A successful training program in Brazil

Walter P. Costa and Francis W. Montanari

The Brazilian Association of Sanitary and Environmental Engineering (ABES) has conducted a comprehensive, nationwide training program for manpower development in the water supply and sewerage utilities since 1973. This program has included training classes, workshops, and seminars and has trained some 73 000 people. It has produced 11 training manuals, 76 teaching films, and 32 technical books. The training program provides the human resources for the National Sanitation Plan (PLANASA), which has an immediate goal of providing water supply and sewerage services to the urban population of Brazil. It provides an excellent model for the training needed to support the International Drinking Water and Sanitation Decade.

The development of human resources is directly related to a nation's overall plans for development. An extensive training program to develop human resources was considered crucial to Brazil's National Sanitation Plan (PLANASA). Started in 1973, the training program is still under way. This paper presents an overview of the PLANASA training program, which, with appropriate adaptation, could serve as a model for similar programs in other countries.

PLANASA

Created in 1971, PLANASA was designed to provide water supply and sewerage services throughout Brazil. The goal to be achieved by 1980 was to provide water service to 80 percent of the urban population (65 million people) and to provide sewerage services to 50 percent of the urban population (40 million people).

One basic PLANASA objective was the creation of a mechanism that would guarantee the permanent financial support needed to provide the services and, later, to extend and improve them. This support comes from the National Housing Bank (BNH) and the various state governments through revolving funds specially dedicated to this purpose. Projects are selected on the basis of their economic and technical feasibility and on the basis of the capabilities of the state sanitation authorities to build, operate, and maintain the facilities.

By 1979, the investments made through PLANASA had reached $3.2 billion: $2.2 billion was spent on water services and $1.0 billion was spent on sewerage services. Investments planned for 1980–1981 total approximately $1.5 billion.

Although the goals of PLANASA might appear overly ambitious, the needs are gigantic. Brazil is a country with 8.5×10^6 sq km of land (3.3×10^6 sq mi) and a population of 120 million, 78 million of whom live in urban areas. The birth rate is about 2.7 percent per year, and the growth of the cities is greater than 5 percent per year. There is a permanent migration of the rural

0003-150X/81/060288-06$02.00

© 1981 American Water Works Association

Best Available Document

population to the cities. Urban population swelled during the last thirty years. The situation became critical during the 1960s when scarcely 50 percent of the urban population was supplied with water (and that service was, at best, precarious) and less than 25 percent had sanitary sewerage. By 1979, more than 53 million urban inhabitants (68 percent) were provided water services; and of the 3920 Brazilian cities, 2233 were integrated into PLANASA. The rest remained independent since PLANASA is a management alternative for municipal governments.

When the Brazilian government created PLANASA, it was felt that the country's sanitation problems should be dealt with nationwide. The principle of regionalization was adopted at the state level, creating an authority as part of state government to provide water and sewerage services in all the cities. The administration, construction, and operation of these services were transferred to the state authorities through concessionary contracts given by the cities.

Recognizing that PLANASA required broad technological support and human resources, BNH created a program of technical support—SANAT—composed of training, technical assistance, development of standards, applied research, publication of technical books, and technology exchange (Figures 1 and 2). To support SANAT, BNH created a 1 percent tax on technical services.

The training program

In 1972 BNH instituted a policy for the development of human resources, establishing criteria for distributing PLANASA funds in the most equitable, most productive manner possible. The principal objectives of this policy were to

- Motivate the state sanitation authorities to promote systematic and continuous staff training;
- Install and carry out training programs for personnel at all levels, thus improving the efficiency of service and reducing the cost of operation;
- Utilize existing educational and training installations through contract activities;
- Promote a financial policy that would eventually allow the training programs to be decentralized and taken over by local authorities, in order to reduce travel and lodging costs;
- Promote the installation of employee training centers among state sanitation authorities;
- Promote the publication of technical books by national authors and the preparation of manuals and audio-visual materials to support PLANASA, training, and the process of continued education; and
- Promote the exchange of experiences and technological information with other programs and institutions, both national and international.

The goal established under the training policy was to train 60 000 employees in six years, including staff at all levels—from directors and managers to unskilled laborers. This goal was established to meet existing personnel demands as well as the surge of requirements expected to result from the implementation of PLANASA.

Planning and execution of the training program were assigned to the Brazilian Association of Sanitary and

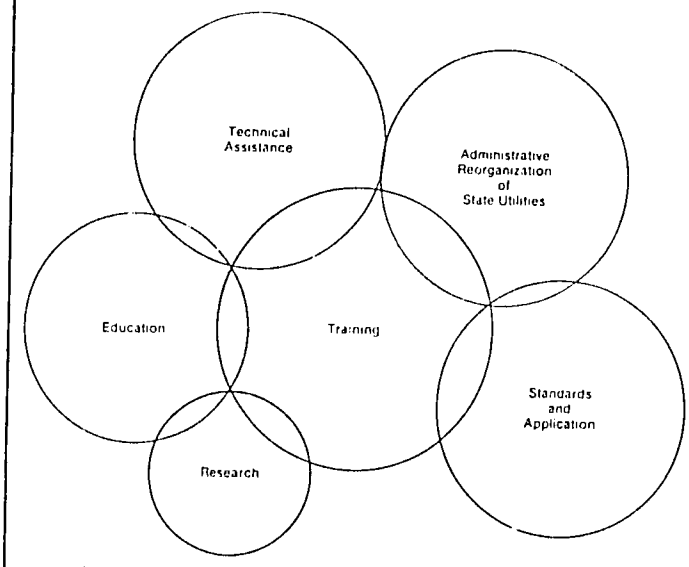

Figure 1. Relationship of training to associated activities

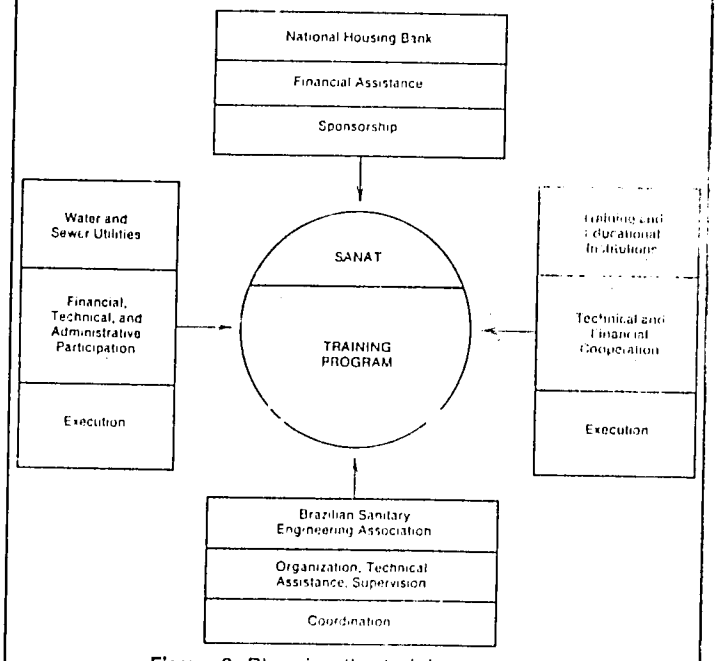

Figure 2. Planning the training program

Environmental Engineering (ABES), a professional association of some 6000 members in 22 separate state sections. ABES developed a service company to plan, program, and coordinate the training program and, eventually, to conduct the seminars and courses. ABES also established an editorial fund for the publication and sale of the training manuals.

In creating a national training program, ABES attempted to make all the forces capable of contributing to its success converge on the program, as shown in Figure 2.

As previously stated, the program is supported and financed by BNH. As the principals interested in the training of their employees, the 22 state authorities also

support and finance the program and participate in the programming and execution. The educational and training institutions, in addition to being responsible for many training activities, also contribute technically and financially. ABES continues to be responsible for planning, programming, coordinating, and executing the program.

Some Brazilian states are larger and more populous than many countries. The distances are great, as are the inequalities of social and economic development. The training program adopted flexible planning procedures and a methodology capable of including a range of variables, including the variety of professionals employed in water and sewerage services; the large and ever-increasing number of employees required by the state utilities; the deficiencies in the educational system and in manpower development; the uncoordinated dispersal of resources, both human and financial, for training; the characteristics of the various states and their inequalities; the high rate of turnover among employees of state utilities and their constantly changing responsibilities within the utilities; and the direct and indirect costs of training and the long distances as a factor in the increase of these costs. These variables pose serious obstacles to the establishment of adequate training programs in the areas targeted for development during the International Drinking Water and Sanitation Decade.

For the purpose of planning and organizing the training program, employees of the state utilities were classified into five occupational groups according to their profession or skill, their level of education, and their job responsibilities: 01—technical and administrative staff (supervisory level); 02—technical and administrative staff (middle level); 03—administrative staff, accountants, office workers; 04—skilled and unskilled workers; and 05—laborers.

Figure 3 shows the general characteristics of the five occupational groups and the type of training given to each one.

Program concept

Figure 4 presents the dynamic concept of the program, which has been progressively improved through evaluation and feedback.

The program initially was divided into four projects covering the principal fields of action.

- Project 1—publication of technical books and development of manuals and audio-visual materials to serve as the basis of training activities;
- Project 2—preparation of trainers;
- Project 3—large-scale professional and technical training for all utility employees at all levels;
- Project 4—administrative development, integrated with another BNH-supported program to develop the state authorities or utilities.

Production of training materials. In carrying out Project 1, the publication of technical books, manuals, and audio-visual materials for training support, agreements were executed with Brazilian technological, educational, and sanitation organizations to develop a technical bibliography appropriate for existing conditions in Brazil. Published jointly by ABES and these institutions, the materials included:

Occupational Groups / General Characteristics	Supervisory Technicians and Administrators	Middle Level Technicians and Administrators	Administrators and Accountants	Skilled and Unskilled Workers	Laborers
Educational Level	College	High School	High School	Junior High School	Elementary School
Activities	Technical Administrative Financial		Office	Operation and Maintenance	
Typical Functions	Management Planning Supervision Design Construction Operation and Maintenance		Clerical Financial Administrative	Construction Operation and Maintenance	Manual Labor Support
Professional and Subprofessional Titles	Engineers Economists Chemists Analysts	Technicians Programmers Surveyors Draftsmen	Administrators Typists Secretaries Accountants	Plumbers Electricians Operators Mechanics	Laborers
Type of Training	Technical and Managerial Skills		Office Skills	Manual and Mechanical Skills	

Figure 3. General characteristics of the training program

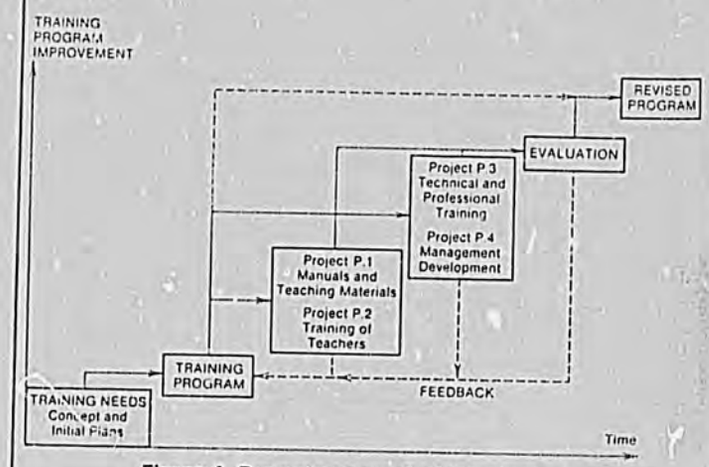

Figure 4. Dynamic concept of the program

BNH
ABES
CETESB

New operation

Repeated operation

Program

Job: service lines

ORDEM	Ref. FT	Tasks	Ref. F.O.	45	46	47	31	48	49	50	51	52	53	54
			ORDEM	1	2	3	4	5	6	7	8	9	10	11
1	36	Mount gasket collar on AC pipe												
2	37	Mount gasket collar on PVC pipe												
3	38	Mount gasket collar												
4	39	Fasten clamp with rigid PVC pipe												
5	40	Fasten clamp with polyethylene pipe												
6	41	Open screw on steel galvanized pipe												
7	42	Place iron												
8	43	Fasten clamp with steel galvanized pipe												
9	44	Place hydrometer												

Install gasket collar on AC pipe
Install rigid gasket PVC
Install PVC collar on PVC distribution main
Manually join PVC pipe
Install water clamp on high-density polyethylene pipe
Close small-diameter pipelines
Attach pipes with manual screw
Mount the tapping device and bore and screw connection
Assemble the nipple in the pipe
Fasten pipe and screw connection
Assemble hydrometer

Figure 5. Task analysis

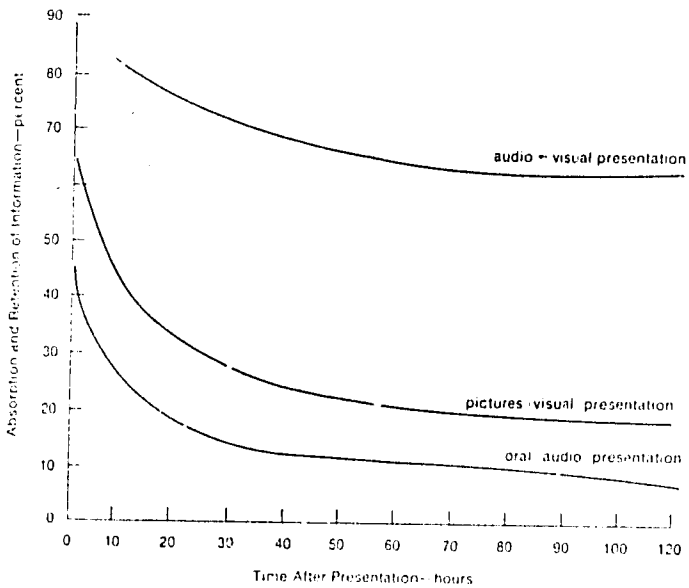

Figure 6. Absorption and retention of information—based on US Air Force statistics

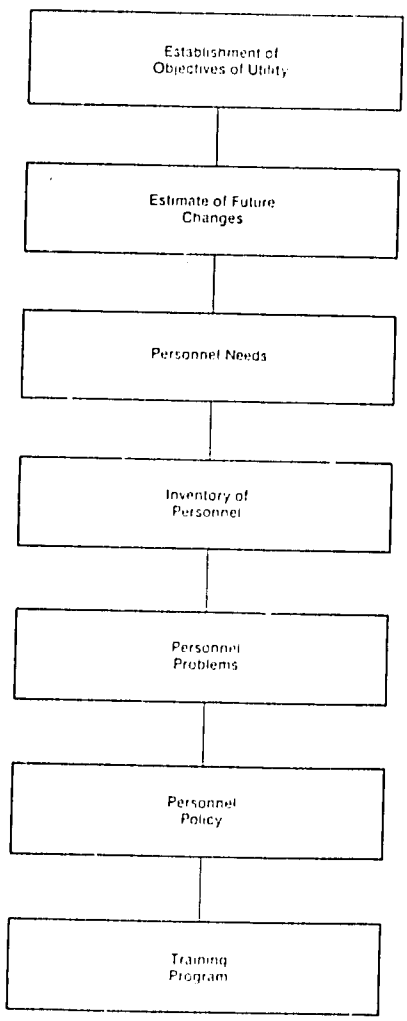

Figure 7. Manpower planning and training for the utility

- 32 technical books, with a total of 96 000 volumes published.
- 76 technical films, with copies in 16-mm. and super 8-mm cartridges for training and with a total duration of 463 min. These films demonstrated specific tasks with narration and explanation. They were packaged in modules according to the tasks, materials, and tools involved.
- five operational training manuals composed of 11 modules and produced in 60 000 sets. Used with the films, these manuals are based on an analysis of the tasks (Figure 5). Principally using pictures rather than words, they present technically correct methods for implementing the operations and attaining high performance.
- One set of slides, with narration, for introductory training in the area of sanitation.

Utilization of these technical films and manuals as training aids requires trainees to absorb and retain a great deal of information through audio-visual presentations, as shown in Figure 6. The use of audio-visual materials is very important in training workers who have educational deficiencies and difficulties in understanding regular texts. Hands-on experience in actual job situations completes the training.

Preparation of trainers. The most important of all training program activities is the preparation of trainers in the authority and utility organizations. This facet of the program is based on two principles that have been validated in practice. (1) The best instructors potentially can be found among the technicians and supervisors within the utilities themselves, and (2) it is entirely possible to transform staff into good instructors, enabling them to teach their colleagues and subordinates on the job. This effort has produced 657 instructors and 76 training managers, who now are able to direct and carry out most of the training activities.

Manpower planning and training. Plans for the training program and its content are dependent on the manpower planning of the utilities. Figure 7 shows the order of tasks followed in carrying out the training program for the state utilities. The manpower makeup of the 22 state utilities is indicated in Table 1.

Administrative development. The efforts of the training program are coordinated with a program for the institutional development of state sanitation authorities. Its purpose is to create new structures, a new mentality, and new work methods in all the agencies associated with sanitation. Started at the end of 1975 through an agreement between BNH and the Pan-American Health Organization (PAHO), the institutional development program generated and sought to install managerial models for all the systems and subsystems in the technical, administrative, and financial divisions of the utilities. Models were developed for 36 systems and subsystems, along with manuals for installing them. The state authorities and the utilities received technical assistance from Brazilian and PAHO consultants through seminars, courses, and other training activities. This program represented another example of manpower development carried out in Brazil.

Execution of the program

Owing to the large size of the country, the program

was carried out at two levels: the centralized activities conducted directly by ABES; and the decentralized activities conducted by the authorities and utilities and the contract institutions under ABES coordination. The 3685 training events consisted of courses, seminars, symposiums, in-service training, travel and visits, scholarships, and correspondence courses. Some 163 180 hours of training activity were conducted with 73 144 participants from 1973 to 1979 (Table 2).

The training benefited all of the occupational groups of the work force in the state utilities (Table 3). As shown in the tables, the number of participants in training activities is greater than the total number of employees in the state authorities and utilities. This is because the training program offered employees more than one opportunity for training. Some employees went through training phases two or three times, primarily those in management development and the training officers involved with new programs and activities developed during the training itself.

Table 4 shows the total direct costs of the program from 1973 to 1979 and gives a breakdown of its financial support. These costs, including ABES administrative costs, the production of teaching materials, travel, and per diem expenses, were about US $10 186 000 for 73 144 trainees, or an average cost of US $140 per trainee.

TABLE 1
The current manpower makeup of the 22 state utilities

Job Level	Occupational Groups	Number of Employees	Percentage of Total Work Force
01	professional, technical, and supervisory personnel, engineers	4333	7.2
02	middle-level technical and administrative personnel	6345	10.5
03	office personnel—administrative and accounting staff	13 568	22.5
04	skilled and unskilled workers	25 800	42.8
05	laborers	10 274	17.0
	total	60 320	100

TABLE 2
Results of training program

Training Activity	Number of Events	Hours of Training	Number of Participants
Centralized activities			
ABES	237	9480	5092
Decentralized activities			
State utilities	1578	78 900	42 170
Other entities	1870	74 800	25 882
Subtotal	3448	153 700	68 052
Total	3685	163 180	73 144

Evaluation

At the conclusion of each session, participants evaluated the activities of the program. Covering programming, methodology, and instructors and comparing established objectives and results, these evaluations provide the information necessary for improving the program.

The results of training in terms of trainee change in attitude or personal satisfaction and in terms of improved productivity at the state utilities were not normally evaluated. However, the overall program has been evaluated in terms of efficiency and effectiveness in relation to the established goals and objectives by means of the following parameters:

- Effectiveness in meeting physical goals, i.e., the projected number of trainees and the projected costs;
- Effectiveness in meeting starting objectives;
- Effectiveness in increasing the efficiency of the state utilities.

Regarding the physical goals, the number of trainees participating in the program greatly exceeded expectations, and direct costs were minimal. Regarding the principal starting objectives, 10 of the most significant objectives were selected for evaluation by means of indexes of attendance, specific weights for each objective, and degrees of priority. Through this methodology, it was possible to aggregate the results and to calculate a global index of 81.13 percent effectiveness for the program. Case studies, conducted by the utilities themselves and designed to demonstrate the influence of the training program, were used to assess increases in efficiency and productivity at the state utilities. At the water treatment plant for the city of Rio de Janeiro, for example, production was increased from 13 m^3/s (300 mgd) to 24 m^3/s (550 mgd). The cost of constructing a new treatment station with a capacity equal to the increase in filtered water would have been approximately $16 million. This savings alone was more than 1.6 times the direct cost of seven years of the national training program and more than three times the amount of money supplied by BNH and the state utilities. Innumerable other cases also proved the efficiency of the program and validated the maxim, "Training pays for itself."

International cooperation

The training program also served as a mechanism for the exchange and transfer of technology. It was supported by technical cooperation from important international institutions, and at the same time, it offered cooperation to other countries. International aspects of the program involved:

- Technical seminars, courses, and conferences with the participation of international experts;
- Scholarships and travel to other countries for Brazilian professionals and technicians, individually or in groups, to visit and study the specialized institutions of other countries;
- Contracting international consultants to provide technical assistance and to conduct specialized courses;
- Importing books, manuals, technical films, and audio-visual materials that could be used or adapted as support for the training.

The following institutions and the activities they provided are noteworthy:

- The US Agency for International Development (USAID), through an agreement with BNH, provided financial support for the program of technical coopera-

TABLE 3
Number of trainees

Job Level	Occupational Groups	Number of Trainees	Percentage of Trainees
01	professional, supervisory, and administrative personnel	13 205	18
02	middle-level technical and administrative personnel	7 746	11
03	office personnel, administrative and accounting staff	18 159	25
04	skilled and unskilled workers and laborers	34 034	46
05	total	73 144	100

TABLE 4
Total direct costs of the program

Supporting Agencies	Financial Participation	
	Amount—US$	Percentage of Support
National Housing Bank (BNH)	4 190 000	41
State utilities	5 320 000	53
Other entities	676 000	6
Total direct cost	10 186 000	100

tion. Independent of the USAID–BNH agreement, the US Agency for International Cooperation, through its mission in Brazil, contributed important support directly to ABES by providing books, office furniture, and technical assistance in program organization.

- The American Water Works Association (AWWA) acted as the agency in the United States to carry out the agreement between BNH-USAID, thus making possible the activities described.
- The Pan American Health Organization (PAHO) was directly associated with ABES by formal agreement. PAHO provided a complete range of technical and financial support, including technical consultants, principally from the Interamerican Center for Sanitary Engineering in Lima, Peru.
- The National Water Council of the United Kingdom, through its training division, has provided continuing cooperation in the development of courses, manuals, and technical visits. The council's most significant contribution was a 60-day training course for 11 Brazilian professionals.
- The Interamerican Association of Sanitary and Environmental Engineering (AIDIS), of which ABES is the Brazilian section, has supported all the training activities and, through the biennial Interamerican Sanitary Engineering Congresses, has placed great emphasis on the area of training.
- A total of 28 Brazilian professionals, directors of the state water and sewerage authorities, visited American institutions associated with water and sanitation activities, including municipal operations and water and sewerage authorities.
- An outstanding activity enhancing international technical cooperation was the Interamerican Conference on the Development of Human Resources for Environmental Sanitation held in Rio de Janeiro in November 1979. Conducted by ABES and PAHO, the conference was supported by PAHO and BNH and was attended by 62 representatives from 18 different countries and eight international institutions in the technical and financial areas of environmental sanitation. The conference dealt with three fundamental aspects: planning human resources, developing an educational technology, and utilizing human resources. It emphasized the necessity of establishing mechanisms for the integrated development of human resources and for carrying out a broad program of international technical cooperation.

The recommendations of the congress are particularly pertinent in connection with the goals of the International Drinking Water and Sanitation Decade, designated by the United Nations Conference on Water in Mar del Plata, Argentina, in 1977. The goals of the decade are ambitious and represent a challenge in terms of human, technical, and financial resources.

Conclusions

The success of any development plan is dependent on manpower resources as well as adequate financial and technical resources. The training of capable, highly motivated personnel should be an integral part of development plans. A training program can be highly successful only if it has the complete support of management and the confidence of the employees to be trained. It must also be well adapted to the social and cultural realities of the country.

Training is an integral part of a utility's personnel policy, which, in addition to satisfying the utility's interests, must seek to meet the human needs of employees. Training should be comprehensive, including employees at all levels, and should emphasize the concept of continuing education. It should be designed to improve the performance and increase the efficiency of individual employees and thus improve productivity in general.

The training should be imaginative, introducing new techniques, new materials, and a new philosophical context within which to carry out the tasks. It must become a force for positive change. The training process should be submitted to continual evaluation, as a means of improving its subsequent programs and its results.

In order to carry out broad programs of training, such as those required for the International Drinking Water and Sanitation Decade, it is necessary to create mechanisms for managing human resources in an integrated manner. Mechanisms of international cooperation should be developed to take advantage of the knowledge of other countries and institutions and, thereby, to accelerate the development of human resources where they are needed most.

Walter P. Costa is a civil and sanitary engineer with the Associação Brasileira de Engenharia Sanitaria e Ambiental (ABES), Av. Presidente Wilson, 164-7° andar, Rio de Janeiro, RJ 20030 Brazil, and Francis W. Montanari is a sanitary engineer, Agency for International Development—NE/PD/ENGR, Washington, DC 20523