G	G	G	G	F	F	None	N.A.	N.A.	85.00	Yes (Chu Group)
21.	G	F	G	F	G	G	.25	No	Yes	10.00	N.A.
22.	G	G	F	F	G	G	.50	No	Yes	No	N.A.
23.	F	G	F	F	F	G	.50	No	Yes	No	N.A.
24.	F	G	F	B	G	G	1.50 - 4.00	No	Yes	300.00	N.A.
25.	B	B	F**	B	G	F	.50 - 1.00	Some	Yes	No	N.A.
26.	B	B	B	B	F	F	1.00	Yes	Yes	No	N.A.

N.A. = Not Applicable
*Each indicator is evaluated Excellent (E), Good (G), Fair (F), and Bad (B) to facil
**System is rated Fair (F) because of turbidity in the water supply

Systems Visited,
licators

	Social Indicators		
	*Management of Water System	Source of Leadership	Other Social Characteristics
	G	Local	Poor Village
	G	Local	Negotiating With DEH to Expand Coverage
	B	Local	Poor, Isolated Village, Only One Person in Charge of O & M
	G	Local	
e	G	Local	Poor Isolated Village
	E	Local	
1	B	Local	Inactive Organization After System Completed
	G	Local	
	G	Local	
	G	Local	Remote Indian Village
	G	Medical Doctor	
	B	Representative & Paramedic	Representative Built Tourist Cottages That Reduce Water Supply
	B	Local	Ethnic Conflicts Between Village Leaders and Representative

ate comparison.

APPENDIX F

COMPLETED WATER SYSTEMS BY PROVINCE

Table F-1. Piped Water Systems Completed Under Loans 040 and 045, By Province

Province	Loan 040	Loan 045	Total
Bocas del Toro	10	2	12
Cocle	39	46	85
Colon	21	15	36
Chiriqui	52	39	91
Darien	6	6	12
Herrera	22	18	40
Los Santos	28	41	69
Panama	46	39	85
Veraquas	64	61	125
San Blas	3	4	7
Total	291	271	562

Source: H. Caudill (AID Project Manager), 6/80.

APPENDIX G

HANDPUMPED WELLS AND LATRINES INSTALLED BY THE MINISTRY OF HEALTH

Table G-1 Number of Handpumps and Latrines Installed By MOH, By Year

Year	Latrines	Handpumped Wells
Before 1968	No Information	2,885
1968	1,829	168
1969	4,726	304
1970	6,051	397
1971	5,294	331
1972	6,078	195
1973	6,431	244*
1974	6,621	250*
1975	6,763	264*
1976	9,011	355*
1977	8,142	410
1978	7,723	355
Total	68,669	6,158

Source: Department of Environmental Health, Ministry of Health, 6/80

* AID Funded

APPENDIX H

LIST OF PERSONS INTERVIEWED

List of Persons Interviewed

The following persons were consulted by the evaluation team and provided assistance with this report.

USAID Panama

Aldelmo Ruiz
Herbert Caudill, Jr.
Pedro Martiz
John Champagne
Guillermo Riley

USAID Washington

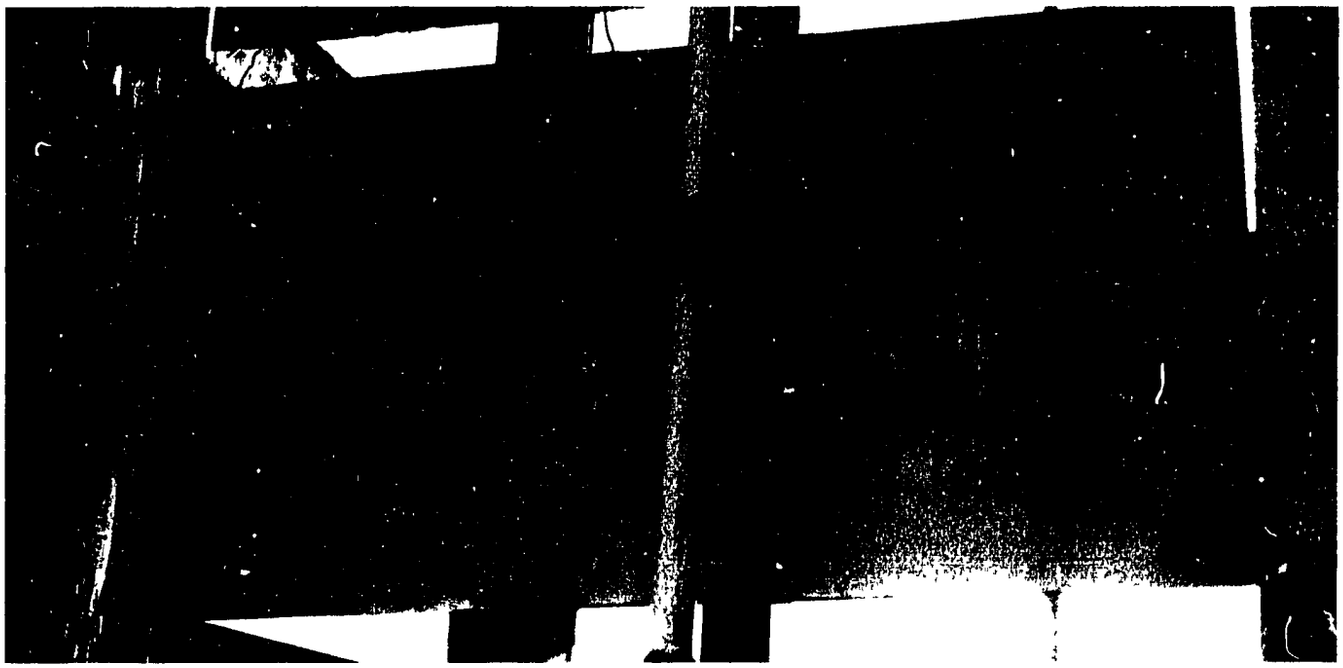
Bernice Goldstein - LAC/DP
Abby Bloom - PPC/PDPR
Tony Cauterucci - LAC/DR
Vic Wehman - S&T/HEA
Daniel Dworkin - PPC/E/S
B. Chapwick - S&T/PO
B. Sandoval - LAC
F. Montanari - NE/PD

MOH Panama

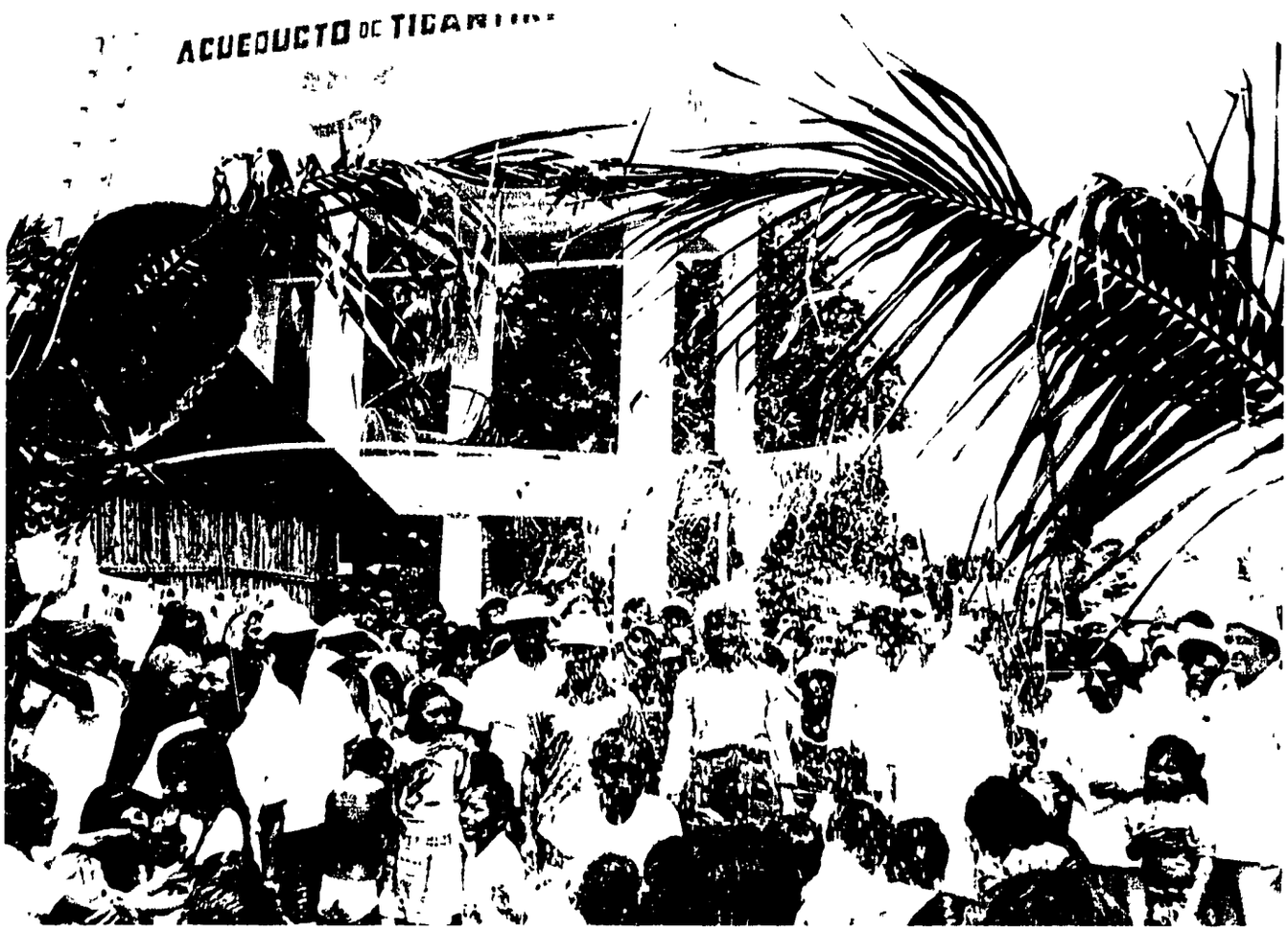
Cristobal Tunon
Jorge Montalban
Noel Camarano
Antonio Sucre
Abdiel Zarate
Francisco Bernal
Aurelio Ramos
Miguel Arcia
Arcelio Batista
Jacob Cattan
Juan Jose Lezcano
Pablo Beitia
Jose Modesto Dutari
Benito Perez
Alejandro Sucre
Argelio Reyes
Aristides Macias
Edith de Bethancourt
Jose Orcasita
Rodrigo Vasquez
Hector Barahona
Manuel A. Escala
Jairo I. Freitas
Emilio Navarro
Enrique Jaen
Benigno Argote
Donatilo Dominguez
Climaco Molina
Odilio A. Laverone
Guillermo Rodriguez
Adolfo Name
Alberto Leon
Edilberto Villar
Jose Pino
Brigido Poveda
Armando Humberto Jaen

APPENDIX I

PHOTOGRAPHS



A sign announces the arrival of piped water in a rural Panamanian community.



When a new piped water system is inaugurated, members of the community, MOH technicians and government officials participate in a joyful celebration.

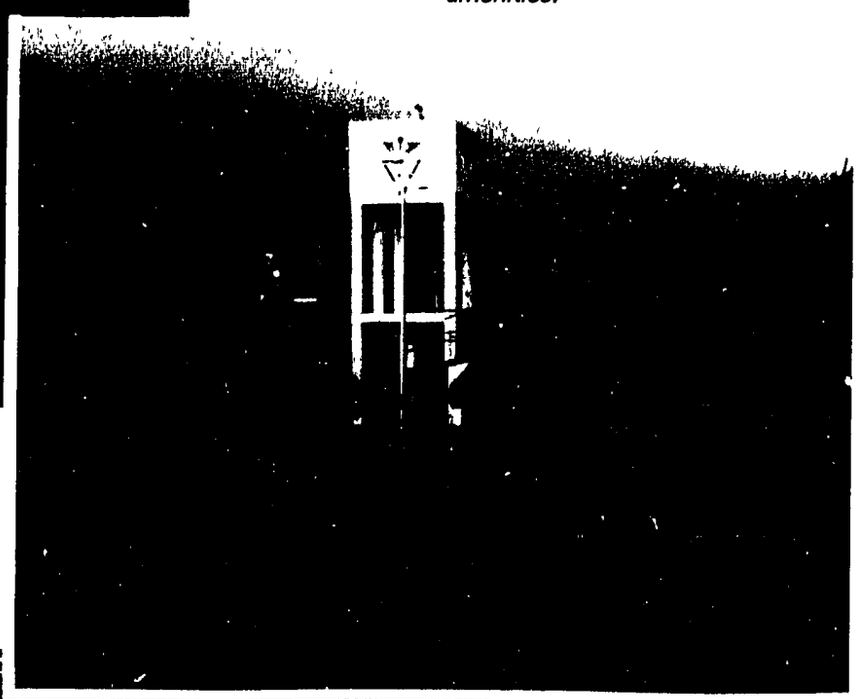
Both men and women participate in the installation of village piped water systems.

DEH technicians provide villagers with on the job training in the installation of PVC pipes.

PVC pipes are relatively inexpensive and easy to install. Sometimes they were connected to springs as far as 20 kilometers from the village.

Antonio Sucre, DEH Chief Engineer, examines the concrete apron at a spring that has been capped.

A community's water storage tank symbolizes its modern piped water amenities.



A filtering system uses sand to remove mud from water before it flows to village taps.

Most handpumps were installed in communities that were too small to qualify for a piped water system.

Before the installation of piped water service, village women washed clothes in local streams that also provided drinking water.

Handpumps are often unreliable. According to DEH estimates, 40-50 percent of handpumps may not be operating at any one time.

With the installation of piped water systems, women no longer have to carry water. In one San Blas village, women have doubled their monthly production of multi-layered fabrics (molas).

Piped water systems make life easier for women, providing extra time for resting or taking care of children.

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