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RESEARCH PRIORITIES
ENVIRONMENTAL HEALTH PROGRAM

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ENVIRONMENTAL HEALTH PROGRAM

I. Introduction

To identify unmet research needs, and define priorities of research in the area of environmental health it is necessary to have a general understanding of the dynamics of the sector in the Region. This necessitates consideration of demographic and economic trends; the prevalence, and seriousness of diseases related to environmental deficiencies; the level, quality, and needs of various environmental services; and the changes in the human environment itself.

Latin America and the Caribbean presently have more than 350 million inhabitants and it is expected that by the year 2000 this figure will reach 600 million¹. About 65 percent live in urban centers and in many of the larger cities more than 25 percent of the residents live in marginal areas. In fact the cities have been expanding so rapidly that extension of basic environmental health services (such as water, sewage and excreta disposal, refuse collection and disposal) and health services have not kept pace. These services which are overloaded and underfunded are not meeting the growing demand.

In Latin America and the Caribbean the incidence of disease related to unsafe water and inadequate disposal of sewage and excreta contribute significantly to the high mortality and morbidity rates. Gastroenteritis and diarrheal diseases fall within the 10 leading causes of death and are responsible for about 200,000 deaths² per year, excluding those due to typhoid fever and hepatitis. In the five countries of the Region with the lowest life expectancy this is the first or second cause of death.

The assignment of the limited resources among the different sectors is one of the most difficult decisions facing governments. Although increasing resources for environmental health have been received they have been insufficient to cover the deficiencies. Because of the current economic conditions in Latin America and the Caribbean, during the 1980's the competition for resources will probably be greater at the same time that the environmental health needs are growing. According to the Economic Commission of Latin America (ECLA) the economic trend from 1981 to 1983 has been down ward and the gross internal product has decreased by 2.8 percent.

II. The Environmental Health Service Situation of the Region

Although great progress was made in the provision of water and sewage and excreta disposal over the last two decades a great deal remains to be done. At the end of 1980 with information provided by 18 countries, (about 89 percent of the total population of Latin America and the Caribbean³) the situation was as follows.

- Of a 205 million urban population approximately 157 million (77 percent) had access to potable water systems by means of either house connections or through public sources no more than 200 meters from the residence.
- Of the 110 million inhabitants of rural communities (defined differently in each country with upper limits ranging from 100 to 5,000 inhabitants only 46 million (42 percent) had access to potable water.
- Sewerage and safe excreta disposal services covered only 54 percent of the urban population and only 10 percent of the rural.
- In 1980 only about 43 percent of the urban population were connected to sewer systems and more than 90 percent of the sewage generated was discharged without treatment into receiving bodies of water.

To reach the goals of maximum possible coverage suggested by the "International Drinking Water and Sanitation Decade" as well as "Health For All by the Year 2000", and taking population increase into account water supply will have to be provided to some 155 million additional urban and 100 million rural inhabitants by the year 1990. It will also entail provision of sewage or excreta disposal services for some 250 million additional urban residents and 140 million rural inhabitants.

Particularly, in the marginal urban areas and in the rural areas, the lack of sanitary excreta disposal facilities is a priority problem which contributes to the enteric and diarrheal disease groups which continue to be a serious health problem in various countries of the Region.

Only 10 percent of the sewage from the municipal sewer systems is presently treated. The remaining 90% which is discharged untreated directly into the receiving bodies of water is the principal cause of their biological contamination.

Solid wastes are currently a growing problem in Latin American and Caribbean Countries, particularly in urban areas where plans and appropriate systems for addressing the growing requirements for storage, collection, transportation and disposal are non-existent. Recent estimates indicate a 1980 urban solid waste production rate of 130,000 tons per day, for the year 2000⁶ due to the accelerating urbanization and the increased production of waste per person this figure will reach 370,000. The public refuse services generally do not reach the marginal areas. Health risks are also increasing due to industrial growth and the inadequate disposal of special and hazardous wastes.

All of the preceeding has contributed and continues to contribute to aggravating the problems of biological and chemical pollution with the consequent increase in intensity and frequency of man's exposure to environmental health hazards including possible carcinogens, teratogens, and mutagens. Additionally some of these substances can also cause mental and physical behavioral changes.

Industrial wastes (solid, liquid, and gas) as well as numerous chemical products which are used in agriculture, industry and the home contribute to rapidly increasing environmental contamination. Accelerating urban and industrial growth has brought about the deterioration of air quality in larger cities. Other important factors are the increase in automobiles, particularly those without emission control devices, and the incineration of household wastes. Although the information which was provided by the Pan American Air Pollution Monitoring Network, with more than 100 stations in the principal cities of Latin America and the Caribbean is limited, it indicates that in many cities there have been significant increases in the parameters measured⁴.

In Latin America and the Caribbean, industrial and agricultural development is clearly in progress with a consequent rapid increase in environmental contamination. For example, the gross internal product of the manufacturing sector has almost quadrupled in the last 20 years, having increased from 37 billion dollars in 1960 to 133 billion dollars in 1980 (in 1980 dollars). The agricultural and mining production had doubled in the same period. In 1977 the chemical industry represented 49 percent of the export total. The agricultural application of pesticides has doubled every five years. Furthermore it is estimated that man uses some 68,000 chemical compounds in the home, industry, agriculture and in his other activities⁵.

Foods are the most important medium of human exposure to persistent pollutants such as heavy metals, DDT, and other organic compounds subject to bioconcentration along the food chains. Additives are another source of food contamination.

As a consequence of migration from the rural areas, the urban population that lives in marginal settlements has proliferated, reaching as much as 25 percent of the population in the major cities. This population lives in substandard housing with deficient water supply and excreta disposal services. In general this segment of the population has few resources and risks greater exposure to hazards of environmental contamination. In the rural areas inadequate housing plays an importante role in the chain of transmission of certain diseases, particularly those transmitted by vectors.

Consequently it can be surmised that countries of the Region experience a wide gamut of environmental health problems ranging from those of basic sanitation to those more characteristic of developed

countries. Furthermore the present trends suggest that pollution by chemicals and toxic substances may become a severe problem in the near future. Also development projects can provide environmental changes with deleterious effects on health and human ecology.

In this setting the protection of human and environmental health is a complex task which includes multiple aspects and unexplored components. Thus, for the Latin American and Caribbean countries, research in the environmental health field has to provide a broad series of technical solutions and measures for overcoming the technical, administrative, operational and economic restrictions which impede the acceleration of solutions to the respective problems.

III. Environmental Health Research in Countries of the Region

The importance of research, as an element which facilitates a positive harmonious development between man and his environment in a continuous process of change and technological development has been recognized by the Latin American and Caribbean countries. In the last decade, attention has been devoted to develop research primarily in subjects of sanitary engineering and more recently in other aspects of environmental health. Nevertheless, the progress achieved in this sense has been slow, with some exceptions.

A good part of the research is carried out in universities often in conjunction with the preparation of a thesis, which isn't always related to the most pressing health problems. Among the universities which conduct research in the field of environmental health are la Escuela Nacional de Salud Pública, Río de Janeiro, y la de Sao Paulo, Brasil; la Universidad Nacional Autónoma de México; la Universidad de Buenos Aires; la Universidad de Chile; La Escuela de Ingeniería Sanitaria de Centro América (ERIS) in Guatemala.

In recent years, due to the urgency of resolving environmental problems, some countries, especially the more industrialized, have established special environmental institutions or agencies. Some are within the Ministries of Health others not. The areas of research vary according to the problem priorities of the state or country. Some of them which carry out or support research related to various type of environmental health, usually oriented to the solution of problems related to quality and quantity of water and air are: la Secretaría Especial del Medio Ambiente (SEMA), Brasilia, la Companhia de Tecnologia de Saneamiento Ambiental (CETESB), Sao Paulo, la Fundacao Estadual de Engenharia de Meio Ambiente (FEEMA), Río de Janeiro, Brasil; el Centro de Investigaciones y Entrenamiento para el Control de la Calidad del Agua (CIECCA), México, D.F., México; la División de Investigaciones sobre la Contaminación Ambiental (DIA), del Ministerio del Ambiente, Caracas, Venezuela; el Instituto Nacional de Ciencia y Técnica Hídrica (INCYTH), Buenos Aires, Argentina; la Subsecretaría de Mejoramiento del Ambiente, México, El Servicio de Nacional de Obras Sanitarias, Chile.

Little research and few studies about the processing and disposal of solid wastes are carried out in the countries, in spite of the critical importance of this problem. Certain noteworthy works which have been carried out by la Companhia Municipal de Limpeza Urbana (COMLURB), Rio de Janeiro, are concerned with recycling waste and extracting thermal energy from the wastes, but many more studies are needed in this area.

National Environmental surveillance systems are found to be in an incipient phase. Under the Global Environmental Monitoring System (GEMS) cooperatively being carried out by UNEP, WHO and other select national and international organizations, some progress has been made in air, water, biological and food contamination monitoring. With the exception of some cities such as Sao Paulo and México there are no advanced networks of air quality surveillance.

Research related to the protection and control of chemical risks, is complex and costly and usually requires long term studies and interdisciplinary expertise. This partly explains the fact that little has been done in this sector in Latin America and the Caribbean. Fortunately, the industrialized countries have made many advances in this aspect and the developing countries can benefit from their experiences, both positive and negative as well as from their research findings. The World Health Organization in collaboration with the United Nations Environmental Program (UNEP) and the International Labor Organization (ILO) sponsors the International Program of Chemical Safety IPCS, with the cooperation of member countries. The program objectives can be summarized in conducting and disseminating evaluations of exposure risks to chemical agents, the validation of methods, promoting cooperation in emergencies and developing personnel.

In the Americas Region, Canada and the United States participate actively through a variety of specialized institutions. However, other countries have institutions which could also participate. For example, in Brazil there are SEMA, CETESB, FEEMA, the Instituto Adolfo Lutz, the Universidad de Sao Paulo and the Universidad de Campinas, among others. In Mexico there are the Instituto Nacional de Recursos Bióticos, el Instituto Tecnológico de Monterey, the Universidad Agrícola Autónoma de Chapingo, the Universidad Nacional Autónoma de México, the Instituto de Seguridad Social, the Secretaría de Salud y Asistencia, to name a few. In Argentina there are the Instituto de Medicamentos, the Facultad de Farmacia y Bioquímica, the Universidad de Buenos Aires. Equally other countries also have institutions capable of collaboration.

Responding to recent global and regional mandates of the directing bodies of the Organization on the IPCS, the Environmental Health Program of PAHO will soon initiate a study of the situation of chemical safety in the Region and will prepare a medium term plan of action (1984-1989). This program will expand the participation of Latin American and Caribbean Institutions and will contribute substantially to the development of research in this area.

The lack of basic infrastructure, funds, sufficiently interested and capable investigators, conducive conditions for research and innovation, and primarily the lack recognition that research can contribute significantly to reducing the cost of projects and programs are the most important obstacles impeding the progress of environmental health research in many countries of the region. In general the planning of environmental health programs and activities has not given sufficient attention to research as an essential component. Moreover the means of gathering, arranging and disseminating scientific and technical data and information, especially that regarding environmental contamination and the effect of chemical contaminants on health in particular are insufficient.

IV. PAHO Collaboration in Environmental Health Research

The Environmental Health Program which includes the HPE unit and its two Technical Centers, the Pan American Center for Sanitary engineering and Environmental Sciences, and the Pan American Center for Human Ecology and Health have collaborated with member countries in various research and investigation projects. Examples of the cooperative efforts follow.

With the financial support of the United Nations Development Program, PAHO was the executing agency for environmental contamination control projects (air, water, and soil) in Río de Janeiro and Sao Paulo, Brasil, from 1970 to 1980. PAHO also executed projects with the Division of Research for Environmental Pollution of the Ministry of the Environment, Venezuela, and with the Mexican Subsecretary of Environmental Improvement. A good part of the effort of these projects was devoted to research directed at resolving specific problems, and in support of prevention and control programs that were concurrently developed. An example of achievement is the Rio de Janeiro project which carried out studies about the recuperation of lake Rodrigo de Freitas, the study of the pollution of Guanabara Bay with dispersion models of contaminants, methods of solid waste disposal and control of air pollution. Several of the operational recommendations from these projects have been implemented and have led to important improvements in the four areas indicated. Also the water quality of the Paraíba, Cauca, Bogotá, Medellín, Rivers was evaluated including the content of toxic substances and the study of the reaction of dissolved oxygen, through the application of simulation models have been carried out. Research on the impact of the dams Salto Alto Grande, (Argentina), Yacyreta, (Paraguay - Argentina) on ecology and human health have been carried out. Important activities with the Environmental Pollution Research Division of the Ministry of the Environment of Venezuela include pollution studies with sediment analysis and bioassays for evaluating the eutrophication process of lake Maracaibo and Valencia. Also air pollution research in the Valley of Caracas and environmental impact of petroleum refineries was conducted with ECO collaboration.

A collaboration effort was carried out with the National Research Council (CNPQ) in a survey of the research in environmental health being carried out by the national institutions and agencies.

Pan American Center for Sanitary Engineering and Environmental Science (CEPIS)

In addition to the participation in some of the previously indicated activities CEPIS has carried out an intensive program of research and technology transfer which includes the identification, evaluation, application, and dissemination of technologies and methodologies for environmental control. Also operational research was carried out related to institutional, economic, and sociocultural factors which condition its application. CEPIS program of appropriate technology transfer was presented for the consideration of the Twenty First Meeting of the Advisory Committee on Medical Research (ACMR) in 1982⁷. The Committee endorsed this and concluded that PAHO should give a high priority to the work of CEPIS. A partial list of CEPIS's research activities between 1982 and 1984 is provided in the Annex I. For the period 1984-1989 a considerable expansion of activities is planned.

Center for Human Ecology and Health (ECO)

The approach of ECO's research efforts have focused primarily on problems related to chemical contamination and ecological and health impacts of development projects, and although different from that of CEPIS is complementary and within the HPE program frame of reference. ECO's function is primarily one of cooperating with national research centers in the identification of problems, gathering and analyzing relevant data and information, design of research, analysis of project management, and analysis and dissemination of research findings. In general, the Center is one of supports, complements, and extends national resources. Examples of the kind of research conducted with ECO collaboration have already been mentioned. To give an idea of the type of projects which include research a partial list is included in Annex II.

ECO is in the process of reorientation. In July 1983, ECO presented their program for research development on the effects of industrialization on health to the Twenty Second Meeting of the ACMR⁸. This committee recommended that through an adequate mechanism, the problem of research in the environmental health field be studied to review the current situation, define priority areas of action and an operative strategy; and also recommended that PAHO support the programs for the preparation of specialized human research resources in environmental health. HPE and ECO are in the process of implementing these recommendations of ACMR based on the recently completed, HPE Medium Term Program which establishes the priority action areas of technical cooperation.

Specialists of HPE, CEPIS and ECO, as well as field personnel contribute to the investigation and transfer of technology through collaboration with participating national researchers.

In the development of the activities described HPE and the Centers have channeled important additional resources. Some are supported with regular PAHO funds but the bulk of funding was obtained as contribution from various bilateral and multi-lateral organizations. National counterpart contributions have also been considerable. One important source of support, UNDP, unfortunately has decreased its participation in projects fostering environmental pollution control, such as those aforementioned which had contributed importantly to the beneficiary countries in terms of infrastructure, trained personnel, laboratories, and technical information.

Presently the assignment of PAHO/WHO funds for research in the field of environmental health is awaiting the redefinition of the Organization's research policy and the establishment of procedures. HPE hopes to increase its use of this important resource in the near future.

The World Bank and the Inter American Development Bank through their water supply and sewage construction projects which includes a technical component are providing resources for institutional development that in some cases support management research.

V. PAHO/HPE Environmental Health Program (1984-1989)

The work of the Organization in the environmental health field has evolved according to the mandates of the PAHO Directing Council including those that have emanated in relation to the United Nations Conferences on the Environment (1971), Human Settlements HABITAT (1976) and Water (1977). The later brought about the launching of the International Drinking Water Supply and Sanitation Decade (1981 - 1990). In the Americas a momentous step was the approval by the Directory Council of PAHO, in 1981 of the Plan of Action for the Implementation of Regional Strategies for achieving Health for All by the Year 2000, including revised goals for the environmental health program.

The protection and promotion of environmental health is an integral component of the referenced Plan of Action aimed at improving the human environment as part of the total effort for social and economic development of the inhabitants of the Region. It is also integrated with other activities such as the control of diseases, the promotion of family health and well being, the strengthening of infrastructure for delivery of health services and the development of human resources. Furthermore many of the areas of activity such as the provision of water supply and excreta disposal; the prevention and control of physical and chemical contamination and other environmental health risks; the prevention of the negative effects of development projects on human health and ecology; the

interaction of rural development with programs for improving the health of farm workers and their families, vector control, and the safe application of pesticides, fertilizers and other chemical products are characterized by their intersectoral nature.

HPE's Medium Term Program has been framed within WHO's Seventh General Program of Work (1984-1989) and the Plan of Action. Consequently, its design responds to the needs of the countries in attempting to improve environmental health. The Environmental Health Program (EHP) focuses its activities on the following interrelated components: Water Supply and Sewage and Excreta Disposal; Solid Waste Management; Prevention and Control of Environmental Pollution, and Housing Sanitation. The indicated order reflects the degree of priority assigned to the components. Other PAHO programs have responsibility for specific areas of environmental health as in the case of control of food which is the responsibility of the Veterinary Public Health Program.

The general objectives of the Environmental Health Program are as follows.

- Strengthen and extend services for potable water supply and disposal of excreta and sewage, to reach and maintain a level of coverage and quality of service commensurate with the postulates of IDWSSD and HFA/2000.
- Extend the coverage and improve the handling and sanitary disposal of solid wastes in both urban and rural areas and the safe elimination of toxic wastes and special solid wastes in Latin American and Caribbean Countries.
- Protect human health from the adverse affects of environmental pollution (including toxic substances) and the adverse modification of the environment resulting from development projects and other environmental risks.
- Improve the sanitary conditions of housing and urban and rural human settlements especially the environmental health aspects that bring the benefits of improved health and living conditions to low income family groups.

The Program assigns priority attention to environmental health research which is oriented primarily toward "problem solving". It is not forgotten that such action is also important from the point of view of developing national capacity for the search of autochthonous, more economical and reliable solutions. Such an approach keeps in mind the social and economic realities of Latin America and Caribbean Countries as well as the prevalence of the problems to be resolved.

The research activities of the HPE Program (1984-1989) are closely tied to the objectives and goals to be achieved in the four indicated components. The development and transfer of technology constitutes the

area of greatest emphasis including the identification of new technologies and methodologies of environmental control and the evaluation of effectivity for resolving priority problems. Institutional, management, and sociocultural factors affecting application are also considered.

VI. Criteria for Establishing Research Priorities

The criteria for priorities of research projects in environmental health, have evolved reflecting the needs and priorities established in the countries. Likewise, the research priorities of the HPE Program reflect the policy of the Organization in its three principal areas of activity: promotion, cooperation and coordination. The criteria for establishing priorities are:

- Contribution to a better understanding of the environmental health problems affecting the countries.
- Reduction of the most important diseases related to an unhealthy environment and contribution towards improving the well being of the people.
- Contribution to achieving HPE program objectives and other country priorities.
- Feasibility of carrying out the research and developing the research capacity of the countries considering the capacity of the institutions and the need to strengthen them.
- Contribution towards developing the technical and scientific self sufficiency of the countries as well as their capacity to resolve health problems.
- Optimizing the investment-relation of the benefits foreseen including institutional, economic, and sociocultural factors which affect the application of the results.
- Capacity of the Program to respond availability of technical and financial support for the research to be successfully completed.

VII. Research Priorities

The specified research priorities change as progress is made and in light of new discoveries and technologies in consonance with the development of country capacity to resolve its own problems and the identification of new problems. The following is a list of the current research priorities of the HPE program according to different program components:

1. Provision of water and excreta and sewage disposal

- 1.1 Development and demonstration of appropriate and low cost technology.
 - a) The improvement of quality, availability, and reliability of services with special attention to the marginal urban and rural population.
 - b) The collection, treatment, reuse and final disposal of sewage and excreta, particularly for marginal urban areas and rural populations.
 - c) The rehabilitation and optimization of existing water and sewer systems, especially through improved operation and maintenance.
 - d) The utilization of renewable energy sources in the provision of water (for pumps and other necessities) as well as in the disposal of excreta and other wastes (bio-gas, methane recovery, etc.).
 - e) Development of water sources in a manner which reduces or precludes the need for further treatment.
 - f) Investigation of factors which restrict the adequate development of water and sanitation institutions.
- 1.2 Socio-economic research for the incorporation of the community in the solution of the problems of supplying water and the disposal of excreta in marginal urban areas and for improving intersectoral relations.
2. Management of Solid Wastes
 - 2.1 Development and application of appropriate and low cost technologies for:
 - a) The construction of sanitary landfills for small communities.
 - b) Community participation in waste collection in marginal urban areas.
 - c) Resource recycling and recovery.
 - 2.2 Research for optimization of collection systems and management of wastes.
3. Improving Housing Sanitation
 - 3.1 Development and application of appropriate and low cost technologies for improvement of housing sanitation.

3.2 Participate in research programs for control of the vector of Chagas' disease.

4. Pollution Control

4.1 Development and application of methodologies and technologies appropriate for:

- a) The evaluation of the effects of chemical pollution on health.
- b) The identification, evaluation, and control of the discharge of toxic substances to surface water bodies.
- c) The identification, evaluation, and control of groundwater.
- d) The evaluation of eutrophication of lakes and reservoirs in tropical climates.

VIII. HPE Program Research Goals and Activities (1984-1989)

The research goals are an extension of the goals of the program components. They are specifically related to the activities of the HPE program and constitute essential elements for its realization. The following table relates the proposal research goals to the program activities.

GOALS AND ACTIVITIES OF PROPOSED RESEARCH IN THE HPE PROGRAM
1984 - 1989

Goals

Activities

Component: Provision of water supply and disposal of sewage and excreta.

1. The member countries will have appropriate technology available for extending water and sewage and excreta disposal services to the marginal urban and rural population.
 - 1.1 Conduct a general investigation of the current technology used for water supply, and collection, treatment and disposal of sewage and excreta and identify need and priority areas for concentration.
 - 1.2 Collect, analyze, prepare, and disseminate appropriate criteria for the design of rural sewage systems and excreta disposal facilities.
 - 1.3 Promote and collaborate in the preparation of inventories of research relevant to technology development for water supply and sewage and excreta disposal, which is carried out in the countries so as to determine unmet needs, delineate emphasis areas and disseminate information.
 - 1.4 Cooperate in the development and application of appropriate technology for the installation of water supply and sewage and excreta disposal facilities.
 - 1.5 Promote and support the conduct of pilot studies utilizing appropriate technology and disseminate the results.
2. Development of projects for reuse of reclaimed sewage for agricultural purposes.
 - 2.1 Participate in the conduct of research regarding epidemiological and economic aspects of sewage reclamation and reuse for agricultural purposes.

Goals and Activities (cont.)

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| 3. | Identify the principal factors which limit the institutional development of water and sanitation service enterprises. | 3.1 | Promote and support investigations of those factors which limit the adequate institutional development of water and sanitation services in Latin America and the Caribbean. |
| 4. | Optimize the installed capacity of water supply and sewerage services. | 4.1 | Promote and support investigation of unaccounted for water in the water systems of large and intermediate cities and the establishment of control programs. |
| 5. | Improve and control the quality of drinking water in all countries. | 5.1 | Promote and support the evaluation of the quality of drinking water provided to both rural and urban populations and identify the most important factors restricting improvement. |
| | | 5.2 | Identify and promote appropriate technologies for utilization in drinking water quality improvement programs with emphasis on desinfection. |
| | | 5.3 | Develop and implement two demonstration projects for drinking water quality improvement. |
| | | 5.4 | Promote and support the identification of industrial sources of fluoride production as well as the location of natural deposits of calcium fluoride in the countries and investigate the feasibility of its use for fluoridation of drinking water supplies. |

Component: Solid Waste Management

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|----|--|-----|--|
| 1. | Mobilization of national resources for research in solid waste management. | 1.1 | Promote and cooperate in applied research and development of technologies in the management of municipal solid wastes and of special wastes. |
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Goals and Activities (cont.)

- 1.2 Collaborate in the diagnosis of the institutional situation of urban sanitation enterprises.
- 1.3 Promote and cooperate in the formation of a network of collaborating institutions including the research and development of technologies in the field of solid wastes.

Component: Environmental Pollution Prevention and Control

1. Evaluation, surveillance, and monitoring of the principal hydraulic resources which serve as drinking water supplies and bodies of water receiving sewage.
 - 1.1 Cooperate in the planning and implementation of monitoring and surveillance programs of water quality and for research of specific problems of water pollution.
2. Evaluation of potential eutrophication problems during the planning of the uses of reservoirs for drinking water supplies in tropical climates.
 - 2.1 Develop simplified methodologies for evaluation of lake and reservoir eutrophication in tropical climates.
3. Conduct scientific research on the effect of environmental hazards on health.
 - 3.1 Promote and support the conduct of scientific research related to the effects of environmental hazards on health.
 - 3.2 Promote and support the conduct of research for designing methods for evaluating the impact of development projects on human ecology and health.

Component: Housing Sanitation

1. Improving the sanitary conditions of housing.
 - 1.1 Promote and collaborate in the investigation of appropriate technology related to the sanitary improvement and other aspects of housing for health improvement and achieving basic levels of well being.

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Annex No. I

PARTIAL LIST OF RESEARCH PROJECTS WITH PARTICIPATION OF
THE PAN AMERICAN CENTER FOR SANITARY ENGINEERING
AND ENVIRONMENTAL SCIENCE

1982 - 1983

Improvement in drinking water quality

- Simplified methods for washing slow sand filters (DTIAPA).
- Simple procedures for disinfection of rural water supplies (PAHEF).
- Control of analytical quality in water laboratories (FFA).

Appropriate technology for collection, treatment, and disposal of sewage and excreta

- Evaluation of microbiological risks of the reuse of sewage in agriculture (DTIAPA/DIGEMA).
- The teaching technology to be applied in the development of a water meter repair manual (DTIAPA).

Extension of water service coverage to the marginal urban population through reduction in unaccounted for water

- Determination of policies for optimum meter maintenance.

Improvement of the collection, transportation, and final disposal of solid wastes

- Recovery and utilization of methane gas from sanitary landfills in large urban areas.
- Nonconventional solutions for waste collection in marginal urban areas through community participation.

Evaluation and control of environmental pollution and hazardous substances

- Development of eutrophication models in tropical lakes.
- Epidemiologic and economic study of silicosis in the Bolivian mining industry.
- Development of unconventional design criteria and construction methods for reducing the cost of sewer systems.

Technical and institutional development of agencies responsible for basic sanitation for nucleated and disposal rural population

- Logistic and organizational requirements for optimizing the operation and maintenance of pumps and motors in rural systems (DTIAPA).
- Evaluation of the technical, economic, institutional, and social factors which influence operation and maintenance of rural water supply systems in Peru (DTIAPA).
- Improvement of the design and operating characteristics of slow sand filters (DTIAPA).

Strengthening of the commercial systems of water enterprises

- Development of a methodology for evaluation and selection of domestic water meters (DTIAPA).
- Control of analytical quality in waste water laboratories (EPA).

Information in sanitary engineering and environmental science

- Regional inquiry of research institutions.
- Regional inquiry of research in progress.
- Evaluation of institutional infrastructure in Peru, for the purpose of establishing a national information network for the Water Decade DTIAPA/POETRI).
- Experimental development and evaluation of regional information services in the field of water and sanitation (CIID/UNESCO).

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- The monitoring and maintenance of the quality of water in the San Juan sewage stabilization lagoons for sustaining aquaculture.
- Research on tailings of mineral concentrating plants.
- Regional project for developing simplified methodologies for evaluation of lake eutrophication in tropical lakes.
- Evaluation of disinfection methods for rural water supplies.
- Design, construction, and evaluation of pilot plants for rapid filtration and short detention.
- Design, construction, and evaluation of pre-filters combined with slow sand filters.

Annex No. II

PARTIAL LIST OF RESEARCH PROJECTS CARRIED OUT WITH THE
COLLABORATION OF THE PAN AMERICAN CENTER
FOR HUMAN ECOLOGY AND HEALTH

1. Salto Grande Hydroelectric Project (1976-1983) Argentina-Uruguay
2. Project of Relocation of Population and Colonization in San Julian, Santa Cruz (1978-1980) Bolivia
3. Contamination from Mine Tailings in Potosi (1982) Bolivia
4. Study of Chemical Contaminants in the La Paz Drinking Water Supply (1982) Bolivia
5. Taxonomy of Bats and Rodents in Eastern Bolivia (1981) Bolivia
6. Industrial Pollution of Freeport and its Effects in Health. (1982) Bahamas
7. Evaluación del Brote Epidémico Industria Manhattan (1981) Colombia
8. Pesticide Intoxication of Agricultural Workers in Cotton (1981) Costa Rica
9. Evaluation of Potential Environmental Health Effects of the Irrigation Project in the Tempisque River Basin (1982-1983) Costa Rica
10. Arsenic Contamination of the La Paz River (1983-Continúa) Guatemala
11. Determination of National Standards of Lead Levels in Blood in Urban and Rural Population (1982-1983) Mexico
12. Rapid Evaluation of Chemical Contamination in the Lerma Industrial Zone, Edo. De Mex. (1983) Mexico
13. Frequency and Distribution of Cancer through Exposure to Substances of Industrial Origin (1984-Continúa) Mexico
14. Investigation of Pesticide Toxicity in the State of Mexico (1982-1983-1984) Mexico
15. Eliminación de Ratas por Uso de Estrategias Ecológicas en la Ciudad de Toluca, Edo. De Mex. (1982-1983) Mexico
16. Analysis of the Effects of Environmental Pollution in Coatzacoalcos y Minatitlan, Veracruz (1979) Mexico

17. Testing the Efficiency of Rodenticides Under Field Conditions in the State of México (1980) Mexico
18. Effects of Chronic Exposure to Arsenic in Drinking Water in Torreon, Coah. (1981-Continúa) Mexico
19. Epidemiological Investigation of the Effects of Nitrous Oxide Vapors Produced During the Burning of National ? in the Federal District (1982) Mexico
20. Health Effects of the San Juan de Miraflores Sewage Stabilization Lagoons, in collaboration with CEPIS (1984-Cont.) Peru
21. Ecological Studies of Rabies in the Mongoose (1981-1982) República Dominicana

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