ENVIRONMENTAL HEALTH RESEARCH

PROGRAM FOR THE DEVELOPMENT AND TRANSFER OF
APPROPRIATE TECHNOLOGY

- CEPIS -
1. INTRODUCTION

The Pan American Center for Sanitary Engineering and Environmental Sciences (CEPIS) is a multinational center for technology transfer in environmental engineering, created in 1968 with its base of operations in Lima, Peru. It is one of the technical branches of the PAHO's Division of Environmental Health Protection (EHP).

The Center's role in technology transfer is developed through four basic functions: research, training, information exchange and direct technical cooperation. In general, technical cooperation activities are linked to one of the other three functions, so that CEPIS carries out its work program through three operational units. One of these is the Technology Development Unit which manages the program for the development and transfer of appropriate technology.

2. PAHO POLICIES AND PRIORITIES

The development of research and of appropriate technologies for health has been recognized as a principal component of the national and regional strategies for Primary Health Care which were endorsed by Resolution XX of the XXVII PAHO Directing Council in 1980.
The document which resulted from that Directing Council meeting - Health for All in the Year 2000: Strategies\textsuperscript{1} - emphasizes the need to:

- give priority to evaluative research and the identification and promotion of innovative technologies;
- define sector policies and programs, consistent with national science and technology policies, and obtain the participation of the sector in the definition of such national policies;
- develop coordinating mechanisms and programs of cooperation at the national and intercountry level;
- identify and exchange information between national institutions and between countries.

The same document also identifies prioritary programmatic areas related to environmental health in the Region. Foremost among these is the provision of water supply and basic sanitation services for rural areas and urban slums, as mandated by the declaration of the International Decade for Water Supply and Sanitation. Specific strategies for achieving the Water Decade goals have been established by the PAHO Directing Council\textsuperscript{2}, all of which are fully reflected in Health for All in the Year 2000: Strategies.

It has been recognized and emphasized repeatedly that water supply and sanitation is a keystone requisite of several other Primary Health Care program


areas, notably for the control of several diarrhetic diseases and parasitic maladies.

Other important environmental health program areas include: solid wastes management; food hygiene; sanitary control of housing; control of pollution and environmental health hazards; and protection of the working environment.

Within the above framework CEPIS has recently created the Technology Development Unit, responsible for implementing a program for the development and transfer of appropriate technology within the areas of specialization and work of the Center. This report summarizes the scope and approach of the research program of the Technology Development Unit.

3. GOALS, SCOPE, PROBLEMS AND APPROACH

The goals of the CEPIS program are to promote the development, evaluation and application of appropriate technology to priority environmental health problems in the Region; to cooperate in strengthening the research capability of national environmental health institutions; and to improve the flow of technical information to and between researchers.

The scope of the Center's program includes pilot and field projects to identify potential new technologies or environmental control methodologies, and to assess their effectiveness in resolving priority environmental health problems, as well as operations research on the institutional, economic and sociocultural factors which are determinants of their successful application.
Thus, the program is a combination of applied (field-oriented) research and development, evaluative studies, and operations research. The role of CEPIS is principally one of promoting and coordinating research and development activities and disseminating research results, although as a Pan American Center of PAHO it also has an active research role within the Regional programs.

There are numerous obstacles to the achievement of the program goals. Only a few countries in the Region have articulated a coherent research policy in the area of water, sanitation and environmental health protection, which links research plans with the needs of the operational agencies of the environmental health sector. In general there is lack of environmental engineers and scientists with research training and experience, and of resources and facilities to support investigative work. At the institutional level management often fails to perceive the importance of applied and operations research to sound decision-making. The combined results is the absence of a vigorous research component in national environmental health programs, a factor which adversely affects their chances of success.

In response to this situation CEPIS and EHP have adopted a general strategy of developing an informal cooperative network of national institutions, and through this network promoting research in operational agencies in selected fields of interest, assisting these agencies in acquiring research competence, and facilitating information and technology transfer. Special emphasis is put on:
- cooperating in innovative research projects;
- seeking the maximum multiplier effect from projects;
- training of researchers;
- strengthening national research infrastructure.

This general approach is explained in detail in section 6 below.

4. PRIORITARY TECHNOLOGY DEVELOPMENT AREAS

The following eight programmatic areas have been established by CEPIS as being of high priority, principally for the International Water Supply and Sanitation Decade and for environmental quality management:

- Improvement of Drinking Water Quality.
- Appropriate Technology for Collection, Treatment and Disposal of Wastewater and Excreta.
- Technical and Institutional Development of Basic Sanitation Agencies Responsible for Services to Villages and Dispersed Rural Populations.
- Strengthening Commercial Systems of Water Companies.
- Extension of Water Services to Slum Areas through Reductions of Unaccounted for Water.
- Improving the Collection, Transport and Final Disposal of Solid Wastes.
- Assessment and Control of Environmental Pollution and Hazardous Substances.
- Information in Environmental Engineering and Sciences.
It should be noted that CEPIS does not attempt to cover all of the prioritary areas related to environmental health as identified in Health for All in the Year 2000: Strategies. Responsibility for some areas has been assigned to other program units of the Division of Environmental Health Protection (EHP) to whom CEPIS reports. For example, occupational health and industrial hygiene is covered by EHP's Human Ecology and Health Center (ECO) in Mexico, and the food sanitation program is concentrated in the EHP Division itself.

The Center operates on a matrix management method. Thus, activities within each of the prioritary programmatic areas listed above are supported by three management units - the Technology Development Unit, the Information Unit and the Human Resources and Institutional Development Unit. This ensures an appropriate mix of research, training and information components in each area.

5. RESOURCES

All of CEPIS' specialists contribute to the research and technology transfer program, as do the researchers from participating national institutions. In addition, to the greatest extent possible the program draws on the expertise and resources of PAHO/EHP's headquarters and field staff and of the ECO Center.

Although CEPIS has limited staff and financial resources, it can and does work effectively to mobilize significant additional resources which are required for the execution of the program. Some come from the PAHO regular budget itself, some from extrabudgetary grants from a number of multi and
bilateral institutions, and there are substantial counterpart contributions from participating national institutions.

6. IMPLEMENTATION STRATEGIES

From the implementation of the research and technology transfer program, a number of specific strategies are being applied. These include:

- the promotion of applied and operations research in national institutions;
- the conformation of a collaborative network of "Centers of Excellence" in research in the Region, aimed at strengthening national research infrastructures and training researchers;
- the preparation of research protocols and project proposals for presentation to granting institutions;
- the execution of research projects, both at national research centers and in CEPIS;
- the application of research results on a broad scale;
- the dissemination of research results.

Each of these strategies is carried out via a number of mechanisms as discussed below with illustrative examples where useful.

6.1 Promotion of Research in National Institutions

The word promotion is used here in a general sense to indicate the need to stimulate and encourage research undertakings.
As a first step decision makers need to be convinced of the value of research for improving the technical and economic performance of their organizations. Through technical bulletins, presentations at professional meetings and direct technical cooperation activities this theme is constantly presented together with illustrative cases. CEPIS also cooperates with national institutions in the identification of their research priorities and the planning and implementation of research programs.

At a broader level, countries are encouraged to define a national research policy for the environmental health sector through national seminars on research and development and technology transfer. The active participation and/or co-sponsorship of the respective national council on science and technology in such events is sought to assure that sector policies and programs become part of the overall national science and technology policy and programs and receive the corresponding support at the national level.

Finally, promotion also means that CEPIS attempts to identify voids in research and to stimulate national research projects aimed at specific problems. This is accomplished through a variety of mechanisms such as research colloquia on particular topics to identify research needs, and the preparation of research protocols and proposals.

As examples of this type of promotion, two international research colloquia cosponsored by CEPIS and CETESB³ took place recently in São Paulo. One was on methane gas recovery from urban sanitary landfills, and the other on simplified methodologies for eutrophication analysis in tropical lakes and reservoirs.

³Companhia de Tecnologia de Saneamento Ambiental (São Paulo, Brasil)
Both meetings identified shortcomings in transferring the approaches used by developed countries to tropical areas. The meetings resulted in specific recommendations for cooperative research to be undertaken at the regional level and the establishment of the required research protocols.

6.2 Collaborating Research Network

By means of the technology development and transfer program, CEPIS seeks to carry out research projects through collaborating national institutions. An example is the project for the comparative evaluation of simple, low-cost disinfection devices. In this project, which is funded by PAHEF, national research groups in five countries are each evaluating a different disinfection process according to a common protocol developed by CEPIS. At the termination of the research work the results will be analyzed together and presented at a regional research dissemination seminar. The same approach is being used in several other regional projects.

The advantages of this networking mechanism are many, among them:

- networking produces a direct and immediate multiplier effect of research efforts in the region;
- it permits the "twinning" of institutions recently embarking upon research work with more technically mature research centers;
- it facilitates the interchange of information and results between researchers in specialized fields;
- it helps to attract block funding from multi and bilateral sources for a concentrated attack on priority water and sanitation problems.
The network approach is not limited to informal groups working on specific research topics. Another strategy is to formally designate national institutions with strong research programs as PAHO Collaborating Centers. Through this strategy the concept of a Pan American Center is expanded to a Pan American Network of Collaborating Institutions. The latter serves as an effective vehicle for the practical application of horizontal cooperation among developing countries (TCDC), while at the same time developing and strengthening the capacity of the individual centers. These PAHO Collaborating Centers play a fundamental role in training researchers and serve as reference centers on research methods and procedures.

CEPIS has experimented with this research network strategy and the results are promising. As more institutions are identified with demonstrated research capability in the prioritary areas of EHP's technical cooperation program, they will be invited to form part of the network and become an active participant in the program.

6.3 Research Protocols and Proposals

It is important to establish the research protocol (including data requirements, methods and procedures) before initiating a project, along with clear statements of objectives. Otherwise it is difficult to compare the results of a project with similar research efforts, and to judge the validity of the research findings. This is evident in the case of cooperative research programs where a common protocol is required, but it is no less true of individual isolated research projects if the results are to be broadly applicable. Also,
the development of a good project document makes it easier to attract local resources and international funding.

Therefore, CEPIS puts considerable emphasis on assisting in the preparation of protocols and proposals. The Center also provides information on the requirements of funding agencies for the preparation of proposals, and can assist in establishing contacts between potential donors and national researchers.

6.4 Doing Research

Although CEPIS does directly carry out a number of research projects, the resources it has for doing research are limited. Therefore, in order to maximize CEPIS' contributions through research and technology transfer, a strategy of developing innovative demonstration projects which have high potential multiplier effects has been adopted. Normally, such projects are undertaken with extrabudgetary resources.

An example is the San Juan Waste Stabilization Lagoons study in which CEPIS is the executing agency. In a first phase, which was funded by the International Development Research Centre (IDRC), the efficiency of lagoons in tropical conditions was evaluated and new design criteria established. Also, a pathogen survival problem was identified. In the second phase, now underway with funding from the Peruvian Ministry of Health and the Inter American Development Bank (IADB), pathogen survival is being researched in greater depth and health risks associated with irrigation reuse of the pond effluents are being evaluated. This project has provided an opportunity for in-service training of several researchers from other countries, and has
lead to the publication of numerous manuals on research methods and procedures for the study of tropical ponds and reuse schemes, as well as design manuals. The importance of this work cannot be over-stressed as irrigation with domestic sewage is commonplace in Latin America.

Apart from research done in CEPIS, its specialists also participate in investigations being carried out in national institutions throughout the Region. Often they act in the capacity of special advisors, or cooperate in periodic evaluations of project progress.

6.5 Application of Research Results

When research results become available and promising new technologies or methodologies have been identified, the Center encourages their application on a broad scale through its technical cooperation activities. The usual practice is to look for several new field demonstration project sites and use them to develop a cadre of engineers and scientists who in turn can act as consultants to still other projects. Thus, CEPIS' role should gradually decrease with continued application of the technology.

6.6 Dissemination of Research Results

The dissemination of research results on appropriate technology is achieved via several mechanisms, several of which were referred to above. These can be summarized succinctly as follows:

- the publication of scientific and technical reports and review articles by CEPIS staff and local investigators;
- scientific and technical meetings at CEPIS and at national research centers;
- the incorporation of research and development results in the didactic material produced in CEPIS and its introduction into the curriculum of regional courses;
- the inclusion of written results and materials into the REPIDISCA\textsuperscript{4} regional document data base so that it appears in selected bibliographies, literature searches and secondary references such as REPINDEX\textsuperscript{5};
- the creation of a computerized research-in-progress file for regional research projects on environmental health topics;
- the publication of a Regional Directory of Environmental Health Research Institutions;
- the production of specialized research bibliographies on prioritary subjects.

7. 1982-83 WORK PLAN

As an example of the types of activities being developed with the collaboration of CEPIS, a summary of the 1982-83 research and technology transfer program is shown in the attached tables. As indicated in the table the individual projects are in various stages of development, but in the long run all will reach the dissemination and application phase.

\textsuperscript{4}Pan American Network for Information and Documentation on Sanitary Engineering and Environmental Sciences.

\textsuperscript{5}REPINDEX is a quarterly computerized index on appropriate technology of non-conventional regional literature and environmental health, published by CEPIS/EHP.
For the Water Decade a number of other high-priority research and development projects can be identified, not only in environmental engineering areas but also on managerial and commercial aspects. Thus, a dynamic approach is required. Additional projects will be incorporated in this program as they are formulated and corresponding resources become available.
## 1982-83 Work Plan

### Improvement of Drinking Water Quality

- Modular designs for water treatment plants (WHO)
- Design, construction and evaluation of simple, low-cost rural water treatment plants
- Simplified methods of cleaning slow sand filters (DTI APA)
- Simple disinfection processes for rural water supplies (PAHEF)
- Analytical quality control in water laboratories (EPA)
- Simplified methods of water analysis
- Evaluation of new treatment processes - granular media flocculators (SANEPAR)

### Appropriate Technology for Collection, Treatment and Disposal of Wastewater and Excreta

- Evaluation of microbiological health risks of wastewater reuse in agriculture (DTI APA/DIGENA)
- Evaluation of toxicological health risks of wastewater reuse in agriculture
- Design of waste stabilization ponds (IDRC)
- Comparison of land application vs. multicell lagoon treatment in reuse projects (SERPAR)
- Small, low-cost wastewater treatment plants
- Small-scale biogas technology for excreta disposal
- Energy recovery from wastewater treatment plants
- Evaluation of OXFAM sanitation units (OXFAM)
- Development of nonconventional design criteria and construction methods to reduce the cost of sewer systems
## 1982-83 Work Plan

### Current status of activity

<table>
<thead>
<tr>
<th>Program Area and Project Title</th>
<th>Project Promotion</th>
<th>Collaborating Centers</th>
<th>Preparation of R&amp;D</th>
<th>Active research</th>
<th>Application of Research Results</th>
<th>Dissemination of Research Results</th>
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<tbody>
<tr>
<td>Technical and Institutional Development of Basic Sanitation Agencies Responsible for Nucleated and Dispersed Rural Populations</td>
<td>X</td>
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<tr>
<td>- Development of an operational model of an institutional development program for rural water and sanitation agencies in Peru (DTIAPA)</td>
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<td>- Evaluation of operation and maintenance of rural water systems (DTIAPA)</td>
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<td>- Logistical and organizational requirements to optimize operation and maintenance of pumps and motors in rural systems (DTIAPA)</td>
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<td>- Evaluation of technical, economic, institutional and social factors affecting the operation and maintenance of rural water systems in Peru (DTIAPA)</td>
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<td>- Seminar on appropriate technology for elevating water in rural areas (OXFAM)</td>
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<td>- Feasibility study for establishing a training delivery system for the Peruvian water and sanitation authorities (DTIAPA)</td>
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<td>- Improvement of design and operating characteristics of slow sand filters (DTIAPA)</td>
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</table>

### Strengthening Commercial Systems of Water Companies

- Application of economic and financial models for project analysis (IDB, IBRD) | X | X | | |
- Development of methodology for evaluating and selecting residential water meters (DTIAPA) | | | | | | X |
- Statistical approach to quality control in commercial systems | X | | | | | |
- Use of surrogate variables to estimate unmetered consumption of residential connections | X | | | | | |
- Educational technology applied to development of meter repairs manual (DTIAPA) | X | X | |
- Development of a velocity-type proportional meter for macrometering | X | X |
### 1982-83 Work Plan

#### Extension of Water Services to Slum Areas through Reductions of Unaccounted for Water
- Determination of optimal meter maintenance policies
- Evaluation of leak-detection equipment

#### Improving the Collection, Transport and Final Disposal of Solid Wastes
- Recovery and utilization of methane gas from sanitary landfills in large urban areas
- Development of simple technology for sanitary landfills for small communities
- Nonconventional solutions to garbage collection in slum areas via community participation
- Manual on occupational health risks in solid waste handling systems

#### Assessment and Control of Environmental Pollution and Hazardous Substances
- Application of mathematical models to evaluate water quality control programs
- Evaluation of submarine outfalls for coastal wastewater disposal
- Development of eutrophication models for tropical lakes
- Epidemiological and economic study of silicosis in the Bolivian mining industry
- Economic evaluation of environmental hazard control methods in the mining sector
- Study of the exposure of female workers to organic solvents (UNIFDM)
- Regional network of water pollution monitoring (GEMS/WATER)
- Regional network of air pollution monitoring (GEMS/AIR)
- Analytical quality control in wastewater laboratories (EPA)

#### Current status of activity

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<th>Project Promotion</th>
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<th>Application of Research</th>
<th>Presentation of Research</th>
<th>Research Result</th>
<th>Research Realization</th>
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**1982-83 Work Plan**

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<tr>
<td><strong>Information in Environmental Engineering and Sciences</strong></td>
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<td>- Regional survey of research institutions</td>
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<td>- Regional survey of research in progress</td>
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<td>- Evaluation of the institutional infrastructure in Peru for establishing a national information network for the Decade (DTIAPA/POETRI)</td>
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<td>- Experimental development and evaluation of regional information services in the field of water and sanitation (IDRC/UNESCO)</td>
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