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Study of Rural Water Supply

and Sanitation

Peru

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STUDY OF RURAL WATER SUPPLY AND SANITATION PROGRAMS

A brief resume will be given in this section of the rural water supply and sanitation program in each of the countries included in the present study. The same general outline will be followed in the presentation for each of the countries.

PERU

HISTORY OF THE RURAL WATER SUPPLY AND SANITATION PROGRAM

While a number of rural water supply projects had been constructed in Peru on an ad hoc basis before 1961, it was in March of that year that the first attempt was made to develop a rural water supply program. It was carried out as a part of the Basic Rural Sanitation Plan for the Department of Junin^{1/}. This program was undertaken as a demonstration project with major cooperation of UNICEF in material and equipment; technical assistance by the Pan American Health Organization; technical and financial assistance of the United States government and the government of Peru through the Servicio Cooperativo Interamericano de Salud Publica; funds earmarked for sanitation, provided by the Public Works Committee of Junin; execution of the Plan by the Health District through its professional and auxiliary personnel; and by the full support of the communities benefitted through their provision of labor, local materials and funds. By choosing the projects which were most economical to construct, the systems built under this program averaged \$/140 per capita. Most of the service was

^{1/} Plan Nacional de Agua Potable Rural - Primera Etapa Peru 1963 - Ministerio de Salud Publica y Asistencia Social Servicio Especial de Salud Publica.

INTRODUCTION

During the five year period from 1971-1975, some progress has been made in providing people living in rural areas in the developing countries with water supply and excreta disposal services. The percentage of the rural population having reasonable access to safe water rose from 14% in 1970 to 20% in 1975.^{1/} The rural population with sanitary excreta disposal facilities increased from 9% to 12% during the same period. Some countries have made excellent progress while others have barely kept pace with population growth.

Revised regional goals for 1980 have been suggested by WHO for each of its six regions, based on progress achieved during the first half of the present decade. These targets result in a derived global target of 36% of the rural population with reasonable access to safe water to be achieved by 1980 and for 24% of that population to have adequate excreta disposal facilities. Even these modest goals will require an estimated expenditure of US\$8,500 million (\$6,500 and \$2,000 respectively) from 1976 through 1980, equal to an annual expenditure of US\$0.82 per capita for water supply and US\$0.55 per capita for excreta disposal facilities (based on 1980 population estimates).

^{1/} World Health Organization, Community Water Supply and Wastewater Disposal (Mid-decade progress report) Document A29/12, 29 March 1976.

provided through public hydrants at a rate of from \$/.3 to \$/5 per family with the rate of \$/8 being established for service through a house connection. This was sufficient to pay the cost of operation and maintenance and set aside a small amount to take care of future needs and extensions.

In February 1961 work was started on a nation-wide study in all the Districts of the country, consisting of preliminary studies and engineering designs for the provision of potable water to the cities and towns. By 1963, 70% of the country had been covered. These studies have been invaluable in the planning for sanitary works in both urban and rural areas. The studies completed at that time served as the basis for the request in 1962 to the Interamerican Development Bank for a loan to provide potable water and sanitary privies for 300 towns of less than 2000 population in ten departments. The request was reduced in 1963 to a 2 year program for 150 towns in six departments. Estimates were based on an estimated cost of \$/.400 per capita, allowing 60 to 100 liter/cap/day. A water rate of \$/10 per family per month was estimated based on a wage of per day and considering 8 days labor per year. The loan, which was signed in March 1964 provided water supplies for 202 villages.

A second loan was signed in April 1967 to provide water supply services for 380 towns and a third loan was signed on to provide water supply for an additional 270 villages. See Figure for a graphic presentation of the funds invested in rural water supply projects between 1962 and 1975. It is noted that the rate of investment in rural water supply construction has dropped off somewhat since 1974, in spite of much higher per capita costs which have risen from \$19.26 during the second stage to \$43.47 during the third stage of the program. Work is still in progress financed in part by the third loan.

Thus a country-wide rural water supply program has grown from a demonstration project started in 1961. 661 systems have been constructed serving 753 towns with 681 Administrative Committees in charge of administering, operating and maintaining those systems. 47,180 house connections have been installed since 1965 as detailed in Figure I. The Administrative Committees have built up a reserve of over \$/5 million after paying the operating and maintenance cost of their systems, and have contributed nearly \$/.35 million toward the capital cost of those systems. (See Figure for dollar equivalents).

POPULATION WITH WATER SUPPLY SERVICES

Year	<u>WATER SUPPLY SERVICES (THOUSANDS)</u>							
	<u>URBAN</u>				<u>RURAL</u>			
	Population	By House Connections		By Public Standposts		Population	With Reasonable Access	
	No.	%	No.	%		No.	%	
1969	5300	2570	48	1090	21	6900	580	8
1975	8900	4961	56	140	2	7533	685	9

See Figure II for a comparison of the growth of the urban and rural population in Peru from 1969 to the end of 1975 with the number of people benefitting from water supply services.

ORGANIZATION RESPONSIBLE FOR RURAL WATER SUPPLY PROGRAMS

The Law for Basic Rural Sanitation passed in February 1962 made the Ministry of Public Health responsible for administering the program covered by the Law. The Sanitary Engineering Office of the Ministry is charged with carrying out the program. The organization of that office at the national level is shown in Figure III and IV.

The work of the Office is not decentralized, except as it works through the Health Zones and Hospital Areas of the Ministry. In addition to personnel assigned to the Central Office, a staff of approximately 25

Fig. 1
PERU
HOUSE CONNECTIONS INSTALLED
NATIONAL PLAN FOR RURAL WATER SUPPLIES

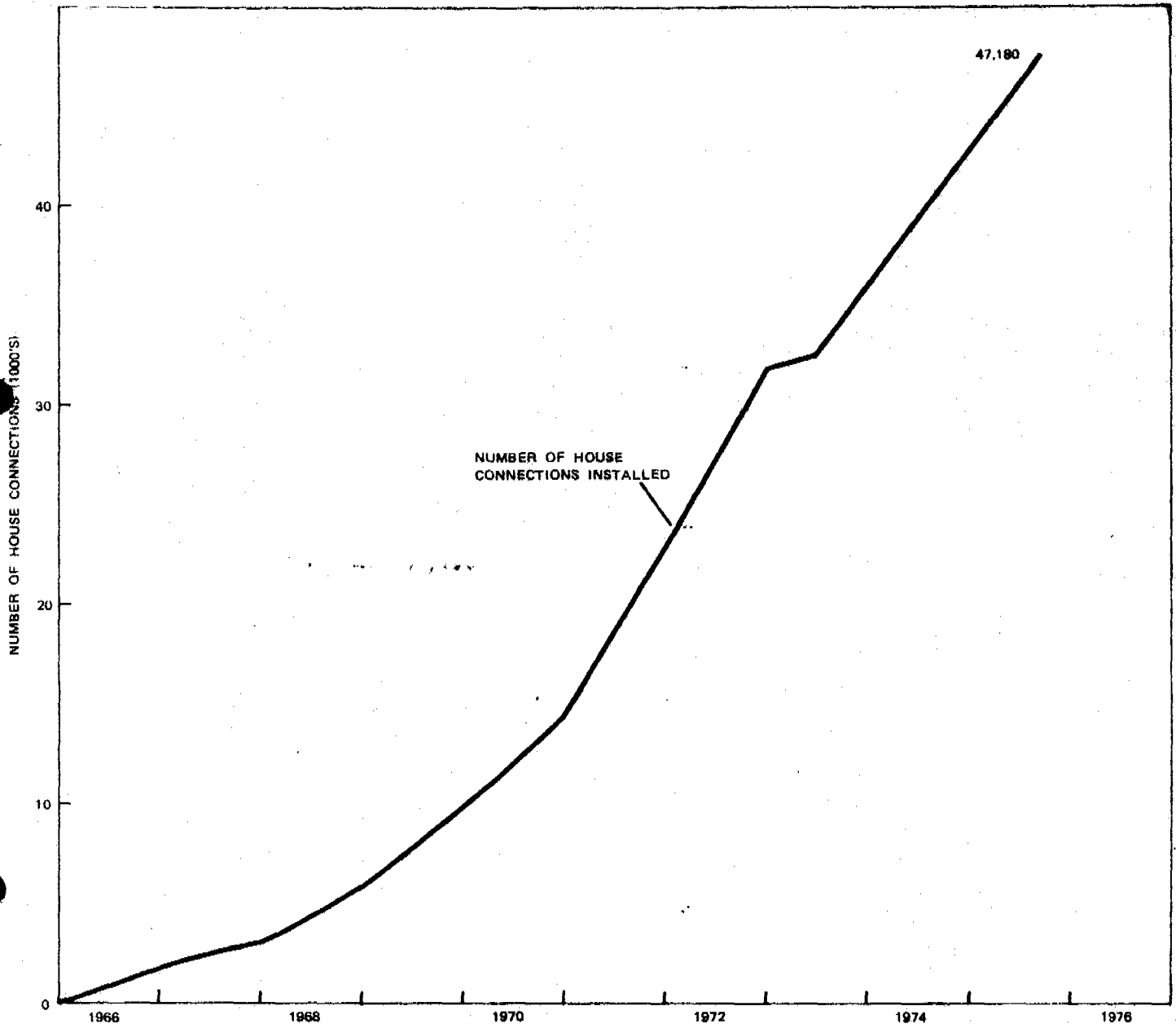
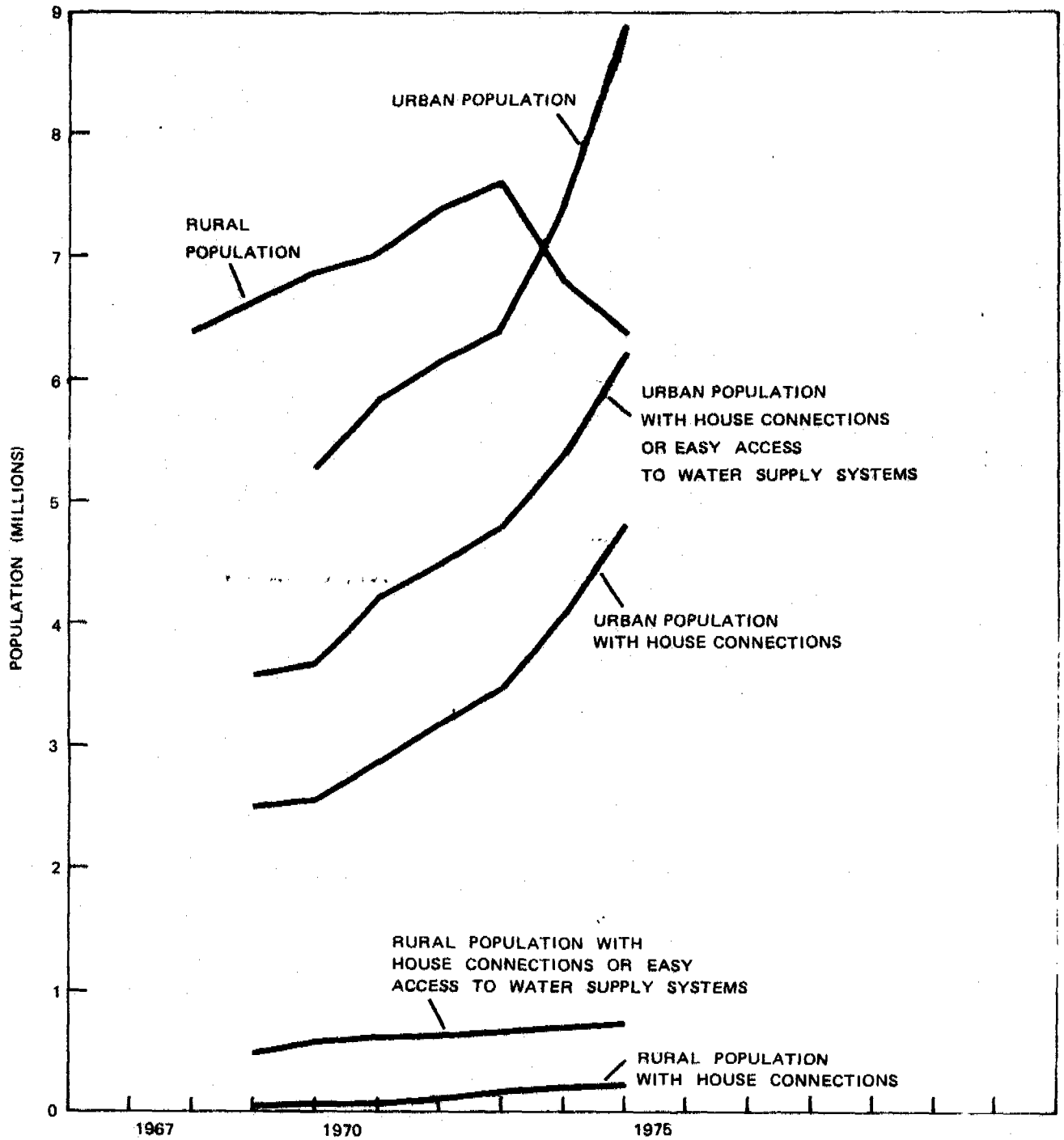


Fig. II
PERU
POPULATION AND POPULATION WITH WATER SUPPLY SERVICES



(DATA FROM PAHO ANNUAL REPORTS)

engineers (including 4 sanitary engineers) works in the field with supervision from the Central Office. Figure V indicates the responsibilities at national, health zone and hospital area, and at community level for the three stages of each project, namely studies and designs, construction, and operation and maintenance.

As of January 1976 the staff of the Sanitary Engineering Office assigned for carrying out the National Program for Rural Water Supplies (PNAFR) consisted of the following:

Engineers - National Level	18
Health Educators	25
Promoters	1
Administrative Personnel	59
Secretaries	22
Sanitary Inspectors (assigned by the regional health offices to supervise operation and maintenance)	18
Total	<hr/> 151

STUDIES AND DESIGNS

The studies and preliminary designs made as part of the nationwide study started in 1962 are brought up to date based on design standards issued in 1974. Standard designs are used wherever possible for such items as storage tanks, pump houses, infiltration galleries, house connections, etc. Infiltration galleries are used with good success, also multiple systems where a number of villages are served from a single source. The studies and designs are carried out by Central Office staff. The same office also takes off material lists and estimates the cost of the projects.

STUDIES & DESIGNSCONSTRUCTIONOPERATION & MAINTENANCECENTRAL OFFICE

PROJECTS DIVISION

Makes Studies & Designs

PROMOTION (1 Eng.
2 H. Ed.
2 Aux.)

Helps Form Admin. Committee in Community.

Supervises Aux. Promoter

WORKS DIV.

Assists in Contract Presentation to Community.

Supervises Zone Eng., Maintains Const. Cost Data.

ADMINISTRATION UNIT

Mat., Equip., Pipe Bought through int. Bids; Cement and Steel Mat. Purchase. No Purchases at Local Level. General Administrative Services.

SUPERVISION OF SERVICES

In Charge of House Conn. Campaign, Calculates Water Rates.

Assists with Extensions, Repairs, Analyzes Incomes from Systems, When Info. Available.

WATER QUALITY CONTROL

Analyzes Water from Possible Sources.

Responsible for Chlorination Program When Used, Also Water Quality Control.

HEALTH ZONES &/OR
HOSPITAL AREASENGINEER (21 Civil
4 Sant.)

Helps Aux. Promoter with Survey, and Organization of Community.

In Charge of Construction

No Responsibility for O & M Except to Instruct Admin. Comm. in Duties for O & M.

SANITATION TECH. (18)
(Assigned by hosp.
Paid by hosp.)

No Responsibility for Const. Phase.

Assigned by Regional Doc. Supervises O & M Reviews Accounts if Submitted Instructs Operator in His Duties.

AUX. PROMOTER (65)

Makes Socio-Econ. & Population Survey, Participates in Forming Administrative Comm. Advises Comm. on duties Generally from the Town in Which System is Being Built.

Coordinates Activities of Admin. Comm. Paid from Funds for Const. (About US\$ 100/mo.)

Responsibility Ceases when System is Turned Over to Admin. Committee.

COMMUNITY

Contracts with PNAPR for System.

Furnishes Labor and Local Material, Necessary Land.

Pays Monthly Water Bill Covering Cost of O & M Allowance for Depreciation Plus Part of Capital Cost of System.

ADMINISTRATIVE COMMITTEE

Admin. Comm. is Organized with Help of Promoter, Aux. Prom., and Engineer

Coordinates Cooperation of Community Urges Householdors to Request House Connections at US\$ 11 Payable in 100 Months.

Responsible for O & M of System, Collect Water Rates, Keep Accounts - Few Committees Submit Accounts to Sanit. Tech. at Regional Hosp. for Review.

OPERATOR

Responsible for O & M of System in Accordance with Operations Manual Prepared by PNAPR. Paid by Admin. Committee.

COLLECTOR

Sometimes a Collector is Paid to Collect Water Rates, Sometimes Payments are Made Directly to Office of Admin. Comm.

In Peru water supply systems are categorized as (a) gravity without treatment plant (GSFT); (b) gravity with treatment plant (GCPT); (c) pumped without treatment plant (BSFT) and (d) pumped with treatment plant (BCPT). Table 1 shows a comparison of labor and material costs as of 1974 and 1975 for several water supply systems of each category. Annex A contains a detailed cost breakdown for an example of each one of the four categories, also a calculation of the water rate to be charged.

SELECTION OF PROJECTS

In general, project selection is based on: (a) the interest of the community as indicated by a written request and an offer to provide local labor, material, a contribution toward the capital cost of the system and to assume responsibility for administration of the system after it is constructed; (b) availability of a reliable source; and (c) a project which benefits the most people at the lowest cost.

HOUSE CONNECTIONS

In Peru every effort is being made to do away with public hydrants in rural water supply projects and an intensive campaign has been launched to stimulate the installation of house connections, making it comparatively easy, financially, for the householder to obtain his water connection. To date a total of 50,700 house connections have been made for rural water supply systems. See Figure for a graphic presentation of the progress in installation of these connections.

When a system is designed, an estimate is made of the number of connections that will be necessary, assuming that 80% of the houses which front on the distribution pipe will be connected within three years of the completion of construction of the system.

A price of Soles 500 has been established for the house connection which consists of $\frac{1}{2}$ PVC pipe (max. of 15 meters), the necessary fittings to connect to the distribution pipe, a shut-off valve and a bronze faucet which is installed inside the property line on a vertical pipe, generally supported by a stick driven into the ground. The Soles 500 is paid off at the rate of S/.5 per month as part of the water bill.

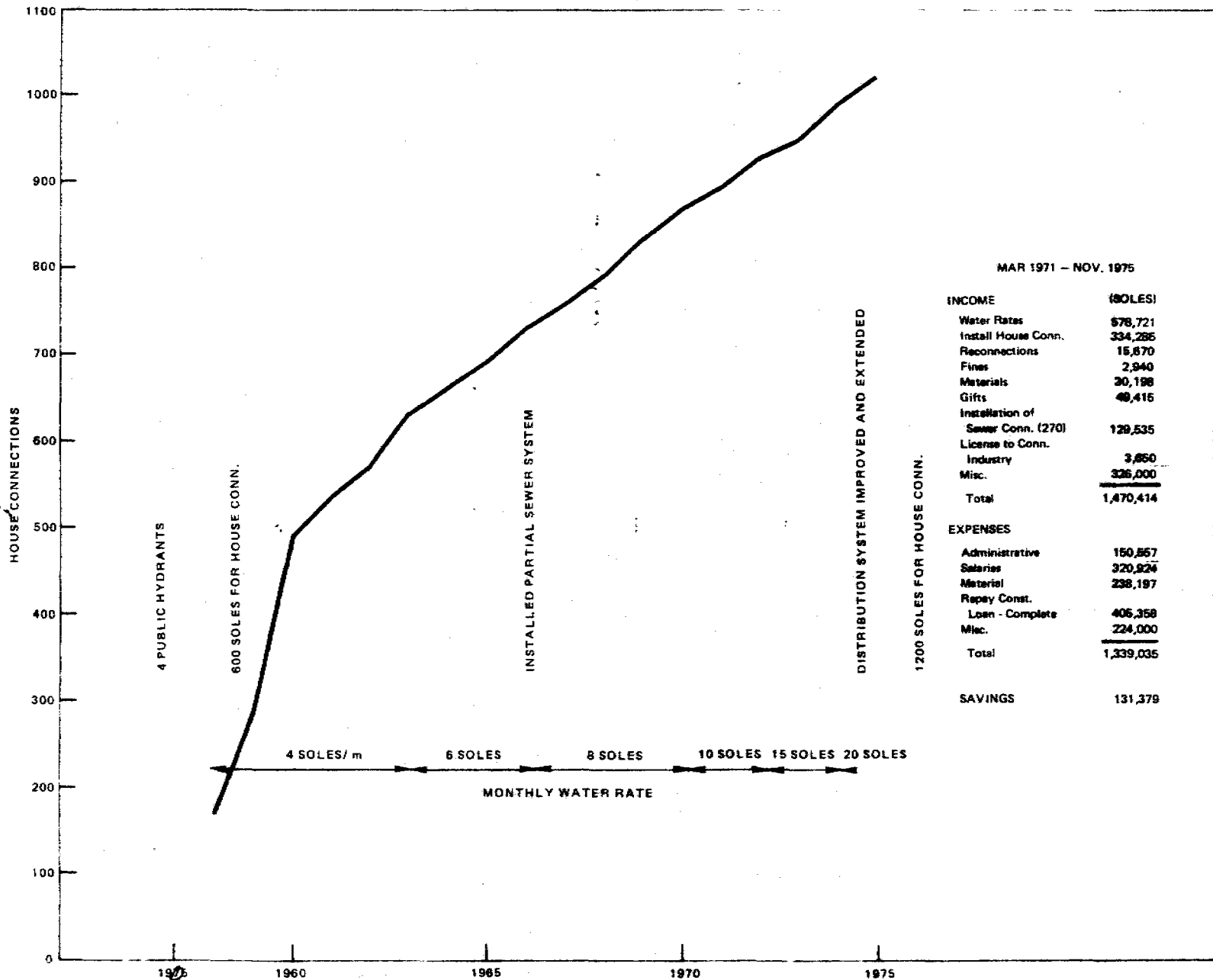
The householder digs and backfills the pipe trench and the connection is made by skilled workers either during the construction of the system or by the plumber of the Administrative Junta.

A large purchase of material for house connections was made about a year ago and this is being distributed to the Juntas for use in their systems. Material with a value of S/20,075,000 has been turned over to the Juntas and payment of S/.16,074,000 has been received for these materials. (See Figure VI for the increase in number of house connections in SIGAYA, JUNIN, PERU with water rates.)

WATER RATES

A monthly water rate is calculated for each rural water supply system by the Supervision of Services Division, based on the cost of the system and the ability of the people to pay for the service. The rate is kept below a maximum of S/ 75 per month by varying the percentage of the amount included for depreciation. See Annex for a sample calculation of water rates for different types of systems. The following tabulation gives the water rates charged and what would have to be charged considering full depreciation costs. The factors used in making the calculations are appended to the Annex.

Fig. VI
 WATER SUPPLY SYSTEM
 SICAYA - JUNIN - PERU
 HOUSE CONNECTIONS
 GRAVITY SYSTEM - 13 Km conduction line



MAR 1971 - NOV. 1975

INCOME (SOLES)	
Water Rates	578,721
Install House Conn.	334,286
Reconnections	15,870
Fines	2,940
Materials	30,198
Gifts	48,416
Installation of Sewer Conn. (270)	129,535
License to Conn. Industry	3,850
Misc.	326,000
Total	1,470,414

EXPENSES	
Administrative	150,857
Salaries	320,924
Material	238,197
Repay Const.	
Loan - Complete	406,358
Misc.	224,000
Total	1,339,036

SAVINGS 131,378

EXAMPLES OF WATER RATES
(1976 Estimates)

TYPE OF SYSTEM	POPULATION SERVED	WATER RATE/MO (US\$)		
		100% DEPRECIATION	% DEPRECIATION USED	
Gravity without treatment	600	0.94	19	0.44
Gravity with treatment	850	1.59	11	0.55
Pumped without treatment	1560	2.59	27	1.33
Pumped with treatment	800	3.26	24	1.60

Special rates are made for ranches, factories, restaurants using more water than used by the ordinary household.

With these rates a total of S/.5,376,000 has been built up by the Juntas as a reserve over and above the cost of operation and maintenance.

The average reserve per system is shown below.

RESERVE FUNDS HELD BY JUNTAS ADMINISTRADORAS

	<u>GRAVITY SYSTEM WITHOUT TREATMENT</u>	<u>GRAVITY SYSTEM WITH TREATMENT</u>	<u>PUMPED SYSTEM WITHOUT TREATMENT</u>	<u>PUMPED SYSTEM WITH TREATMENT</u>
of Systems*	442	103	104	12
erve Per System	S/.7560	S/.7920	S/.10,890	S/.7150
al Reserve	S/ 3,342,260	S/.815,525	S/.1,132,484	S/.85,746

Many of these systems are multiple systems so that a total of 753 towns are provided service by the 661 systems included above.

Although no data is available for all 661 systems on the percentage of householders which are behind in their monthly payments a report as of the end of 1975 for 18 systems recently completed indicates that of 3031 households 1284 are up-to-date (42%). While this low rate of payment is for recently completed systems, and may not be applicable to systems that have been in service for some time, the estimation in 2 of the departments

were that possibly 40 to 45% of the accounts were behind in payment.

This is partly due to lack of regular supervision of the Juntas Administradoras. In one Junta, financial reports had not been submitted for more than one year.

MATERIALS AND EQUIPMENT

All materials and equipment are purchased by the Administration Unit at the Central Office level based on material lists furnished by the Design Division. Cement and steel are purchased within the country. Invitations are issued for international bidding on all other materials and equipment. Distribution is made to the project site where the material is received by the engineer in charge of the construction of the project.

PROMOTION

Considerable emphasis is placed on promotion before and during construction of the projects. A group of 8 promoters work out from the Central Office in assisting to form the local Administrative Committees, and supervising auxiliary promoters who are generally selected from the community involved and paid from the project construction funds. The auxiliary promoter makes a socio-economic and population survey, and helps the Administrative Committee to coordinate the activities of the community during the construction stage. His responsibility as well as that of the promoter ceases when the system is completed and turned over to the Administrative Committee for administration. The duties of the promoter and auxiliary promoter are covered in a manual.

CONSTRUCTION

Most construction is carried out by administration under the supervision of the engineer in charge of the project, assisted by the auxiliary promoter. They are under the overall supervision of staff from the Central Office and submit monthly progress reports to them.

COMMUNITY PARTICIPATION

Full community participation is one of the requisites for a community to be included in the PNAFR program. In many parts of Peru there has been a long history of cooperative activities within the communities, which has made it comparatively easy to obtain similar participation for the community water supply projects. Often times there is already a community action committee in existence. Sometimes this is transformed into the Administrative Committee for the water supply project with the assistance of the engineer, promoter and auxiliary promoter. Sometimes one member of the existing committee is selected by the community to head the new Administrative Committee.

Generally the community has taken many steps toward obtaining its water supply system long before any action is taken toward forming the Administrative Committee. Some communities have had requests pending in the Central Office for their systems for three or four years before the requests can be accepted. As soon as a design and estimate has been prepared in the Central Office, they are presented to the community through the Committee, together with an estimate of the contribution in labor, local materials and funds expected from the community, as well as an estimate of the water rate which will have to be paid. These are discussed, and if agreeable, a contract is signed between the Sanitary Engineering Office of the Ministry of Public Health and the community. Local contributions amount to 10 to 15% of the cost of its project, about three quarters of this being in labor and local materials and the remainder in cash.

FINANCIAL ASPECTS

The capital costs of each project are financed from three sources at the present time. About 40% of the cost comes from the third Inter-American

Bank loan; 10 to 15 % comes from the community in the form of labor and local materials (approx. 75% of the community contribution) and in cash paid over a period of a number of years; and the remaining 45 to 50% comes from the national budget.

The following investments have been made in the PNAPR from 1962 up to and including that proposed under the third Bank loan to 1978.

(1)
INVESTMENTS IN NATIONAL PLAN FOR RURAL POTABLE WATER SYSTEMS (THOUSANDS \$)

(2)	PEOPLE BENEFITTED		PER CAPITA COST US\$	FINANCING		
	VILLAGES	POPULATION		SOURCE	AMOUNT	%
STAGE I 1962-1967	223	210,000	20.15	UNICEF	228.3	5
				IDB	1650.0	39
				GOVERNMENT	1901.6	45
				COMMUNITY	452.1	11
				TOTAL	4232.0	100
STAGE II 1967-1971	502	436,700	19.26	IDB	3560.3	42
				GOVERNMENT	3591.4	43
				COMMUNITY	1260.3	15
				TOTAL	8412.0	100
STAGE III 1972-1978	270	280,000	43.47	IDB	4700.0	39
				GOVERNMENT	6132.2	50
				COMMUNITY	1338.8	11
				TOTAL	12171.0	100
TOTAL 1962-1978	995	926,700		UNICEF	228.3	1
				IDB	9910.3	40
				GOVERNMENT	11625.2	47
				COMMUNITY	3051.2	12
				TOTAL	24815.0	100

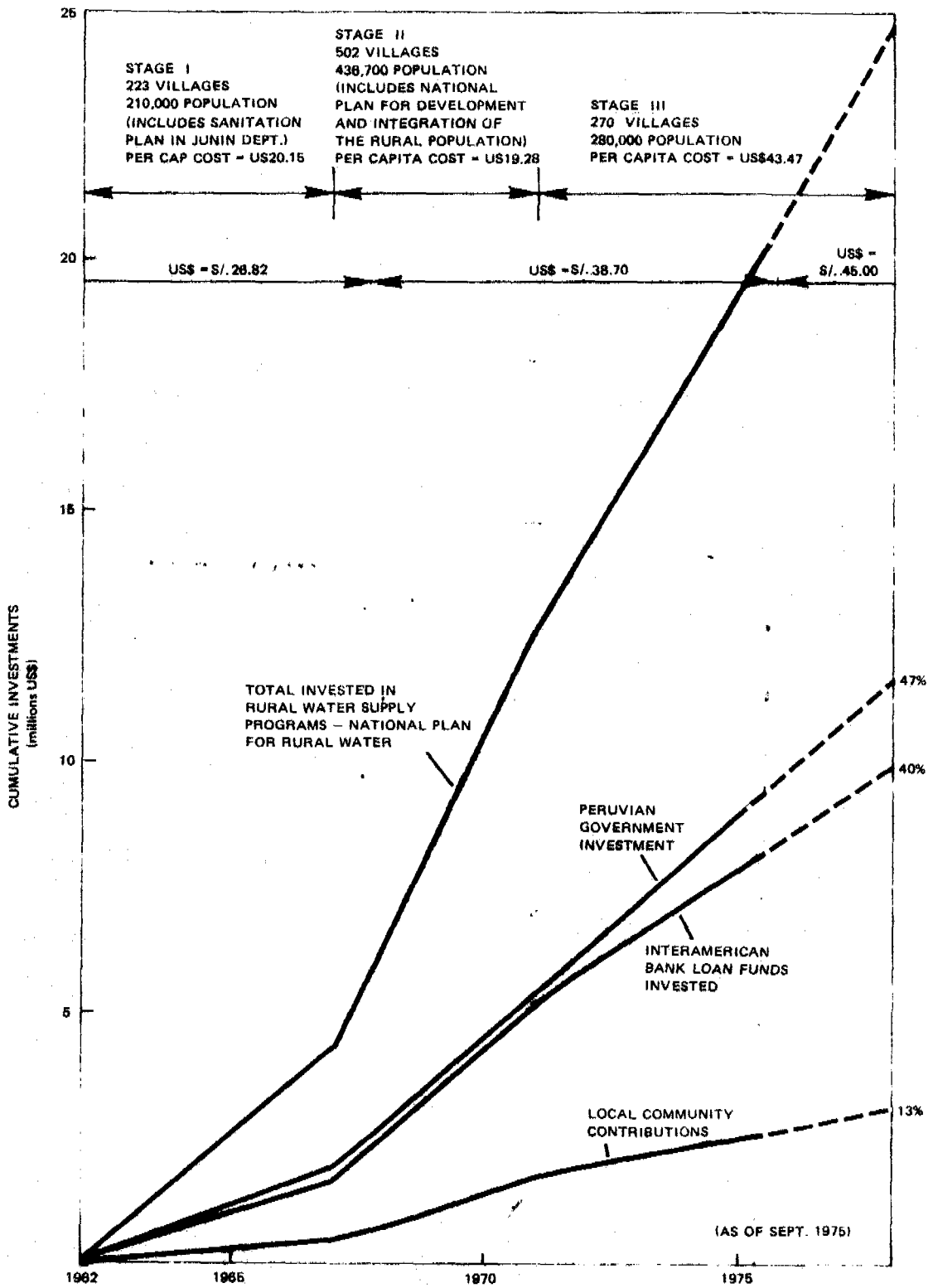
1. Includes central office administrative costs.
2. Includes the original demonstration project in Junin.
3. Includes the projects built under the National Plan for the Development and Integration of the Rural Population.
4. Includes the projects covered by the third loan from the Inter-American Development Bank.

All US\$ amounts are at 1975 values. See Figure VII for a graphical presentation of the investments in rural community water supply project from to 1978.

The tremendous increase in per capita costs estimated for the projects constructed during the third stage of the program is noted immediately. A large part of this is due to inflation, with some of it being the result of the fact that most of the easy-to-build, low cost systems were built during the first two stages and now it is necessary to attack the more costly projects. As indicated in Table inflation increased the total costs for the four classifications of systems by about 23% from 1974 to 1975.

As there is no overall supervision nor control of the 681 Administrative Committees operating the 753 rural water systems constructed under the PNAFR, there are no consolidated records of costs of operation and maintenance of the systems, nor of the income derived from those systems. The only information available is that a total of S/.5,376,000 has been built up by the Administrative Committees as a reserve over and above the cost of operation and maintenance of the system. An additional S/.34,572,000 has been repaid toward the funds loaned to the communities toward the capital costs of their systems.

Fig. VII
PERU
NATIONAL PLAN FOR RURAL WATER SUPPLIES
FUNDS INVESTED (1962 - 1978)
(CUMULATIVE - MILLIONS US\$)
(INCLUDING CENTRAL OFFICE ADMINISTRATIVE COSTS)



POINTS OF PARTICULAR INTEREST

The following comments are based on observations made in each country at national, state and local levels and are recorded as observations and not as evaluations. A review will be made of these observations, at the end of the section, to determine what combination of factors seem to contribute most to the success of a water supply program and what factors tend to restrict this success.

In many countries in Latin America an attempt is being made to increase the percentage of people served by house connections and reduce or eliminate the use of public hydrants.

PERU

A close relationship is maintained between the design office and the office responsible for operation and maintenance of the rural water supply system so that advantage is taken of O and M experience in designing future systems (at national level). The monthly water bill is composed of three items:

1. A water rate based on estimated cost of operation and maintenance plus a percentage of the estimated depreciation cost for the system. The percentage used is varied from system to system to arrive at a monthly water rate which is within the financial capacity of the majority of water users. (The percentage varies from 10% to 30%). The fund to cover depreciation and maintenance is kept in an account of the Administrative Committee.
2. An item to pay for the cost of installing a house connection at the rate of \$5.00 for 100 months.

Many methods are being used to stimulate the majority of the householder fronting on the distribution system to make requests for their

house connections. The central office made a special purchase at considerable saving of material required for house connection installations. This is issued on credit to the Administration Committee for each system which in turn allocates material to each householder signing a contract for a house connection. People are urged to request their connections while the system is being built by being offered a lower price at that time. An attempt is being made to stimulate users to keep their water bills paid up to date by persuasion, rather than by disconnecting the service thus maintaining more connections in service and avoiding the need to make reconnections.

An Administrative Committee is organised for each system before a project is undertaken. It signs a contract with PNAFR indicating the responsibility of each. The amount of the monthly water bill is indicated. The Committee is responsible for obtaining and coordinating community participation during the construction of the system under the supervision of the PNAFR engineer and promoter and then for the operation and maintenance of the system with some supervision by a health inspector from the nearest hospital or regional health post. The Committee accounts are reviewed by this inspector in his office every three or four months. The lack of close liaison with the Administrative Committee is reflected in the large percentage of users who are behind in paying their water bills (on the order of 50%).

Maintenance and repairs beyond the capacity of the local Administrative Committee are carried out by the Supervision of Services Department of the central office by request. There is no preventive maintenance program.

It has been suggested that an association of Administrative Committees be formed with annual meetings to stimulate the Committees to improve the administration of the systems for which they are responsible. This

could lead to training programs for members of the committees, also for operation of the systems. It could provide a means for the central office to maintain better contact with the Committees.

A considerable stock of cast iron fittings and materials were observed in dead storage because of a change to the use of PVC and asbestos cement. This unused material should be inventoried and an attempt should be made to put it to some use, possibly in urban systems where such material may still be used.

A simple, valve-less, inexpensive, easy to operate filtration plant is being developed at SEPIS and tried out on a demonstration basis. Designs, costs, and results should be made available as soon as possible.

Promotion is carried out by promoters from the central office working with auxiliary promoters assigned to individual projects as well as through the engineers responsible for the construction of the systems. Excellent community participation was observed in some systems under construction, also in the attitude of the members of Administrative Committees and of the communities. (200 men, women and boys of a population of 3000 assisted at one time in backfilling an infiltration gallery as part of the participation of one community in the construction of its own water supply system.)

PERUSANGALLAYA, HUAROHIRI, LIMA

POPULATION 1975 1995 90 liter/cap/day
 600 900
 120 Houses

Gravity System from a Spring.

<u>COST ESTIMATE</u>	<u>LABOR</u>	<u>MATERIAL</u>	
Intake Structure	3384	7532	
Conduction Line	28104	60308	
Storage Tank (Repair Existing Tank)	5094	22070	
Chlorination Equipment	200	300	
Distribution System	123062	192289	
House Connections (120)	14400	56400	
Transportation		15000	
Total	174,244 33%	353,899 67%	528,143 100%

<u>GENERAL EXPENSES</u>	<u>LABOR & MATERIAL</u>		
Tech. Direction & Admin.	14% *	(*Admini- stration	73940
Promotion & Community Organ.	5% *	153,162)	26407
Equip. Installation Expense	6% *		31689
Central Office Inspection	4% *		21126
Accident Insurance and Social Laws (60.72% of labor)			<u>105801</u>
	TOTAL		<u>258,963</u> S/.787,106
<u>DIRECT COST OF SYSTEM</u>			<u>633,944</u>
Administration (24% of direct cost)			153,162

Per Capita cost S/.1057, US\$ 27.31 (based on 1974 cost)

Using 19% of the estimated depreciation costs, resulted in a water rate of
 S/20.00 per month, US\$ 0.44 per month.

Calculated 1976

Using 100% of the depreciation costs would have given a water rate of S/.42.31,

PERU

	<u>PIURA PROV.</u> Pop. 1975	<u>PIURA DEPT.</u> Design 1995	
<u>VICHAYAL</u>	1113	1781	120 liters/cap/day
<u>RIO VIEJO</u>	146 1559	714 2495	Min. Wage = S/.120

Deep well with electrically operated pump (using existing well).

<u>COST ESTIMATE</u> (1974 prices)	<u>LABOR</u>	<u>MATERIALS</u>	
Pumping Equipment	20,000	375,116	
Pump Houses	10,598	26,787	
Reservoir, 100 M ³	47,520	84,457	
Elevated Storage Tank 60 M ³	110,963	332,460	
Conduction Line	3,308	13,458	
Distribution System	263,255	477,074	
Chlorination Equipmt.	800	1,200	
House Connections	23,520	92,120	
Transportation		52,000	
TOTAL	S/.479,964 25%	1,454,672 75%	1,934,636 100%

GENERAL EXPENSESLABOR & MATERIAL

Tech. Direction & Admin.	14%* (*Admini- stration	270,849
Promotion and Comm. Organ.	5%* 561,014)	96,732
Equip. Installation Expense	6%*	116,078
Central Office Inspection	4%*	77,385
Accident Insurance and Social Laws	60,72% of labor	291,434

TOTAL

852,478
S/.2,787,114

DIRECT COST OF SYSTEM

Administration (25% of direct cost)

2,226,100
561,014

Per Capita cost S/.1428, US\$ 36.90 (based on 1974 costs)

Using 27% of the estimated depreciation costs, resulted in a water rate of

S/.60.00 per month, US\$ 1.33.

Calculated 1976

Using 100% of estimated depreciation would give a water rate of 3/.116.46,

US\$ 2.59 per month.

LAMPIAN, CANTA, LIMA

POPULATION 1975 1995
848 1272
 212 Houses

80 liters/cap/day

Using existing intake structure on a river, gravity system with treatment plant. (Considering 507)

<u>COST ESTIMATE</u>	<u>LABOR</u>	<u>MATERIAL</u>	
Sand Trap	5,022	21,621	
Treatment Plant			
Settling Basin	17,921	41,396	
Slow Sand Filter	33,297	85,660	
Valve House	6,528	30,018	
Chlorination Equip.	2,200	1,300	
Distribution System	93,490	213,481	
House Connections	19,440	76,140	
Fence Around Treat. Plant	1,840	4,600	
Transportation		<u>37,500</u>	
TOTAL	179,738 26%	511,716 74%	691,454 100%

<u>GENERAL EXPENSES</u>	<u>LABOR & MATERIAL</u>		
Tech. Direction & Adain.	14%	96,804	} 200,522
Promotion & Community Organ.	5%	34,573	
Equip. Installation Expense	6%	41,487	
Central Office Inspection	4%	27,658	
Accident Insurance and Social Laws (60.72% of labor)		109,137	
		<u>309,659</u>	
	TOTAL		1,001,113

DIRECT COST OF SYSTEM	800,591
Administration (25%)	<u>200,522</u>
Depreciated value of existing system	<u>482,329</u>
TOTAL DIRECT COST	1,282,920

Per Capita cost S/.1512 US\$ 39.07 (based on 1974 cost). Using 11% of the estimated depreciation costs, resulted in a water rate of S/.25.00 per month, US\$ 0,55 per month.

Calculated in 1976

Using 100% depreciation would result in a water rate of S/.71.42, US\$ 1.59 per month.

BAGAZAN, REQUENA, LORETO

POPULATION 1973 1993
 800 1280
 122 Houses

100 liters/cap /day

Caisson river intake, gasoline driven deep well pump, pressure filter, elevated steel storage tank.

<u>COST ESTIMATE (1973 prices)</u>	<u>LABOR</u>	<u>MATERIALS</u>	
Caisson	30,083	116,100	
Pump House	8,968	19,295	
Pumping Equip.	10,300	117,800	
Filter House	17,573	44,525	
Pressure Filter	30,000	360,000	
Chlorination Equip.	3,000	44,000	
Conduction Line	1,855	4,056	
Regulating Tank	150,000	750,000	
Distribution System	106,729	156,064	
House Connections(122)	14,640	57,340	
Transportation		84,000	
TOTAL	373,148 17.5%	1,753,180 82.5%	2,126,328 100%

GENERAL EXPENSES

LABOR & MATERIALS

Tech. Direction & Admin.	14%*	(*Admini- 297,686 stration	
Promotion and Community Organ.	6%*	616,635)	127,580
Equipment Installation Expense	5%*		106,316
Central Office Inspection	4%*		85,053
Accident Insurance and Social Laws (60.72% of labor)			<u>226,575</u>

TOTAL

843,210
2,969,538

DIRECT COST OF SYSTEM

Administration (26% of direct cost)

2,352,903
616,635

Per Capita cost S/2941, US\$ 76.00.

Using 24% of the estimated depreciation costs, resulted in a water rate of S/72.00 per month US\$ 1.60 per month.

Calculated in 1976

Using 100% depreciation would result in water rate of S/.146.5, US\$ 3.26 per month.