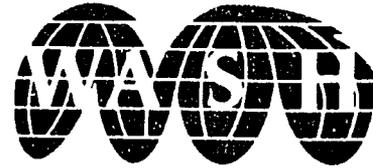


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**UNDP-World Bank
Water and Sanitation Program**



**WATER AND SANITATION
FOR HEALTH PROJECT**

WASH Field Report No. 281

**TEMPORARY WORKING GROUP
ON APPLIED RESEARCH:
REPORT TO THE 1990 COMMITTEE**

Prepared for the 1990 Committee
and the Office of Health, Bureau for Science and Technology,
U.S. Agency for International Development
under WASH Task No. 026

July 1989

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ACRONYMS

ADB	Asian Development Bank (Philippines)
AID	U.S. Agency for International Development
AIT	Asian Institute of Technology (Thailand)
ARCT	African Regional Center for Technology (Senegal)
BOAD	<i>Banque Ouest Africaine de Développement</i> (Togo)
BRL	Blair Research Laboratory (Zimbabwe)
CEFIGRE	<i>Centre de Formation Internationale à la Gestion des Ressources en Eau</i> (France)
CEMAT	<i>Centro Mesoamericano de Estudios Sobre Tecnologia Apropriada</i> (Guatemala)
CEPIS	<i>Centro Panamericana de Ingenieria Sanitaria y Ciencias del Ambiente</i> (Peru)
CESI	Country External Support Information (WHO/Geneva)
CETESB	<i>Compania de Tecnologia de Sanamentio Ambiental</i> (Brazil)
CIEH	<i>Comité Inter-Africain d'Etudes Hydrauliques</i> (Burkina-Faso)
CSIR	Division of Water Technology (South Africa)
CSC	Commonwealth Science Council (United Kingdom)
DANIDA	Danish International Development Agency
ECO	Pan American Center for Human Ecology and Health (Mexico)
ESA	External Support Agency
GEMS	Global Environmental Monitoring System
GTZ	German Agency for Technical Cooperation
IDRC	International Development-Research Center (Canada)
IHE/DELFT	International Institute for Hydraulic and Environmental Engineering, Delft University (Netherlands)

IIC/JICA	Institute for International Cooperation/Japanese International Cooperation Agency
IRC	International Reference Center (Netherlands)
IRCWD	International Reference Center for Waste Disposal (Switzerland)
IWSA	International Water Supply Association
KFAED	Kuwait Fund for Arab Economic Development
KFW	<i>Kreditanstalt für Wiederaufbau</i> , (Germany)
ODA	Overseas Development Administration (United Kingdom)
PAHO	Pan American Health Organization
RIVM	Dutch National Institute of Public Health and Environmental Protection
SDC	Federal Department of Foreign Affairs (Swiss Development Cooperative Agency)
SKAT	Swiss Center for Appropriate Technology (Switzerland)
UNCHS	United Nations Center for Human Settlement
UNDP	United Nations Development Program
UNDP/PROWESS	United Nations Development Program/Promotion of the Role of Women in Water and Environmental Sanitation Services
USEPA	United States Environmental Protection Agency
WASH	Water and Sanitation for Health Project (U.S.)
WHO/UNEP	World Health Organization/United Nations Environmental Program

EXECUTIVE SUMMARY

Introduction

At the International Drinking Water Supply and Sanitation Decade Consultation held in the Hague on November 2-4, 1988, representatives of international development institutions, bilateral donor agencies, NGOs, and developing countries proposed the establishment of a 1990 Committee and four temporary working groups under the headings. country-level support, information, applied research, and administrative arrangements. The terms of reference for the working groups were finalized at the 1990 Committee meeting in Paris on December 7-8, 1988. Each group was requested to prepare and submit a report to the 1990 Committee by April 30, 1989. This report was presented and discussed at a meeting of the 1990 Committee that was held in Geneva on May 31, 1989. Following the Geneva meeting, the report was revised to reflect the recommendations of the committee members.

This report presents the results of the work of the Temporary Working Group (TWG) on Applied Research. The TWG on Applied Research strongly endorses the view that applied research should address problems and obstacles which impede the ability of those active in the water supply and sanitation sectors, including beneficiaries, to achieve the major service objectives of the sector for the 1990s. In support of this view, the TWG has provided a list of research topics (presented in Section 4 and briefly summarized below) that is intended to set the general directions for applied research in the 1990s. This list was developed at a working group meeting held in London in March 1989, that included representatives from both ESAs and developing countries. We believe that this list identifies major problem areas that must be addressed if the sector is to meet the goal of expanded and sustainable water supply and sanitation services, even though it purports to be neither definitive or exhaustive of all research needs. It should be noted that the list of research topics also addresses the issues that were raised in the 1986 WHO/GTZ publication, "Global Sector Concepts for Water Supply and Sanitation."

While the recommended list of priority research areas is intended to set the tone of future applied research, many other areas, including further development of appropriate technologies, also need to be addressed. Many of these potential applied research topics are identified in the summary of submittals to the TWG (see Appendix E). These summaries provide a rich and diverse portfolio of research topics which will be useful as research organizations develop their individual programs for the 1990s. The TWG recommends, however, that a substantial amount of new research efforts be directed to the topics listed in Section 4. We believe that this list reflects the growing consensus that the major obstacles to progress require broader based, multi-disciplinary approaches and the recognition that institution strengthening is of critical importance for increasing both implementation capacity and service sustainability.

Lastly, the TWG, in compliance with the terms of reference, developed terms of reference (see Section 6) for the Temporary Working Group on Environmental Pollution. The TWG on Applied Research endorses the view that environmental concerns are of critical importance and should be considered as an integral component of water supply and sanitation efforts. A list of applied research topics for environmental sustainability is also included in the recommended priority topics of this TWG and should be considered as a starting point for the TWG on Environmental Pollution.

Summary of Recommendations

The TWG focused its attention on applied research needs relating to:

1. Expansion and enhancement of services;
2. Benefits of improved water supply and sanitation services;
3. System sustainability over time; and
4. Environmental sustainability of water supply and sanitation programs

The TWG developed sample lists of research topics--a list developed at the TWG meeting in London (which included Sections 4.1 through 4.4 of this report) and a more extensive list (included in Appendix E) based on submissions provided by a broader group of institutions. Several priority research concerns expressed in both lists are highlighted below

1. Technology development remains an issue, but the major problems center on tailoring technology choice to specific local conditions. One exception is the need to develop improved treatment technologies using saline and brackish waters, especially in arid areas;
2. Identifying effective institutional modes and means of ensuring continuous effective performance is the issue commanding most attention;
3. Cross-cutting economic and financial concerns, ranging from improved benefit measurement to achieving appropriate levels of cost-recovery, represent a major theme of recommended research,
4. Among subsections the most serious research gaps are apparent in the analysis of sanitation, waste management, and related environmental concerns;

5. There is a significant level of concern over the growing needs of urban and peri-urban areas, especially over the need to develop strategies for lowering the cost of providing service.

For consideration by the 1990 Committee, the TWG makes the following additional recommendations regarding applied research processes and activities. Additional recommendations are included in Section 6 of this report.

1. The TWG believes that it is important to encourage alternative approaches to key questions utilizing the insights of different disciplines and practical experience. There is no one best way to organize and rank appropriate research. The criteria which we have employed--in a rough way--in selecting priorities are (1) the importance of the information being sought, (2) the probability of being able to design research which will provide reasonably accurate answers, and (3) the scale of research needed and the timeframe needed for completion.
2. Establishment of a coordinating body for applied research is considered not desirable, and would probably be counter-productive. Instead, the Collaborative Council should arrange for periodic monitoring and review of research progress and identification of emerging issues. Such reviews must involve experts from developing countries.
3. Access to the research findings needs to be improved. In view of the time available, the Core Team has submitted this recommendation to the TWG on Communication of Information, asking that special attention be given in that group's discussions to measures for disseminating research findings. In particular there is a need to develop ways of capturing "fugitive literature," especially that covering research activities in developing countries. Among the options is the dissemination of research findings through the centers of the International Training Network for Water and Waste Management established through the UNDP/World Bank Program and support for an abstracting journal specifically devoted to WS&S research issues.

4. The TWG recommends that instead of creating one centralized body for the organization of applied research activities (see item 2 above), international and developing country networks be established and encouraged around principal research topics. Each network would have the responsibility for collecting and disseminating information for a particular research area to interested parties. Such a series of decentralized networks have the advantage of being relatively inexpensive and of encouraging country level participation and are capable of reaching large numbers of in-country institutions and individuals. WASH, IRC, PAHO/CEPIS, AIT, and REPEDISCA have had successful experience with this model in rainwater harvesting, guinea worm control, and other areas. Some level of central coordination could be provided by modifying the CESI system to track applied research projects at the county level. CESI could also be used to identify country-based organizations and individuals that could participate in applied research activities.
5. The terms of reference for the Temporary Working Group on Environmental Pollution should be adopted to substantially expand and complement the research on environmental sustainability considered by this TWG.
6. The TWG believes that it is not possible, at this time, to estimate the cost of carrying out needed research on each of the topics listed herein. The priority research topics are not all-inclusive but are intended to set general directions for the 1990s. The cost of research on each topic will depend on further definition of the topic by the institution involved, the approach used, the costs of the particular implementing organization, and other factors. Despite the difficulties of identifying specific research costs, we would like to emphasize the need to establish target funding levels for applied research. Applied Research has often been neglected and the potential benefits from applied research are often underestimated. Accordingly, the TWG recommends significantly higher levels of funding for applied research than are currently available. For planning purposes, it would not be inappropriate to set aside up to one percent of the resources required for the planning and implementation of WS&S for applied research.

ESA COLLABORATIVE COUNCIL
TEMPORARY WORKING GROUP ON APPLIED RESEARCH
REPORT TO THE 1990 COMMITTEE
APRIL 1989

1. Introduction and Background

At the International Drinking Water Supply and Sanitation Decade Consultation held in The Hague on November 2-4, 1988, representatives of international development institutions, bilateral donor agencies, NGOs, and developing countries proposed a Collaborative Council to provide direction for sustainable water supply and sanitation (WS&S) programs and approaches into the 1990s. Also at the Hague meeting, responsibility for coordinating the approaches for the 1990s was given to a temporary "1990 Committee" and four temporary working groups under the headings country-level sector support, information, applied research, and administrative arrangements were established.

At the first meeting of the 1990 Committee held in Paris on December 7-8, 1988 the terms of reference for each of the temporary working groups were finalized and the end of April 1989 was set as the deadline for submission of reports. The Temporary Working Group (TWG) on Applied Research was activated in early January, 1989.

The terms of reference for the Temporary Working Group on Applied Research (see Appendix A) called for a core group consisting of USAID/WASH, IDRC, and the UNDP/World Bank Program to begin work. The core group, less IDRC which was unable to participate, in the design work, held its first meeting in early January 1989, and USAID/WASH was selected as the Secretariat for the TWG.

2. TWG Purpose and Approach

2.1 Purpose

The Terms of Reference for the TWG on Applied Research state the need for applied research in the WS&S sector in the following manner, "There is a recognized need for studies and demonstration of new approaches over a wide spectrum of applied research, covering technical, socioeconomic and financial aspects of water supply and sanitation and wider environmental issues. This research should be planned to strengthen and make better use of local institutions and capabilities."

Furthermore, the key objectives in the Terms of Reference TWG on Applied Research are:

- to review and summarize research results;
- to identify gaps between these results and remaining problematic issues,
- to make recommendations and suggest priorities for additional research needs to fill these gaps;
- to prepare draft terms of reference and proposed membership for a temporary working group on environmental planning.

2.2 General Approach

The first task of the core group was the selection of other members of the TWG. The terms of reference called for a small group of about 15, with about half (approximately seven persons) being representatives of developing countries. Considerable time and effort were devoted to identifying potential TWG participants and potential donors to support participants from developing countries, selecting participants which represent a cross section of geographical regions, subsectors, and disciplines and matching interested and available participants with supporting donors.

In addition, to meet the objectives of the Terms of Reference the core group established the following general process:

- It sent requests to 147 organizations (including members of the collaborative council) requesting submissions for past, ongoing, and proposed research and suggested research topics.
- It prepared a summary of submissions received by March 10 as background information for the working group meeting in London (March 16 - 17, 1989).
- It held a working group meeting in London with participants from international organizations and developing countries.
- It prepared a draft report to the 1990 Committee, incorporating the results of the working group meeting and the submissions that were received by April 15, 1989.
- It reviewed the draft report with the participants of the London meeting.
- It prepared a draft final report to the 1990 Committee.

- It presented the results of the TWG's report to the 1990 Committee at the May 31, 1989 meeting of the 1990 Committee in Geneva.
- It prepared a final report based on the discussions at the Geneva meeting.

Key elements of this process included:

Membership of the TWG. As directed by the terms of reference, the core group (WASH and UNDP/World Bank) selected other members of the group from those organizations which expressed an interest and who submitted responses to the request for applied research information. Group membership was restricted to 15. Unfortunately, because of the short time available, the difficulties of arranging funding for participants from developing countries, and several last minute cancellations, the core group consisted of only four instead of seven country participants from developing countries. As the secretariat for the TWG, WASH is preparing a letter to the 1990 Committee on lessons learned on the issue of country level participation in these types of meetings. The letter expresses support for the participation of developing country representatives in these meetings but raises concerns over the mechanisms available to meet this objective.

Submissions The core group drafted and sent a letter (see Appendix B) requesting assistance in identifying key applied research issues to 147 organizations including all Collaborative Council members and many major research institutions (see Appendix C). To date nearly thirty responses have been received (see Appendix D for a list of organizations responding) and each response has been summarized (see Appendix E). Summaries of those responses received prior to March 10, 1989 were provided to the participants of the London meeting as background information.

The responses varied considerably in level of detail and breadth of focus--many being strictly technical in orientation. Together, however, the responses provided a broad cross section of topics in six general areas: engineering, operations and maintenance, finance, and social, health, and institutional development. From the submissions, over a hundred research topics (see Appendix E) were identified and these were also presented to the working group in London as background information.

3. London Working Group Meeting

The meeting of the Working Group was held in London, England on March 16 - 17, 1989. The Commonwealth Science Council was host for the meeting which was attended by 15 persons, including representatives of ten international organizations and four developing countries. The list of participants is included in Appendix F. The meeting was designed by WASH and UNDP/World Bank and facilitated by WASH staff member, Fred Rosensweig. Brian Appleton, supported by WHO/Geneva, acted as rapporteur for the meeting and produced a

report on the meeting. The Agenda for the London Meeting is contained in Appendix G.

In order to ensure the identification of applied research priorities over a wide spectrum of WS&S needs, the workshop started with an initial plenary discussion which agreed on four global objectives which would need to be met in the water supply and sanitation sector during the 1990s. The global objectives identified in the workshop were also used as the framework to organize the subsequent discussions on specific research topics and are used later in this report for presentation of recommendations to the 1990 Committee

The global objectives established by the London working group are as follows:

3.1 Expanded and Enhanced Services

Though the 1980s have seen an increase in the rate of provision of WS&S services, coverage rates are barely keeping up with population growth. Acceleration in the numbers of people served is essential to tackle the big backlog. The problem is aggravated when inappropriate levels of service are provided. These often mean high per capita costs, lower coverage rates, and, usually, malfunctioning systems providing inadequate service. Applied research is needed to help developing countries and their ESAs to determine realistic levels of WS&S services for different communities and to accelerate their WS&S programs to match the urgent demands.

3.2 Benefits of Improved WS&S Services

Too little information is available about the range of benefits which may result from WS&S improvements or the preconditions necessary to achieve optimum benefits. Thus, communities, governments, and donors find it more difficult to justify investments in WS&S because they cannot properly take into account health, economic, and social benefits, and intended beneficiaries frequently do not achieve the anticipated benefits because they are not aware of the complementary activities needed.

The question to be resolved, partly through applied research, is how promotion, planning, and implementation of WS&S programmes can maximize the health, social and economic impact of WS&S improvements.

3.3 System Sustainability

WS&S systems frequently provide less service than they were designed for and go out of service at a high rate. In the past, sector agencies in developing countries and external support agencies have proved better at constructing WS&S systems than they have at keeping them functioning. The general issue, for which applied research can help to provide answers, is how WS&S systems can be kept in reliable operation and fully utilized by the intended beneficiaries.

3.4 Environmental Sustainability

Competing demands for water for irrigation, livestock, and industry can have a detrimental effect on potable water supplies, and many development activities threaten to deplete or contaminate scarce water resources. Similarly, isolated development of WS&S projects may have a deleterious effect on the environment and interfere with broader objectives. Applied research can help to demonstrate ways of achieving integrated water resource management and other environmental objectives.

After the global objectives were established, working group discussions and plenary reviews were used to select priority research topics. Each of the topics was then amplified to provide a better understanding of the general objectives and approach. Initial drafts of the recommendations outlined for each topic were reviewed by each participant immediately following the meeting, and their individual suggestions were further reviewed by the Core Group in compiling this report.

4. General Conclusions and Recommendations on Research Priorities

The TWG on Applied Research strongly endorses the view that applied research should address problems and obstacles which impede the ability of those active in the water supply and sanitation sectors, including beneficiaries, to achieve the major service objectives of the sector for the 1990s. As discussed in the previous section, the TWG on Applied Research believes these major objectives to be:

1. Expansion of service coverage and enhancement of service to those covered
2. Maximization of service benefits.
3. Sustainability of coverage and service provision.
4. Environmental sustainability of water supply and sanitation efforts needed for beneficial service provision.

The first objective is a needed extension into the 1990s of the primary objective of the International Water Supply and Sanitation Decade now drawing to a close. Objectives two and three respond to the experience of the Decade by recognizing the importance of efficiency in expansion of coverage and service provision as well as continuity in service levels once achieved. Objective four is a recognition that, on one hand, environmental degradation, particularly of water resources, represents a major threat to the ability of the sector to provide affordable services, and, on the other hand, that sectoral activities should be organized and managed to reduce adverse impacts on the environment.

The deliberations of the TWG on Applied Research and submissions from institutions active in the sector also revealed significant, cross-cutting themes for applied research. Five of these themes deserve special mention.

First, technology issues have commanded a great deal of attention in the past and water supply has received much more attention than sanitation. The TWG acknowledges the fact that support for applied research on specific technological developments, especially sustainable technologies, should continue. In general, however, the need appears to have shifted toward greater emphasis on sanitation and waste management technologies relative to water supply and toward informational and institutional mechanisms to better promote and utilize existing technologies. In addition, there has been a general recognition that many other elements, including community participation and the importance of social factors, are also critical to the success of WS&S programs

One important exception to the shift in emphasis toward sanitation and waste management is the need to address the growing shortages of water for drinking water supplies, not only in arid areas but worldwide. The problems in arid areas are particularly acute due to the scarcity of fresh water. For these areas, applied research to develop lower cost treatment methods for saline and brackish waters is especially critical. In other areas, the problems of water shortages is often due to competition with other sectors and contamination of sources. In such areas regulatory reform, appropriate pricing, and better intersectoral coordination are required. Applied research has a significant role to play in addressing these water supply issues.

Second, the investigation of alternative institutional modes and means of improving the performance of institutions commands more attention than any other single theme. Elements of research on institutional issues are a prominent feature of the topics recommended under all of the major objectives. One key aspect of these issues is the need to more thoroughly investigate implementable community managed approaches and other roles for beneficiaries and private sector involvement. Underlying much of the proposed institutional research is the need to understand how institutional performance can be improved and how alternative institutional arrangements influence and are influenced by incentives or disincentives for undertaking needed activities.

Third, a substantial emphasis on cross-cutting economic and financial concerns is apparent in the recommended topics. The economic concerns relate to a needed elaboration of benefit identification and measurement. One use of this information is to link the benefits to the costs of alternative technologies and service levels to be employed in expansion of coverage and enhancement of service provision. A related use is to help ensure that cost-recovery mechanisms and levels are appropriate and can be effectively implemented to contribute to financial sustainability of service institutions. Similarly, the recommendations include investigation of alternative models for financing the sector if or when the costs cannot be covered by beneficiaries. Additional recommendations concern the need to enhance the benefits of WS&S activities by developing and promoting better ways to influence behavior through health and hygiene education.

Fourth, the recommended topics represent more concentrated attention to waste management and linked environmental issues than have been true in the past. The topics explicitly recognize the need to investigate approaches for waste reuse and water resource conservation as well as the joint investigation of which

water resource environments are most at risk and which water supply and sanitation activities are most at risk from environmental damage to water resources. The topics recommended could lead to more systematic consideration of and planning for improved interventions over the whole water cycle.

Fifth, the TWG found a significant level of concern for the problems of urban and peri-urban areas. Population growth rates in these areas are accelerating at a rapid pace (often without services) and the need to address the lack of adequate water supply and sanitation coverage for such large segments of the population may dominate the sector in the future. Attention should be given to improving the management of existing supply capacity to extend coverage and reduce cost as well as finding lower cost technologies that will allow financial resources to be extended. And, strategies must be developed that will encourage wide community participation in the design, implementation, and operation and maintenance of peri-urban water supply and sanitation systems.

In developing a list of priority issues to be addressed through applied research, the TWG believes it important to note the need for recognition in the planning and financing of applied research programs of a number of emerging concerns which may have received insufficient attention in past research. In particular, the TWG sees a need to emphasize the special problems posed by rapid urban growth, the shortage of available information on ways of integrating water supply and sanitation development with other environmental programs, the important influence that women can have on the successful implementation and upkeep of WS&S projects and on local financing and cost recovery, and the comparatively low priority in the past of research on topics such as waste management and surface water drainage, in comparison with water supply.

The TWG also stresses the need in all applied research projects for an emphasis to be placed on ways of implementing the research findings. Linked to this issue, is the need to take full advantage of past research, to utilize developing country institutions, and to disseminate research findings in effective ways. Recognizing the overlap here with recommendations being developed by the parallel TWG on Communication of Information, the Applied Research TWG recommends that application of research findings should feature prominently in the criteria for selecting where and by whom particular research projects should be carried out, and that the TWG on Communication of Information should be asked to give special attention to dissemination of the results of applied research. Further recommendations on this issue are included in Section 6 of this report.

For each of the four global objectives, the TWG developed a series of individual topics for which applied research may be needed. This list was developed at the working group meeting held in London in March 1989, that included representatives from both ESAs and developing countries. The participatory process that was used resulted in a less rigorous elaboration of the research agenda than is normally encountered in individual organizational programs. However, we believe the list of research topics represents a consensus of current needs and sets the general tone and directions for applied research in the 1990s. We believe that this list identifies major problem areas that must be addressed if the sector is to meet the goal of expanded and sustainable water supply and sanitation.

services, even though it purports to be neither definitive nor exhaustive of all research needs.

While the recommended list of priority research areas is intended to set the tone of future applied research, many other areas, including further development of appropriate water supply technologies, also need to be addressed. Many of these other potential applied research topics are identified in the summary of submittals to the TWG (see Appendix E). These summaries provide a rich and diverse portfolio of research topics which will be useful as research organizations develop their individual programs for the 1990s.

The research topics identified at the London meeting are presented below, under the global objectives established by the working group. They are not presented in a priority order. Further elaboration of the purpose of the suggested research and approaches to carrying it out are included topic-by-topic in Appendix H. In most cases, the suggested starting point is a desk study and literature search to complete the list of past and ongoing research, and to evaluate available research results before initiating new studies. Many of these preliminary research activities will then lead to additional field work and demonstration projects

4.1 Expansion and Enhancement of Service

Topic 1.1 Investigate and demonstrate institutional arrangements to achieve accelerated and sustainable service coverage.

Very similar in principle to Topic 3.3, this topic would probably be combined with the investigations listed under that topic above. It would seek to identify and test appropriate combinations of public and private sector agencies, NGOs, community organizations, and women's groups in the planning, financing, operation, and maintenance of WS&S systems in rural and peri-urban areas. Measures for monitoring and evaluating performance should be an important part of the study.

Topic 1.2 Explore ways to rehabilitate existing systems, taking account of the importance of community participation.

The aim should be to develop approaches to rehabilitation which encourage agencies and communities to review design standards and service level expectations (topic 1.6).

Topic 1.3 Analyze the effectiveness of alternative financial models for WS&S programs, including cost recovery procedures, and ways to stimulate development of effective developing country capital markets.

The aim of this topic is to develop guidelines and demonstrate successful approaches in different circumstances, including ways of financing sanitation schemes and integrated projects. Studies of methods of stimulating willingness to pay and effect cost recovery in low-income communities (see also Topic 3.6) should be included in this research.

Topic 1.4 Review and develop methodologies for improving the cost-effectiveness of investment in sanitation.

Overlapping with Topic 3.5, this research would include studies on the costs and benefits of community participation in WS&S programs and ways in which women and children can be motivated to press for and initiate sanitation improvements.

Topic 1.5 Study methodologies for selecting particular service level norms and water quality criteria, in particular the trade-offs between the quality and quantity of water needed for domestic purposes in different circumstances.

The aim should be to demonstrate the links between choice of service level and coverage achievable with available resources and to develop guidelines for choice of technology and service level in conjunction with the community.

Topic 1.6 Investigate ways of encouraging review and use of local norms and standards for service level and water quality and design criteria for WS&S and drainage facilities

Linked to the previous topic, and to Topic 2 dealing with rehabilitation, this research should be directed towards ways of changing attitudes and expectations to match realistically achievable targets

Topic 1.7 Provide guidance on appropriate ways of mobilizing community support for and participation in the provision of sustainable WS&S in urban fringe and slum areas, with special emphasis on integrated development of water, sanitation, drainage, and waste management.

Research needs to be directed at peri-urban areas, to develop approaches which will overcome the constraints associated with rapid urban growth and to test and demonstrate feasible ways of providing integrated services

Topic 1.8 Demonstrate the potential for and benefits of local manufacture of WS&S components.

Guidance is needed on the types of WS&S technologies which are most suitable for local manufacture, the facilities and support which need to be provided to establish sustainable production, and the influence of fiscal/tax policies on the viability of local manufacture. A review of previous case studies should be combined with new demonstration projects.

Topic 1.9 Investigate ways of integrating low-cost sewerage into urban housing programs, techniques for retrofitting sewers in built-up areas, and appropriate methods to reclaim wastewater and other wastes for reuse.

Analysis of case studies should lead to the development of guidelines and initiation of demonstration projects.

Topic 1.10 Develop guidelines for training courses, curricula, career structures and incentives to create and retain enough skilled staff to plan, implement, and sustain community-managed WS&S projects.

Analyses of case studies and demonstration projects are needed to identify the right approaches on community-managed projects.

Topic 1.11 Investigate ways to adapt known technologies for treatment of saline and brackish waters for use in developing country situations.

Given the widespread presence of saline and brackish waters--particularly in arid and coastal areas--the adaptation of traditional but expensive technologies to produce lower cost schemes for treating these waters is needed. External financing and technical assistance for in-country research organizations should lead to modifications of traditional designs to produce lower cost, locally constructed and maintained treatment systems.

4.2 Benefits of Improved WS&S Services

Topic 2.1 Demand Measurement

The aim should be to develop predictive models for assessing the proportion of households willing to pay for water and sanitation facilities at given levels of service (and levels of consumption) under varying socioeconomic and environmental conditions.

Topic 2.2 Health Benefits

Research should be directed at assessing how WS&S facilities and hygiene education messages may best be designed to maximize health benefits and minimize health risks.

Topic 2.3 Assessing Environmental Benefits

Methodologies need to be developed for appraising the environmental benefits of waste disposal, drainage and pollution control measures

Topic 2.4 Intersectoral Integration

Analyses of past and new case studies should seek to evaluate the cost-effectiveness of combining implementation of water supply, sanitation and hygiene education programs, and of integrating these with other activities in the health and education sectors and with solid waste and drainage programs.

Topic 2.5 Demand Stimulation

Linked to the previous topic, research is needed into ways of encouraging demand for and use of enough water and sanitation facilities to achieve optimum benefits. At the community level, demand could also be stimulated by investigating ways to make sanitation facilities more appropriate and attractive to beneficiaries. For water-short areas, there is also a need to investigate

measures to reduce extravagant demand, or to make most effective use of available resources.

4.3 System Sustainability

Topic 3.1 Assess incentives/disincentives to improvements in institutional performance in the WS&S sector.

Under this topic, the aim will be to assess the constraints which at present prevent sector institutions from achieving performance targets, particularly in the field of operation and maintenance. Research will then be aimed at identifying or developing incentive schemes to improve performance. It is expected that new sets of indicators may be needed for monitoring and assessing at various levels (from overall policy/management to field level), the state of WS&S system maintenance

Topic 3.2 Determine and establish the relative importance of the causes of system failure and ways in which they can be avoided.

From past and future evaluations of WS&S projects, it should be possible to categorize the factors which lead to breakdown or malfunctioning of WS&S systems. This will help in the planning of new projects or rehabilitation of deteriorated systems, and should provide important data for development of organizational models and HRD needs (topics 1.1 to 1.4).

Topic 3.3 Investigate organizational/operational models for sector institutions to improve their capacity to support the operation and maintenance of installed WS&S facilities.

The aim should be to establish a range of options, based on case studies and demonstration projects, which will help developing countries and ESAs to select, for any particular program, institutional arrangements which make best use of the capabilities of public and private sector agencies, non-governmental organizations, existing and new community organizations, and the priority given by women to maintenance of family hygiene

Topic 3.4 Develop criteria to establish an appropriate mix of responsibilities between the community and other institutions for the long-term sustainability of WS&S systems.

There is a clear link between this topic and the preceding one. The important difference is that the focus here is on the community. Accepting the important role that community management has to play in the upkeep of installed facilities, the aim will be to investigate appropriate community structures and to find ways in which those structures can best be organized to obtain support from outside agencies in a timely and cost-effective way

Topic 3.5 Identify the operation and maintenance requirements of different WS&S technologies, with special emphasis on on-site sanitation facilities.

By identifying an appropriate range of existing projects for analysis, the aim will be to collate information from a variety of different sources and develop guidelines for the O&M implications of various technology choices. The aim should be to establish manpower and organizational support needs as well as cost implications.

Topic 3 6 Investigate appropriate workable strategies for cost recovery in low-income communities or areas.

A literature review and desk study of past research will identify suitable case studies and permit analysis of models. It is important to test strategies employing techniques of cross subsidies, social tariffs, etc, and to examine ways in which the involvement of women in local financing of water and sanitation schemes can generate willingness and capacity to pay from local resources.

Topic 3.7 Identify ways in which research results can be used to ensure the adaptation of technologies to local conditions.

The prime aim of this research topic is to develop direct links between research and development activities and the community to increase local awareness of the advantages of proven low-cost technologies in the most cost-effective manner. Comparative studies will be needed to demonstrate whether increasing community involvement in technological research and development has a positive influence on subsequent implementation of research findings.

Topic 3 8 Compare different strategies for raising official and public awareness of the need for maintenance of installed facilities

A review of existing educational materials, health and hygiene education methods, and public awareness campaign strategies should lead to development of guidelines for sector agencies and ESAs on ways of strengthening the promotional messages.

Topic 3 9 Determine the best means of selecting personnel, determining training needs, carrying out training, and retaining trained personnel.

Linked to the previous topic, but with a specific focus on human resources development (HRD), this research should take advantage of information from other sectors and develop recommendations for HRD programs in the WS&S sector which will help developing countries to train and retain skilled staff at all levels.

Topic 3.10 Examine ways in which health education contributes to sustainability of WS&S systems, including cost-effectiveness.

Selection of existing projects as case studies could allow simple and inexpensive testing of approaches aimed at demonstrating whether health messages through conventional or new channels have an effect on attitudes toward upkeep of WS&S systems.

4.4 Environmental Sustainability

Topic 4.1 Identify which WS&S activities are most at risk from environmental damage to water resources and prescribe protective measures.

Guidelines should be developed which allow planners and designers to anticipate and guard against competing demands for water resources, potential threats from industrial or agricultural pollution, or activities such as deforestation or flood protection

Topic 4.2 Determine what environments are most at risk from WS&S activities and what actions are required to protect them.

The complement of topic 4.2, this research should seek to develop recommendations for ameliorative measures needed to ensure that WS&S projects are planned and designed in an environmentally responsive way. Rapid assessment techniques with appropriate indicators are needed to assist in program planning

Topic 4.3 Review and develop methods and models for waste management and water resource protection.

Reviews of existing experience should lead to development of a series of models, including legal and organizational frameworks and technical recommendations, for implementing sound environmental management policies.

Topic 4.4 Identify the potential of and appropriate methods for optimizing reuse of wastewater and other wastes.

Linked with topic 2.8, the aim should be to review standards and develop a sound scientific basis for water quality standards for different types of use. This should be accompanied by studies of the cost-effectiveness of various water reclamation techniques, and ways of promoting resource recycling, including safe reuse of sewage solids and household waste

Topic 4.5 Investigate how water supply and sanitation can best be integrated into related planning and regional planning.

The aim should be to identify successful examples of institutional structures and planning methodologies which ensure that WS&S needs are considered alongside associated agricultural and environmental objectives.

Topic 4.6 Develop appropriate and cost-effective methods for providing WS&S-related environmental education.

Research in school and higher education curricula is needed, and in alternative measures of raising public and political awareness of environmental issues. Indicators may also need to be developed to monitor the effectiveness of different approaches

The TWG recommends that members of the Collaborative Council be invited by the 1990 Committee Chairman to review the topics listed here and identify ways in which their ongoing assistance in the sector may contribute to the proposed

applied research. ESAs may, for example, with the approval of their developing country partners, suggest ongoing projects which offer data for a desk study, or which may be suitable as case studies for one or more topics. Clearly, any known research already conducted on the listed topics will be of value in determining the Collaborative Council's own work program.

5. Recommendations for Establishing a Temporary Working Group on Environmental Pollution

As requested by the 1990 Committee, the TWG discussed the proposal to create a Temporary Working Group on Environmental Pollution Aspects of Water Supply and Sanitation Recognizing that a number of environmental issues are intimately linked to the WS&S sector, and that sustainable development requires that the quantity and quality of freshwater resources be managed rationally, the TWG endorsed the need for a Collaborative Council Work Program to address environmental issues.

In seeking to define the Terms of Reference for a new Temporary Working Group, the Applied Research TWG identified relevant issues as pollution of surface water sources by agricultural runoff and industrial wastewater discharges; water resource management issues involving competing demands for scarce resources, contamination/salinization of groundwater supplies caused by overpumping for irrigation or by excessive use of agricultural fertilizers, public health threats caused by inadequate waste management, and, the potentially harmful environmental effects of WS&S system expansion.

5.1 Terms of Reference

1. Review and refine a research agenda for environmental sustainability, using the environmental topics identified (see Section 4) by the TWG on Applied Research as a starting point
2. Define the main problems in environmental pollution from two standpoints:
 - (i) Identify the environmental impacts of WS&S activities and recommend ameliorative measures.
 - (ii) Identify the effects on WS&S systems of environmental degradation due to other sectoral activities.
3. Identify alternative technologies, institutional arrangements, and regulating strategy options for coping with environmental pollution.
4. Identify mechanisms for coordinating efforts to bring about better pollution control and environmental protection.

5. Develop an Action Plan for the Collaborative Council.

5.2 Targets/Work Plan

1. Inaugural Meeting--September 1989.
2. Assignment of tasks to agencies in TWG.
3. Review Meeting--March 1990.
4. Concise status report on problems and recommended strategy for the 1990s--June 1990.

5.3 Core Group

It is suggested that the TWG should be led by a Core Group including the UNDP/World Bank Water and Sanitation Program and the WHO/UNEP team involved in the Global Environmental Monitoring System (GEMS).

5.4 Suggested Membership

The TWG should consist of approximately 15 people, including the Core Group plus about five representatives from developing countries and five from donor countries. The Core Group should be responsible for making final selection of the TWG membership--ensuring that it is multi-disciplinary and geographically representative in nature. Consideration should also be given to participation of experts from one or more international environmental lobby groups. Suggested agencies who should be approached as potential members are UNCHS/(Habitat), CSC, USEPA, CEFIGRE, CETESB (Sao Paulo), CEPIS (Peru), GTZ, ECO (Mexico), PEPAS, IRC, IDRC, AIT (ENSIC), DANIDA, Environment Canada, CIEH, RIVM, the All-India Institute of Public Health and Hygiene, and a representative from China.

6. Summary of Recommendations

As called for in our terms of reference, the TWG has provided recommendations on research priorities in the water supply and sanitation sector. These specific recommendations are shown in section 4 and elaborated further in Appendix H. We believe that the recommended research could make a significant contribution to the achievement of the major objectives in the increased coverage, enhanced service, sustainability of services, and sustainability of environmental resources needed in the sector. The TWG recognizes that the list of priority research topics is not definitive. Institutions and individuals engaging in research will have, and properly should have, their own sense of priority and approach. What we believe we have accomplished, however, is the elaboration, for endorsement and ESA funding, of some key themes that will continue to address the unmet needs of the 1980s as well as provide forward-looking guidance for the next decade.

The TWG believes it important to note the need for recognition in the planning and financing of applied research programs on a number of emerging concerns which may have received insufficient attention in past research. In particular, the TWG sees a need to emphasize the shortage of available information on ways of integrating water supply and sanitation development with other environmental programs, the important influence that women can have on the successful implementation and upkeep of WS&S projects and on local financing and cost recovery; and the comparatively low priority in the past of research on topics such as waste management and surface water drainage in comparison with water supply.

For consideration by the 1990 Committee, the TWG makes the following additional recommendations regarding applied research processes and activities.

1. The TWG believes that it is important to encourage alternative approaches to key questions utilizing the insights of different disciplines and practical experience. There is no one best way to organize and rank appropriate research. The criteria which we have employed--in a rough way--in selecting priorities are (1) the importance of the information being sought, (2) the probability of being able to design research which will provide reasonably accurate answers, and (3) the scale of research needed and the timeframe needed for completion.
2. Establishment of a coordinating body for applied research is considered not desirable, and would probably be counter-productive. Instead, the Collaborative Council should arrange for periodic monitoring and review of research progress and identification of emerging issues. Such reviews must involve experts from developing countries.
3. Access to the research findings needs to be improved. In view of the time available, the Core Team has submitted this recommendation to the TWG on Communication of Information, asking that special attention be given in that group's discussions to measures for disseminating research findings. In particular there is a need to develop ways of capturing "fugitive literature," especially that covering research activities in developing countries. Among the options is the dissemination of research findings through the centers of the International Training Network for Water and Waste Management established through the UNDP/World Bank Program and support for an abstracting journal specifically devoted to WS&S research issues.
4. The TWG recommends that instead of creating one centralized body for the organization of applied research activities (see item 2 above), international and developing country networks be established and encouraged around principal research topics. Each network would have the responsibility for

collecting and disseminating information for a particular research area to interested parties. Such a series of decentralized networks have the advantage of being relatively inexpensive and of encouraging country level participation and are capable of reaching large numbers of in-country institutions and individuals. WASH, IRC, PAHO/CEPIS, AIT and REPEDISCA have had successful experience with this model in rainwater harvesting, guinea worm control, and other areas. Some level of control coordination could be provided by modifying the CESI system to track applied research projects at the country level. CESI could also be used to identify country-based organizations and individuals that could participate in applied research activities.

5. Developing country governments should be encouraged to include research and development activities in their water supply and sanitation programs to ensure identification of key national research priorities
6. ESAs should provide financial support for research and development and for evaluation in WS&S program budgets to ensure adaptation of techniques and approaches to local conditions and to encourage development of local research findings. A high priority should be given to developing in-country research capabilities.
7. End users of research results should be involved in the research from its early stages to help promote rapid application of research findings.
8. Support should be given to mechanisms which speed the exchange among developing countries of research needs, ideas, plans, and findings. On particular topics appropriate mechanisms may include regional workshops, multi-country research projects, exchange of experts (through travel grants), and use of local consultants.
9. Developing country agencies and ESAs should be urged to support the development and use of participatory research, monitoring and evaluation especially at the community level, where the involvement of community members, particularly women, in surveys and other research activities has been shown to have a positive effect on the quality and application of findings
10. Pilot and demonstration projects should be encouraged to test new approaches. Demonstration projects should also be seen as important dissemination and promotional tools, which can convince policy makers of the need for innovative approaches by providing evidence of benefits quickly and cost-effectively.

11. The terms of reference for the Temporary Working Group on Environmental Pollution should be adopted to substantially expand and complement the research on environmental sustainability considered by this TWG.
12. The TWG believes that it is not possible, at this time, to estimate the cost of carrying out needed research on each of the topics listed herein. The priority research topics are not all-inclusive but are intended to set general directions for the 1990s. The cost of research on each topic will depend on further definition of the topic by the institution involved, the approach used, the costs of the particular implementing organization, and other factors. Despite the difficulties of identifying specific research costs, we would like to emphasize the need to establish target funding levels for applied research. Applied Research has often been neglected and the potential benefits from applied research are often underestimated. Accordingly, the TWG recommends significantly higher levels of funding for applied research than are currently available. For planning purposes, it would not be inappropriate to set aside up to one percent of the resources required for the planning and implementation of WS&S for applied research.

APPENDIX A
TERMS OF REFERENCE FOR TWG ON APPLIED RESEARCH

APPENDIX A

TERMS OF REFERENCE FOR TWG ON APPLIED RESEARCH



1990 COMMITTEE
PARIS - 7 & 8 DECEMBER 1988

4

Temporary Working Group
on
Applied Research

- 4.1 The Terms of Reference drafted at the Hague Consultation for the Temporary Working Group on Applied Research were reviewed by the 1990 Committee. It was agreed that the TWG should be led by a core group consisting of USAID/WASH, IDRC, and the UNDP/World Bank Programme, and that this group should decide which agency would become the lead agency. In the meantime, the Secretariat will send updated Terms of Reference to the core group, requesting that they should be circulated to all members of the TWG. They should also be sent by the lead agency to all members of the Collaborative Council, with an invitation to submit written contributions for consideration by the group.
- 4.2 The Committee agreed that the membership of the TWG should be restricted to about 15, with about half being representatives of developing countries. The core group will select its membership from among those agencies which have already expressed an interest in participating, and those who send written submissions. IRC and WHO have indicated that they would like to participate, in addition to those agencies which expressed interest at the Hague meeting. It was recognized that specialists in applied research need not necessarily be drawn from within member agencies of the Collaborative Council, and the Committee agreed that the group should be free to include nominees chosen for their specific research expertise. Funding of the TWG will be provided by participating agencies and by ESAs which have indicated a willingness to support developing country representatives.

Terms of Reference

Introduction

- 4.3 There is a recognized need for studies and demonstration of new approaches over a wide spectrum of applied research, covering technical, socio-economic and financial aspects of water supply and sanitation and wider environmental issues. This research should be planned to strengthen and make better use of local institutions and capabilities.

Objectives

- 4.4 The key objectives of the temporary working group are to>
- a) review and summarize research results
 - b) identify gaps between these results and remaining problematic issues
 - c) make recommendations and suggest priorities for additional research needs to fill these gaps.

4.5 To achieve these objectives, the TWG will need to accomplish the following tasks:

- 1. Review the key issues requiring applied research identified in the report of the Interlaken Consultation, those in the UNDP/World Bank paper on research issues, and elsewhere, and assess priorities**
- 2. Provide a listing of existing, completed and proposed applied research linked to key issues identified. The listing is to be prepared on a best effort basis, within available resources, and should not become an exhaustive research programme in itself. It is stressed that information gathering based on donor responses does not often include developing country research, and effort must be made to address this problem. The participation of regional research specialists in the group's discussions is one suggestion for gathering information on developing country activities**
- 3. Identify gaps and develop a research priority list, including both topics and resources. Priorities should respond in a practical way to the needs of project planners and managers in overcoming problems in assessment, implementation and evaluation of the impact of their programmes**
- 4. Prepare draft terms of reference and proposed membership for a temporary working group on environmental pollution aspects, linked to the water and sanitation sector. The UNDP/World Bank programme has expressed a willingness to play a lead role in this proposed working group. The draft terms of reference and proposed membership should be referred to the 1990 Committee Chairman.**

4.6 The 1990 Committee agreed that the TWG should establish its own timetable for accomplishing the assigned tasks by the end of April 1989, anticipating the need for a 4-stage process

- initial meeting of the core group to assign tasks and invite submissions (by Jan 15, 1989)**
- submissions by interested agencies (by Feb 15, 1989)**
- meeting of full working group (by Mar 10, 1989), with the agenda to include finalization of proposals for the Temporary Working Group on environmental issues for consideration by the 1990 Committee Chairman**
- Submission of final report to 1990 Committee Chairman (by Apr 30, 1989).**

APPENDIX B

LETTER REQUESTING RESEARCH ISSUES, JANUARY 27, 1989

APPENDIX B

LETTER REQUESTING RESEARCH ISSUES, JANUARY 27, 1989



WATER AND SANITATION
FOR HEALTH PROJECT

Operated by USAID Associates

Sponsored by the U.S. Agency
for International Development

WASH Operations Center
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Arlington, Virginia 22209 2111 U.S.A.

Telephone: 703-261-2111
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Cable Address: WASHAID
FAX No. "01 525 419"

January 27, 1989

Dear Mr. _____,

RE: Request for assistance in identifying key applied research issues

At the International Drinking Water Supply and Sanitation Decade Consultation held in The Hague on November 2-4, 1988, representatives of international development institutions, bilateral donor agencies, NGOs, and developing countries established an external support agency Collaborative Council to provide direction for sustainable water supply and sanitation programs and approaches into the 1990s. The Council has assigned responsibility for coordinating the approaches for the 1990s to a temporary "1990 Committee." The Council also recommended the establishment of four temporary working groups under the headings: country-level sector support, information, applied research, and administrative arrangements.

At the first meeting of the 1990 Committee which was held in Paris on December 7-8, 1988 the terms of reference for each of the Temporary Working Groups were finalized. The Temporary Working Group for Applied Research was instructed to carry out the following tasks by the end of April 1989:

- a. Review the key issues requiring applied research identified in the reports of the Interlaken Consultation, the UNDP/World Bank paper on research issues, and elsewhere, and assess priorities.
- b. Provide a listing of existing, completed, and proposed applied research linked to the key issues identified.
- c. Identify gaps and develop a research priority list, including both topics and resources.

Camp Dresser & McKee International, Inc.
Associates in Rural Development, Inc.

International Science and Technology Institute, Inc.
Research Triangle Institute
University Research Corporation

Training Resources Group
University of South Carolina at Chapel Hill

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- d. Prepare draft terms of reference and proposed membership for a temporary working group on environmental pollution aspects linked to the water and sanitation sector.

The members of the Temporary Working Group on Applied Research include USAID/WASH, UNDP/World Bank Program, WHO, IDRC, GTZ, Ministère de la Cooperation et de Developpement (France), and Commonwealth Science Council. Efforts currently are being made to add several representatives of developing countries to the Temporary Working Group. The USAID/WASH Project has agreed to serve as the secretariat for purposes of coordination.

Your assistance is requested in identifying the key research-related issues and activities in accordance with the objectives outlined in a. through d. above. We have somewhat arbitrarily divided the sector into the following subsectors: social, technical, economic/financial, health, institutional and human resources, and environmental pollution. Any information you or your organization can provide to the Temporary Working Group on these matters will be of great assistance in helping it develop the applied research agenda for the 1990 Committee. Your submission should be based on a review of the issues identified in the Interlaken report and the recent UNDP/World Bank paper on research. It should also include a listing of any additional issues that you think should be considered and any existing, recently completed and proposed research which is linked to the key issues. Finally, please indicate whether you or your organization have any resources available to support proposed research.

Submissions regarding applied research should be sent to the WASH Project no later than February 24, 1989. Our address, telex and FAX numbers are listed at the top of this stationery. The Temporary Working Group plans to meet in London in March 16-17, 1989, to review all submissions and prepare the preliminary findings for the 1990 Committee.

On behalf of the Temporary Working Group on Applied Research, I strongly urge your participation in defining these important research issues and look forward to hearing from you in the next few weeks. The Temporary Working Group would like to take this opportunity to thank you for your assistance.

Sincerely yours,

Craig Hafner
for the Temporary Working Group
on Applied Research

APPENDIX C

LIST OF ORGANIZATIONS/PEOPLE RECEIVING REQUEST LETTER

- 25

APPENDIX C

LIST OF ORGANIZATIONS/PEOPLE RECEIVING REQUEST LETTER

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LIST OF ORGANIZATIONS WHICH SUBMITTED RESPONSES

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BACKGROUND

At the International Drinking Water Supply and Sanitation Decade consultation held in The Hague on November 2-4, 1988, representatives of international development organizations bilateral donor organizations, NGOs, and developing countries established an external support agency Collaborative Council to provide direction for sustainable water supply and sanitation programs and approaches into the 1990s. The Council has assigned responsibility for coordinating the approaches for the 1990s to a temporary "1990 Committee." The Council also recommended the establishment of four temporary working groups under the headings Country-level Sector Support, Information, Applied Research, and Administrative Arrangements.

At the first meeting of the 1990 Committee, which was held in Paris on December 7-8, 1988, the terms of reference for each of the temporary working groups were finalized. The Temporary Working Group (TWG) for Applied Research was instructed to carry out the following tasks by the end of April 1989:

1. Review the key issues requiring applied research identified in the reports of the UNDP/World Bank Paper on Selected Sector Issues and Proposed Research Priorities, the Interlaken Consultation, and elsewhere, and assess priorities.
2. Provide a listing of existing, completed, and proposed applied research linked to the key issues identified.
3. Identify gaps and develop a research priority list, including both topics and resources.
4. Prepare draft terms of reference and proposed membership for a temporary working group on environmental pollution aspects linked to the water and sanitation sector.

The following documentation has been prepared as background information to assist members if the TWG on Applied Research in carrying out the above tasks. Part I summarizes the key issues outlined in the UNDP/World Bank and Interlaken reports. These should provide a helpful for developing a priority list of applied research topics. Part II is a summary of responses received to date from various organizations and individuals concerning past, on-going, and proposed research, as well as proposed priority research topics. The responses range from brief topic suggestions to project abstracts. These can be used as a guide as the temporary working group for applied research undertakes the above-mentioned tasks.

PART I

**RESEARCH ISSUES SELECTED FROM UNDP/WORLD BANK
AND INTERLAKEN REPORTS**

A. SELECTED SECTOR ISSUES AND PROPOSED RESEARCH PRIORITIES FOR THE FRAMEWORK FOR GLOBAL COOPERATION, UNDP/WORLD BANK WATER AND SANITATION PROGRAM

This paper outlines some of the major areas of applied research that need to be undertaken in the near future. Emphasis is placed on three key areas needing particular attention: rural water supply and sanitation, urban sanitation, and municipal water management. The issues of coverage and sustainability are at the heart of all three of the key areas. Several other issues are equally important and deserve to be investigated in detail, including issues of integrated water resource development, finance, and sector institutions. The World Bank and the UNDP/World Bank Program will be developing research proposals in all of these areas in the near future.

1. Rural Water Supply and Sanitation Issues

The Core Issue: The Institutional Question

The core issue is the general lack of a sound institutional strategy for the delivery of rural water supply and sanitation services: What are the possible roles of the public sector (including the donor community), the private sector, and the beneficiaries themselves in the provision and management of sustainable rural water supply and sanitation?

The Basic Needs Issue: Prescribed Needs

Access to an adequate quantity and quality of potable water and hygienic disposal of human waste, are basic needs, at least as important as the need for food and shelter. Yet consideration of the basic need for rural water supply and sanitation often distorts the efficient allocation of investment resources by resulting in services being supplied that do not match demand. The desire to serve basic needs often becomes a justification for externally imposed solutions which in the long run are not sustainable.

Demand Issues: Felt Needs and Effective Demand

Demand will emerge from consumers' perception of service costs coupled with their perceptions of the benefits that will arise from the service. There are a number of issues related to both the costs and the benefits of rural water supply and sanitation (RWSS).

Supply Issues: The Distorted Market

There are numerous issues related to rural water supply and sanitation (RWSS), some of them a consequence of the core issue discussed above--the relative roles of the public and private sectors. The often-extreme market distortions in a developing country are exacerbated further in rural areas, where governments and donors are givers of services, and poor communities are receivers.

Sustainability Issues: Maintaining the Flow

As with most capital investment, the preservation of assets and their effective utilization are the key measures of success in RWSS. The issues of operation and maintenance of RWSS are the critical subset of the core issue described above.

Rural Sanitation Issues. Where They Differ

It is widely believed that there should be full integration of rural water supply, sanitation, and health education interventions to maximize potential benefits, especially improvements in health. While the arguments for integration are compelling, there are fundamental differences in the provision of rural water supply and rural sanitation that render integration difficult and often cause such projects to be less than successful. The main differences between the two interventions arise from the roles they play within the community.

Environmental Issues: What Is the Damage?

Both water resources and land resources suffer from ill-planned RWSS development. The issue is to minimize the damage.

2. Urban Sanitation Issues

Investment Cost Redirection

If projected needs are to be met, the unit cost and project cost of sanitation investment must be reduced by technology, cost-reduction measures considered in project planning, cost-effectiveness of project implementation, improved management of sanitation services and investment, alternative sources of funding, and early involvement of communities.

Effective Demand Stimulation

One of the requirements for designing economic sanitation systems is to match system capacities to effective demand. To do this it is necessary to obtain an accurate assessment of effective demand. Available data suggests that the need for adequate sanitation is high. But a big gap exists between need and effective demand. In part, this gap is the result of the high cost of sanitation, of low and declining incomes, and the limited consumer access to credit.

Institutional Framework and Development

The key institutional issue is whether the well-established organization structures for providing sanitation services through the use of conventional sewerage are also appropriate for low-cost and intermediate sanitation technologies. Another issue is the choice between private and public provision of sanitation services. A third issue is the adequacy of existing methods for billing and collection.

Improvement in the Economic Analysis of Projects

To instill confidence in the sector and thereby enhance the chances of attracting public or private investment in sanitation for low-income communities, while improving the efficiency of investment in the sector, it would be necessary to further develop and strengthen the analytical basis for project choice and justification.

Policy Framework

Few LDCs have consolidated policies and legislation on urban sanitation. Given current demographic and industrialization trends, there is a pressing need for the development of guidelines to provide a basis for the formulation of national policies and legislation on the provision of urban sanitation services. Such policies shape the institutional, regulatory, and financial environments within which urban sanitation development occurs.

Information Dissemination

One problem that more information could help dispel is the widespread skepticism about lower-cost alternatives to conventional sewerage.

3. Municipal Management Issues

Low Priority and Awareness

Relatively low priority is given to this sub-sector at the international, national, and municipal level. Waste management is generally regarded as a local concern to be dealt with by the municipal governments. At the municipal level, officials are seldom aware of the substantial social and economic benefits that can result from effective liquid and solid waste management systems.

Policy Framework

To achieve improvements in urban waste management, programs and projects must be evaluated within a broader framework of economic and resource development policy and environmental planning. Unfortunately, many developing countries lack such a comprehensive framework. This helps explain the low priority given to waste management.

Institutional Capacity

Implementation of a national urban waste management strategy requires a considerable institutional infrastructure. There are five main areas in which sound institutional capacity is indispensable but seldom found at the management level: planning for provision of services, information support, operational planning and management, human resources, and organizations (both public and private).

Financial Resources

Given the present-day constraints of limited funds in developing countries, investment capacity may be an obstacle to achieving the major improvements required in waste management activities. It has long been recognized that low-cost sanitation alternatives are needed to reach urban coverage levels.

Technology Selection

A need exists for greater dissemination and transfer of appropriate technology solutions and a reshaped "image" of low-cost approaches in the minds of consumers and practitioners.

B. **SELECTED SECTOR ISSUES FROM THE INTERNATIONAL DRINKING WATER SUPPLY AND SANITATION CONSULTATION, INTERLAKEN, SWITZERLAND, OCTOBER 1987**

The IDWSSD Consultation in Interlaken endorsed the WHO/GTZ publication, "Global Sector Concepts for Water Supply and Sanitation," and discussions led to the amplification of six key problem areas that are inhibiting attainment of the Decade goals. The six problem areas are briefly summarized below.

Institutional and Human Resources Development

Institutions responsible for water supply and sanitation sector activities in developing countries are frequently inefficient and financially weak.

Cost Recovery

Cost recovery is generally ineffective.

Balanced Development

Imbalances exist between the provision of water supply and sanitation and between sector inputs in central urban areas and those in urban-fringe and rural areas.

Operation, Maintenance, and Rehabilitation

Operation, maintenance, and rehabilitation receive insufficient attention and the problem is aggravated by application of inappropriate and often too-sophisticated technologies (which are neither affordable nor manageable).

Community Involvement

Community participation and hygiene education efforts are inadequate.

Coordination and Cooperation

Coordination and cooperation are inadequate among external support agencies, between these agencies and the national water supply and sanitation sector agencies, among the sector agencies themselves, and between the water and sanitation sector and related sector programs.

In addition, GTZ and SDC sponsored a paper for the Interlaken Conference entitled "Beyond the Decade."

This paper, prepared by John M. Kalbermatten and Michael G. McGarry, reviews the water and sanitation sector and progress made during the Water Decade. It outlines some of the constraints and issues which must be resolved for continued

progress. Finally, it proposes a program for the sector after the Decade. Summarized below are some of the key issues presented which deserve attention:

Priority Issues Around which Applied Research Activities Can Be Planned

There are numerous issues surrounding the water supply and sanitation sector which deserve analysis ranging from institutional development to technology choice. Most have been discussed. However, there are five interconnected issues which stand out as being crucial to the advance of the sector in the years ahead: decentralization, community participation, integration, affordability, and women's involvement.

Decentralization

Success in providing self-sustaining services in low-income communities implies effective outreach and utilization of the resources of the community itself. This cannot be accomplished through centralized institutions which take the contractor/construction approach to project implementation. Decentralization which transfers responsibility and authority to the field has figured predominately as a common element in successful projects. This means that although policy and program planning takes place at the center, project decisions are made in the field in association with the beneficiary community. For those in responsible positions in highly centralized agencies, delegating authority to the field is often difficult. However, it is the only way that responsibility for long-term care of the facility will be assumed by the community.

Community Participation

In retrospect, it is clear the projects in low-income communities, which have not involved the beneficiaries in a meaningful way, have tended to fail; those that have had strong community inputs have been the most successful at reaching more low-income people with long-lasting services. The process of involving communities is by no means a simple one. It often requires changes in the orientation and attitudes of staff and the implementing agency itself to ones that look upon the community as a partner in development rather than merely a recipient of technology.

Integration

It is now widely-recognized that full health benefits are not achieved by water supply alone. Sanitation and hygiene education are needed as complementary inputs. Integration is possible but project planners will have to be flexible and innovative in the methods they devise and in the institutions they select. Almost without exception, the successfully integrated project will have to involve two or even three ministries outside the water supply agency, and the methods used will have to draw on resources outside the conventional water sector.

Affordability

With increasing emphasis on cost-recovery, questions of affordability and willingness to pay are becoming increasingly fundamental to the financial viability of projects and to the agencies implementing them. Experience has demonstrated time and again that willingness and ability to afford services depends not only on income and the cost of the facility, but also on how the money is collected and managed. Affordability is not only a question of whether the user is capable of paying for the service received. It is also a question of whether the economy of a country can afford investments in the sector.

Women's Involvement

Although women are valuable resources to projects in terms of providing labor and maintaining facilities, greater benefits can be derived through their involvement in management decisions throughout the project cycle. Success of sanitation and hygiene education commonly rests with the women since they hold these responsibilities in the home.

Water Demand Management

Many areas in developed and less-developed countries are short of water now or expect to be shortly. One of the tools to overcome or prevent water scarcity is water conservation and reuse. Conservation and substitution must become a standard part of water resource and water supply planning in areas of actual or anticipated water scarcity. This planning must include appropriate pricing at marginal cost of water, without which the user is naturally reluctant to make investments in water saving appliances or methods.

System Rehabilitation

The coming decade can be expected to see a substantial effort at rehabilitation and replacement of aging systems. Sector planning must reflect the need for system replacement, not just the development of additional sources of supply. But it must also consider whether the same systems should be rebuilt or whether new concepts of water conservation, recirculation, and reuse would result in a more-effective, less-costly solution.

Environmental Impacts

Water supply and sanitation projects have intended and unintended environmental impact. Sewage treatment projects which use the effluent to preserve/create wetlands or parks with or without recreational water use are examples. The opposite, unintended environmental damage, is more common. Water supply and waste disposal projects thus have a significant impact not only on the services which are their principal objectives but on the environment as well.

Reuse and Recycling

The best way to prevent pollution and protect water supply is not to discharge waste. This can be accomplished by two complimentary actions, reduction of waste generation, for example, through more efficient water use, and by reuse or recycling, such as waste-water irrigation or solid waste recycling.

Resource Generation

New approaches to delivery are beginning to facilitate resource generation. The beneficiaries themselves are playing an increasing role in this effort. Women, especially, remain a largely-ignored resource. The private sector and NGOs represent major resources for the sector but have been uncoordinated. National governments will have to become less-dependent on external resources. They will have to increase their own resource bases by recognizing that this sector can indeed be self-sustaining and they must reorient their policies and practices to reflect this.

PART II

**SUMMARY OF SUBMITTALS TO THE TEMPORARY WORKING GROUP (TWG)
ON APPLIED RESEARCH**

THE AFRICAN REGIONAL CENTER FOR TECHNOLOGY (ARCT)

The African Regional Center for Technology (ARCT)
B.P. 2435
Avenue Cheikh Anta Diop
Dakar Senegal
Telex G1282 CRATEC S
Fax (221) 25-77-13
Dr D. Babatunde Thomas
Executive Director

ARCT sees the provision of adequate water supply as a crucial issue, especially in Africa, where polluted water is a source of numerous diseases. ARCT is at present only involved with issues concerned with the food and energy sectors and as such would be in a position to collaborate on research topics which include components in these sectors.

Past Research and On-Going Research: No submission presented for this report.

Priority Research Topics

Technical

- Development and maintenance of improved water pumps, including handpumps.

Technical/Environmental

- Assessment of water pollution by industrial wastes (e.g., effluents from textile dyeing, coloring, and other chemical processes).
- Waste water management and recycling.

Environmental

- The effect of pollution on marine life, especially for certain coastal communities.

Technical/Health

- Water purification techniques.

ASIAN DEVELOPMENT BANK

Asian Development Bank
2330 Roxas Boulevard
Metro Manila Philippines
P.O. Box 789 Manila Philippines
Cable Address: Asian Bank Manila
Telex ADBPH (ITT) 40671
Javier M. Gumpz
Manager, Water Supply Division
Infrastructure Department

The Bank is generally of the opinion that applied research issues should be identified from expressed felt needs at the grass-roots level. The Bank is particularly interested in the issue of self-help family water supplies in the rural areas and the deinstitutionalizing of rural water supplies whenever possible. The Asian Development Bank is presently engaged in some studies.

Past and On-Going Research

Institutional Development/Technical

Regional Study on Domestic Shallow-Well Water Supplies, TA 5311 (RAS/86/045)

Proposed Research: no submission presented for this report

Priority Research Topics

- Given that rural water supply coverage in Asia has shown little improvement over the last decade using traditional means of development through government agencies, radically different alternative development mechanisms need to be explored. One such mechanism is the concept of family-owned and -maintained handpumps on wells and boreholes. How much more self-help would occur if some assistance was given these people by provision of credit or reduction of capital costs through mass-production and bulk purchasing?

BLAIR RESEARCH LABORATORY

Blair Research Laboratory
P.O. Box 8105
Causeway
Harare
Zimbabwe
Peter Morgan

It is now well established that the success of programs is based partly on the suitability of the technology itself, but equally important is the choice of on-site field supervision and management. Very few water and sanitation programs are sustainable without the full support and cooperation of local communities and traditional leaders, and these people must gain the support and encouragement of local program managers. Very shortly, Blair Research Bulletins will be available.

Past and On-Going Research

Health

- Studies of water purification techniques.
- Investigation of personal hygiene practice (handwashing).

Social

- Promotion of full community participation in water and sanitation projects (latrine, well, and tubewell construction).
- Development of educational literature and audiovisual material.

Technical

- Handpump research and development (Zimbabwe Bush Pump)
- Family-based water projects (upgraded well and its application).
- Extended family-based water projects (bucket pump and its application).
- Investigation of techniques applicable to growth points and peri-urban settlements.

Proposed Research and/or Priority Research Topics

Human Resource Development

- Develop techniques for effective training programs in the rural setting.

Social

- Investigate more extensive local participation in handpump maintenance.
- Investigate the best means of conveying technology and health related messages to the user community.

Health

- Investigate in greater depth relationships between water supply and health, with particular reference to personal hygiene practice.
- Further investigate simple water purification techniques for use where only surface water is available.

Health/Technical

- Further investigate waste water drainage areas for community water points.
- Establish a realistic set of water quality criteria.

Technical

- Simplify maintenance techniques for handpumps.
- Investigate in-country traditional water/sanitation technologies and methods of upgrading and modernizing systems.
- Investigate family-based water supply programs.
- Investigate extended family-based water supply programs.
- Further investigate gravity-based water supplies (rainwater catchments, gravity and siphon wells, springs, etc.).
- Further investigate community based techniques for well sinking, hand operated tubewell drilling, and borehole drilling.
- Investigate appropriate sanitation technologies for in-country use and the use of local materials in latrine construction.
- Investigate pit filling times for pit latrines.
- Investigate pit emptying techniques for rural programs.
- Investigate appropriate water and sanitation techniques for peri-urban settlements.

- Investigate and develop in-country capacity for manufacturing hardware suitable for the sector.
- Further investigate alternative water pumping techniques (wind, solar, water power), especially for remote areas.
- Further investigate robust tap technology for community standposts.

CARE

CARE
660 First Avenue
New York NY 10016
Cable: PARCELUS NY
Mary Ruth Horner
Director
Primary Health Care Unit

CARE has included below a number of issues which have arisen from their field activities around the world. They are not conducting any significant research at the moment. However CARE has had WASH implement a number of field studies which can be termed operational/applied research. CARE would consider identifying a CARE project to serve as a site for field-related activities and contribute as in the past staff time (NY and field), workshop related resources, and funds to support these activities should a relevant activity be identified.

Past and On-going Research: none

Proposed Research and/or Priority Research Topics

- Community Participation in Monitoring and Evaluation
- Indicators of Community Participation. Development of practical indicators of community participation in water and sanitation projects
- Periodic Assessment of Water Quality. Guidelines for various scenarios (when, where, why, by whom).
- Additional Primary Health Care (PHC) Interventions. Guidelines which give clear indicators of when a community is ready and able to take on additional PHC once they are in control of O&M and use of their improved water source.
- Donor Education Community Management Approaches.
- Sanitation. Practical approaches to incorporating relevant interventions for the improvement of sanitation.
- Post-installation monitoring.
- Models for Hygiene Education.

CENTRO MESOAMERICANO DE ESTUDIOS SOBRE TECNOLOGIA APROPIADA (CEMAT)

Centro Mesoamericano de Estudios Sobre Technologica Apropriada (CEMAT)
la AV. 32-21 2. 12
Apdo. Postal No. 1160
Guatemala, C.A. 01012
Dr. Edgardo Cáceres
Executive Director

CEMAT is engaged in research in several areas including, water supply and sanitation. CEMAT is a non-profit private organization whose main purpose is to help in the economic development, technical cooperation, and social progress of Guatemala and other mesoamerican countries. After 12 years of work, CEMAT has actively participated in the experimentation, evaluation, and diffusion of different technologies offered as alternatives for rural development. CEMAT works at the domestic, entrepreneurial, and communal levels. CEMAT has several laboratories and a number of professionals and technicians presently engaged in research and available for further studies as well as some funds to undertake relevant research activities

Past Research: No submission presented for this report.

On-Going and Proposed Research

Technical

- **Alternative sanitation technologies**
 - Longitudinal study of DAFF latrines.
 - Agricultural evaluation of DAFF manure.
 - Institutional transfer of technology.
- **Investigating domestic water flocculation**
- **Development of improved design of water catchment tanks in seismic zones.**

CSIR (Division of Water Technology, South Africa)

Division of Water Technology
CSIR
P.O. Box 395 Pretoria
0001 South Africa
Telex 3-21312 SA
Telefax (021) 841-4785
Mr. Ian Pearson
Program Manager for Appropriate Technology

The Division of Water Technology of CSIR is a research, development, and implementation body with some research equipment, manpower, and financial resources to support proposed research activities. The Appropriate Technology Program of the Division is particularly involved in Water Decade activities with emphasis on pilot implementation projects in southern Africa.

Past Research

Technical

- Development of a borehole chlorinator for use with hand or motor-driven pumps
- Horizontal roughing filtration and slow sand filtration

Social

- Sociological evaluation of rural water supply projects

On-Going and Proposed Research

Technical

- 200 liter (44 gallon) drum water treatment plants for home use (e.g., slow sand filters, iron removal, setting tank).
- Low-cost tube settlers
- Disinfection methods (on-site chlorine generation)
- Alternative water distribution networks

Financial

- Cost effectiveness and cost recovery for water supply and sanitation

Social

- Improved technology transfer methods (e.g., videos, interactive education, education and training programs)

Priority Research Topics

Technical

- Small-scale desalinization of brackish boreholes, nitrite and fluoride removal, shallow wells in sandy soils, preparing for crisis (floods, drought, etc.).

Financial

- Conversion of existing systems (government installed maintained, and run) to community-owned systems.

Health

- Investigation of alternatives to clothes-washing in rivers to minimize bilharzia, malaria, etc.; health education programs.

Institutional and Human Resources

- Provision of employment through water supply and sanitation projects; education and training in contracting and management.

Environmental

- Waste disposal methods; biogas production and utilization; pollution of groundwater and springs.

Social

- Community will should be considered and monitored.

INSTITUTE FOR INTERNATIONAL COOPERATION (JICA)

Institute for International Cooperation, JICA
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Tokyo
162 Japan
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Telex: 22271 JACAHDQ
Facsimile: 03-269-2054
Harou Iwahori
Senior Advisor

Mr. Iwahori believes that, while the objectives of the applied research outlined in the reports are reasonable, technological and socio-economic issues relating to water and sanitation vary widely from country to country. For research and demonstration projects, he feels that it is important to involve as many developing countries as possible from the planning stage, in order to maximize the impact of activities eventually undertaken.

Past and On-Going Research: No submission presented for this report.

Proposed Research: No submission presented for this report.

Priority Research Topics

Mr. Iwahori has suggested the following process be adapted for the implementation of applied research:

- Step 1: Checking of the issues on completed projects in each country.
- Step 2: Grouping of the above issues.
- Step 3: Planning the applied research or demonstration projects for each grouping of issues.
- Step 4: Approving the demonstration projects by developing countries
- Step 5: Implementation of demonstration projects.
- Step 6: Assessing the Results.
- Step 7: Implementation of pilot projects in each participating developing country with bilateral support.

INTERNATIONAL DEVELOPMENT RESEARCH CENTER (IDRC)

International Development Research Center (IDRC)
P.O. Box 8500
Ottawa, Canada K1G 34H
Alex Redekopp

The environmental program of the IDRC includes water and water-use activities. Special attention will be given to studies dealing with water accessibility/water quality monitoring. The titles are listed on the following two pages.

Past Research

IDRC has provided a significant number of abstracts of applied research conducted over the last five years. The titles are listed on the following two pages.

A Sampling of the On-Going Research

Technical/Environmental

Agro-based Wastewater (Thailand)

This project will explore the potential of a relatively novel, cost-effective waste treatment technology treating wastes from slaughterhouse and piggeries in the first instance and thereby reduce the high level of pathogenic microorganisms normally discharged into small watercourses which are frequently used by villagers for drinking water purposes.

Technical

Hydrams (Malaysia)

This project will refine an existing computer model to optimize hydram design and test a light-weight hydram made from PVC fittings which can be assembled on-site in remote areas to serve rural villages.

Technical/Socio-cultural

Integral System for Recycling Organic Waste (Mexico)

This project will identify the factors which facilitate and/or impede the adoption, operation and maintenance of the SIRDO (Integrated System for Recycling Organic Waste) system and also assess the technical and economic performance of the SIRDO system and its related productive activities.

Wells and Handpump Testing (Kenya)

This project will test the performance of a UNIMADE handpump under field conditions in Kenya and, in addition, will investigate various appropriate well digging/drilling techniques, examine the water quality, community acceptance and utilization of the newly developed water sources.

Environmental Health/Institutional

Schistosomiasis Control: A Community-based Approach (Zimbabwe)

This project will design, implement and evaluate an integrated community-based schistosomiasis self-help control program which will improve water supply and sanitation systems in the project community and test the reliability of inexpensive urine dipsticks as a rapid screening method for schistosomiasis

Socio-Cultural/Institutional

Women, Water and Sanitation (Egypt)

This project will identify shortcomings in the management of water supply and sanitation facilities in two villages in Egypt and evaluate the capacity of rural communities to identify and plan community managed programs to overcome the shortcomings.

Environmental Health/Health Impact Assessment

Evaluation of Environmental Sanitation (Brazil)

This study will examine the effect of two different low-cost sewerage technologies on diarrhoeal diseases with a focus on intestinal nematode infections and nutritional status and assist in determining the health impact of sanitation improvements in poor peri-urban areas.

Community Organization/Hygiene Education/O-M

Participatory Strategies in Water Supply (Costa Rica)

This project focuses on the adaptation of the UNIMADE handpump to Costa Rican conditions and examines/evaluates different approaches to community organization, health and hygiene education and pump installation and maintenance procedures including the participation of trained villagers as instructors in neighboring villages.

Institutional/Technical

Water Pumping Technology--Phase III (Costa Rica)

This project will develop and test a strategy for introducing self-sustaining indigenous manufacturing capability. It will implement, examine, and evaluate two strategies with multi-disciplinary inputs: the "top-down," with large commercial producers; and the "bottom-up" with grass-roots cottage industries or NGOs involved in water resources development.

Attachment A

List of Topics from IDRC

- Agro-based Wastewater (Thailand)
- Hydrams (Malaysia)
- Integral System for Recycling Organic Waste (Mexico)
- East Africa Pesticide Network
- Occupational Health and Rural Community Education (Peru)
- Small-Scale Desalinators (Botswana)
- Solar Disinfection (Thailand)
- Rainwater Catchment (Malaysia)
- School Sanitation (Lesotho)
- Water Supply and Sanitation Research Information System (Latin America)
- Water Pollution (Tunisia)
- Macroinvertebrate Survey (Korea)
- Schistosomiasis Control. A Community-Based Approach (Zimbabwe)
- Livestock Wastes (Korea)
- Sanitary Conditions (Nepal)
- Theytancottai Water Treatment (India)
- BLISS Waste Treatment (Philippines)
- Sanitation Systems (Bangladesh)
- Hydraulic Ram Pump (Uganda)
- Handpump Manufacture (Indonesia)
- Rural Sanitation Research (Sierra Leone) - Phase II
- Dracunculosis (Togo)
- Latrine Installation Program Evaluation (Mali)
- Water Quality Control (Latin America)
- Rainwater Collection (Philippines)
- Solar Disinfection (Lebanon)
- Solid Waste Management (Peru)
- Waste Management Training (Singapore)
- Hydram Potential (Tanzania)
- Horizontal Sand Filtration (Thailand)
- Water Quality Control (Morocco)
- Women, Water, and Sanitation: An Action-Research Project - Phase I (Egypt)
- Wastewater Resource (Peru)
- Solar Liquid Piston Pump (Ghana)
- Water Quality Control (Egypt)
- Rice Husk Filters (India)
- Rainwater Contamination (Thailand)
- Evaluation of DAFF Latrines (Guatemala)
- Handpump Technology (Costa Rica)
- PVC Handpumps (Cameroon)
- Windpump and Composting Latrine Technology (Panama)
- Deep Well Pumps (India)
- Environmental Slum Improvement (Thailand)

- Dissemination of PVC Handpump in Rural Areas (Mali)
- Children as Change Agents (Honduras)
- Water Quality Survey (Zimbabwe)
- Water Disinfection (Bolivia)
- Coal-Based Sorbents (India/Canada)
- Water Quality Data Management (Malaysia/Canada)
- PVC Handpumps (China)
- FRCS Manual (Philippines)
- Waterlines - Phase II
- Water Pumping Technology - Phase III (Kenya/Malaysia)
- Wells and Handpump Testing (Kenya)
- Human Pathogen Survival (Zaire)
- Socioeconomic Study of EWWCA Handpump Project (Ethiopia)
- Women in Handpump Technology - Phase II (Sri Lanka)
- Excreta Disposal (Bolivia)
- Soil-Transmitted Helminths - Phase II (Indonesia)
- Community Self-Reliance (Thailand)
- Pollution Load in the Maimbazi Stream (Tanzania)
- DAFF Latrine (Guatemala)
- Groundwater Pollution (Tanzania)
- Evaluation of Environmental Sanitation (Brazil)
- Water Quality (Malawi)
- Schistosomiasis Transmission (Botswana)

INTERNATIONAL REFERENCE CENTER FOR COMMUNITY WATER SUPPLY AND SANITATION

International Reference Center for Community Water Supply and Sanitation
P.O. Box 93190
2509AD, The Hague
The Netherlands

IRC has done a number of research studies and has included in their submission both a list and summary of relevant IRC projects and documents as well as a list of key issues for applied research. IRC feels that to facilitate the selection process it would be useful if some selection criteria could be drafted and discussed. Two headings have been added in the areas of needed research, one to cover research addressing integrated concepts and the other to address improved information exchange and better application of research results.

Past Research: None submitted for this report.

On-Going and Proposed Research

General (integrated concepts)/Information Exchange

Piped studies for small communities: The program aims to establish thorough development and demonstrate efficient and appropriate ways of community-based approaches in piped supply; to store the knowledge generated, and to promote wider application.

General (integrated concepts)/Information Exchange/Technical

Simple pre-treatment methods for rural water supply and slow sand filtration development and demonstration. these projects form an integrated approach to simple treatment for rural water supplies with a focus on transfer and dissemination of experiences and information.

General (integrated concepts)/Social

Community education and participation: The program assists in further development of the knowledge base on community participation with particular emphasis on sanitation and urban fringe areas to update UNDP/IRC's publication on the role of women.

General (integrated concepts)

Maintenance System Development for Rural Water Supply: Through collaboration and linkages with national ministries and projects and international and regional organizations, the program aims to generate new information on maintenance practices and requirements for the development of guidelines for operations and maintenance.

Topology of low-cost urban water supply and sanitation applications and review of O&M Aspects of low-income urban sanitation: the proposed programs bring together and analyze available information on innovative approaches in low-income urban areas, establish a topology of potential approaches, and review O&M aspects

and performance of sanitation systems for the formulation of recommendations for planning, design, and implementation of future low-cost systems.

Health

School Sanitary Facilities Guide/School Hygiene Education: A guide will be produced providing a range of options with technical and programmatic details for the construction and use of school sanitary facilities.

Hygiene Education in Water Supply and Sanitation: After finalizing the key issue paper on hygiene education planning and implementation and a document on hygiene education evaluation, the program will disseminate these together with the already published bibliography.

Health/Social

Community Self Improvements in Community Water Supply and Sanitation: The project wants to test, in a number of countries, solutions and methodologies for community self-improvements in water supply and sanitation together with the development of related training methods for Community Health Workers.

Financial/Economic

Community-based Financial Management: Integrating experiences from IRC's demonstration projects, IRC's knowledge on CBFM will be further developed and exchanged and the application of techniques will be promoted. Particular emphasis will be given to local organization and maximizing financial self-sufficiency at community levels

Institutional Development/Human Resources Development

Evaluation and Training Aiming at the improvement of the evaluation process to make it more relevant and more efficient through the collection and exchange of information on evaluation and promotion of development and application of methods and procedures for both monitoring and evaluation.

Environmental

Water Resource Protection: Establishment of state-of-the-art concerning water resource protection for small- and medium-size settlements in rural and urban locations in developing countries.

Renewable Energy Utilization in Rural Water Supply and Sanitation: Update of earlier-published information on renewable energies; stimulation of international exchange of information and promotion for fuel/water supply applications.

Information Exchange

Training and Briefing Programs for Project Staff in Water Supply and Sanitation: Briefing programs and tailor-made training courses are developed to provide country- and job-specific information in the CWSS and related fields and to improve their levels of knowledge for future projects.

Priority Research Topics

General (integrated concepts)

- Review and analysis of different approaches to rural water supply and sanitation in relation to political and administrative structures and implementing organizations.
- Establishment of appropriate models for implementing sustainable water supply and sanitation projects in different types of urban fringe areas.
- Review of existing maintenance approaches, both for water supply and sanitation systems and to test innovative (VLOM) strategies
- Compare different strategies/establish new strategies for rehabilitation (technical, social, organizational).
- Identify suitable strategies for efficient water use in piped water supply systems, both in urban and rural areas (leak detection, metering, community involvement).

Health

- Comparative study of various approaches to hygiene education in relation to cost, organization, and manpower involved.
- Comparison of different approaches in hygiene education to school-aged children and identification of requirements and potential for strengthening.
- Review of technical solutions facilitating hygiene practices both in schools and in homes.
- Review of effectiveness of knowledge, attitude, and practice (KAP) studies
- The informational content of health education in sanitation programs. What is the balance between health information and advice based on other arguments in favor of improved sanitation?
- Health impact of water improvement, sanitation, and health education alone or in combination.

Social

- Comparison of different approaches to stimulate community involvement (social marketing, participatory approaches, etc.).
- Testing strategies for diffusion of appropriate technologies to communities with self-managed facilities.
- Ways to develop joint decision making by agency and community about the choice of technology and design of water supply and sanitation facilities.

Financial/Economic

- Analysis and development of methodologies for community-based financial management, cost recovery, and resource coverage.
- Assessment of cost and cost-effectiveness of community participation.
- Development of payment systems in relation to cost recovery and equality

Technical/Social

- Conditions for successful community involvement in operation and maintenance.
- Maintenance of simple sanitation systems including facilities in public buildings and schools.
- Payment systems in which beneficiaries bear the financial cost of O&M particularly for water supplies without individual house connections.

Technical

- Review of the experience with local manufacturing and particularly the production of handpumps.
- Comparison of the efficiency/cost-effectiveness of well construction.
- Review and develop suitable methods of water treatment and testing.
- Assess the potential for rainwater harvesting.

Institutional and Human Resource Development

- Review of effectiveness of overseas training programs and post-graduate courses particularly related to socio-economic issues
- Review of appropriateness of socio-economic component in engineering programs in developing countries.
- Monitoring and evaluation.

Environmental

- Review the established legal framework for environmental protection and test application of legal measures.
- Investigation of the effectiveness of different water source/catchment area protection methods
- Exploration of field experience with renewable energy, particularly for water pumping and water heating.

Effective Information Exchange

- Identify ways to ensure that research results are being disseminated and are getting applied.
- Review of methods to facilitate access to and use of earlier efforts and findings in other countries.
- Testing of strategies for diffusion of appropriate technologies to communities with self-managed facilities

Impact of Water Supply and Sanitation Programs

- Socio-economic impact More firmly based evidence is required of benefits accruing from various types of water and sanitation improvements. More information is needed about results of projects which stimulate economic use of water and time gain in the planning phase as opposed to projects in which such uses are left to the initiative of users.
- Comparison at national level of socio-economic benefits of various types of improvement or levels of service in relation to numbers benefited in order to encourage policies for wider coverage as opposed to high level of service
- The feasibility of increasing socio-economic and health impact through community participation.

INTERNATIONAL REFERENCE CENTER FOR WASTE DISPOSAL

International Reference Center for Waste Disposal
IRCWD/EAWAG 133
CH-8600 Duebendorf
Switzerland
Telex 828-687
Roland Schertenleib
Director IRCWD

IRCWD suggestions for applied research topics are oriented toward technical topics as IRCWD is basically a group of engineers working on technical problems of water supply and sanitation in least-developed countries. IRCWD, however, does share the opinion that non-technical issues (social, institutional, financial, etc.) are extremely important and in most cases the key factors for project success or failure. IRCWD feels that the role of applied research in the overall context of development should be considered and discussed. The purpose and aim of conducting applied research should be two-fold--it is important to find the answer to key problems related to water supply and sanitation, however, investment and strengthening of local research interventions during the process may in the long run be as important as the immediate results.

Past and On-going Research: no submission presented for this report.

Proposed Research and/or Priority Research Topics

Technical

- Development of realistic water quality guidelines which do not call necessarily for a zero coliform count in all piped systems whether urban or rural
- Development of guidelines for treating polluted surface water for water supply with special emphasis on slow sand filtration and different pretreatment technologies.
- Development of guidelines on the choice of pit emptying technology packages and their implementation.
- Development of guidelines on the safe distance between water supply and on-site sanitation installations, taking into account different hydrogeological conditions.
- Research on problems related to the collection and disposal of sillage and on possible integration into the surface water drainage systems.
- Research on simple anaerobic treatment systems with better efficiency than the traditional septic tank.

- Studies on the survival of worm eggs in different types of low-cost sanitation systems.
- Evolution of existing and development of new low-cost and intermediate wastewater treatment technologies in light of the specific pathogen removal priorities identified to date.
- Development of guidelines for the reuse of wastewater and night soil in aquaculture systems.
- Research on non-conventional or community-based waste management systems in peri-urban areas.

Financial

- Collecting more field experience and cost data on non-conventional sewer systems for middle income communities.

INTERNATIONAL WATER SUPPLY ASSOCIATION (IWSA)

International Water Supply Association
Foundation for the Transfer of Knowledge
1 Queen Anne's Gate
London SW1H9BT
Telefax 44-1-
J.G. Janssens
Technical Director
P.O. Zegersdreef 46
B-2130 Brasschaat
Belgium

Mr. Janssens, within IWSA, is currently making a general inventory of on-going research projects in developing countries and newly industrialized countries. This survey should be available in the near future.

Past Research and On-Going Research: No submission presented for this report.

Proposed Research: No submission presented for this report.

Priority Research Topics

Institutional Development/Human Resource Development

- Development of organizational instruments: local study and research groups.
- Human resource development:
 - Agreements of cooperation between centers of applied research in developing and newly industrialized countries and in undustrialized countries.
 - Joint research projects in industrialized countries.
- Dissemination of related technical and scientific literature and reports; development of easily accessible knowledge systems directly meeting the needs of specific problems and situations.
- Technological resource development to support operation and management of treatment plants, in order to master certain situations and conditions.

Technical

- Coagulation - hydraulic rapid mixing and flocculation.
- Development of natural polyelectrolytes as flocculation agents from locally available products such as moringa oleifera seeds, starch derivatives, etc.

- Rapid filtration, using local materials for filler material.
- Two-stage upflow-downflow direct filtration.
- Constant rate vs declining rate filtration.
- Horizontal flow roughing filters, as a pre-treatment to slow sand filtration.
- Slow sand filtration.
- Package plants: solar energy, slow sand filter, UV disinfection.
- Powdered activated carbon, prepared from local agricultural and suitable solid wastes.
- Management of coagulation sludges in developing country cities: characterization, thickening, denaturing, disposal.
- Upgrading and rehabilitation; operation and maintenance.

Other

Research and Development

- Appropriate technologies.
- Modernization (application of new technologies) versus use of appropriate technologies.
- Applied research, feasibility research, pilot studies, case studies.

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KREDITANSTALT FÜR WIEDERAUFBAU (KFW)

Kreditanstalt für Wiederaufbau (KFW)

Palmengartenstrabe 5-9

Postfach 11-11-41

D-6000 Frankfurt am Main 11

Telex 41-13-52 KWFM D

Dr. Thomi

KFW is not in a position to make funds available for research activities as its resources are reserved for project financing, while the Ministry of Economic Cooperation has among its responsibilities funding of research activities such as those suggested below.

Past Research and On-Going Research: No submission presented for this report.

Proposed Research: No submission presented for this report.

Priority Research Topics

Social

- Evaluation of motivation and education activities in the field of hygiene and sanitation.

Financial

- Conditions for successful cost recovery activities in administrative and political terms.

Environmental

- Evaluation of strategies for environmental protection under the following aspects: control by governments and active participation of industries and communities.

KUWAIT FUND FOR ARAB ECONOMIC DEVELOPMENT

Kuwait Fund for Arab Economic Development
P.O. Box 2921
Safat Kuwait
Telex: 22025 ALSUNDUK
22613 KFAEDKT
Hisham Al-Wogayan
Director of Operations

In considering supplying water for arid and semi-arid zones, it has become apparent that countries in these zones will face increasing problems in conjunction with availability of adequate and perennial water resources. The main issues that require attention in the Fund's opinion are those related to increasing recharge of groundwater, reuse of sewage effluent, development of small-scale desalinization units, improvement in the efficiency of the use of solar energy, and improvement in the traditional means for utilizing water resources. The fund will consider participation in financing projects/studies or offering technical assistance for feasibility studies and pilot projects. The application for such financing must come directly from the governments concerned, showing priorities.

Past and On-Going Research. No submission presented for this report.

Proposed Research and/or Priority Research Topics

Technical

Artificial Recharge of Groundwater

The problems encountered in artificial recharge in arid and semi-arid zones are substantially different than those encountered in humid countries. These problems are basically due to the high rate of evaporation and considerable depth of aquifers. Surface methods for artificial recharge are exposed to a high rate of evaporation besides excessive siltation due to a high rate of suspended solids collected in barren catchments. On the other hand, the use of ordinary injection wells for recharging groundwater faces serious clogging problems. A pilot project is recommended using radial wells for recharging. The technology for drilling horizontal screens has advanced substantially in recent years. Improvement of this technique could open up new opportunities for increasing artificial recharge in arid zones as radial wells also provide better operational desilting conditions as compared to ordinary wells.

Reuse of Sewage Effluent

Sewage effluent should become a new source of water in arid and semi-arid zone countries, particularly when it originates from expensive desalinated sea water or depleting ground water resources. The methods for reuse of sewage effluent in arid zone countries are either highly sophisticated and costly or basically similar to those used in humid climate countries. The use of efficient systems that can be operated at low cost is not common as yet. There is a need to attempt to use sewage effluent for recharging ground water below the surface so

as to avoid exposure to high evaporation and to bring the sewage effluent closer to the aquifer, but not so close as to prevent the purification required in transit to the aquifer.

Development of Small-Scale Desalinization Units

Populations in remote areas are sometimes compelled to drink water with high salt content. Also brackish water is sometimes available, but due to its high salinity it is not possible to use. It seems that small desalinization units available at present are either too complicated to use in remote areas or require imported materials which are not easily available. Simple systems relying on solar energy should be developed using locally-manufactured materials as much as possible.

Use of Solar Energy

The progress made in this area is still very limited. The capital costs of supplying and installing small pumps, for example, is very high and their capacities relatively low. There should be an expanding market for the utilization of such pumps, provided a substantial improvement in their hydraulic capacity can be achieved coupled with a reduction in their cost.

Improvement in Traditional means for Utilization of Water Resources

Improvement in manufacturing large-diameter screens for dug wells. The present precast, reinforced concrete screens have a limited open area and, therefore, sometimes hinder the flow of water from a highly permeable aquifer.

Improving the yield of highly traditional wells by drilling horizontal screens in thin but permeable layers. A considerable number of dug wells have been constructed at high cost but the yield is low due to the small thickness of the aquifer.

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE

Sandy Cairncross
London School of Hygiene and Tropical Medicine
Keppel Street
London WC1E7HT
United Kingdom

A background paper for the Commission on Health Research for Development
May 1988

Water supply and sanitation are technical interventions, but their implementation has significant social dimensions. Insofar as they are considered to have public health objectives, they have epidemiological dimensions as well.

Past and On-going Research. No submission presented for this report.

Priority Research Topics

Technical Aspects

The principal engineering problems posed by the sector are relatively minor. Examples of purely technical questions which might be studied include cheaper and easier techniques for siting and drilling boreholes, pumps for dewatering during well construction, and water meters capable of durability and accuracy when used in an intermittent water supply. In the sanitation sector, there is a need for a reliable and hygienic hand-operated pump for emptying pit latrines and desludging septic tanks

Social/Institutional Development

- How can local institutions best be organized for the maintenance of village water supplies?
- How can sanitation best be promoted?
- How can water supply and sanitation best be paid for without undermining their expected benefits?
- Can water supply and sanitation programs be implemented efficiently by a single agency?
- How can private enterprise be harnessed to benefit the sector?
- How can implementation research into water supply and sanitation best be promoted?

Health/Epidemiological Aspects

- There is still no scientific consensus as to whether water supply affects endemic diarrheal disease at all, and if it does whether it achieves this through improvements in water quality, or quantity, or both.
- Studies of the health impact of water supplies in conditions where they are known (or are likely) to have brought about an increase in water use per capita.
- Studies of the factors which determine the quantities of water used for domestic purposes, particularly for hygiene
- Studies of replicable interventions to promote hygiene
- Water supplies can be expected to influence diseases other than diarrhea, and yet we are largely ignorant of its impact on other infections.
- There is little experience in practice of how to target sanitation problems at children. The development and the health impact of facilities specifically designed for children, such as cheap locally made chamber pots or children's latrines) is an important area for research.

NATIONAL RURAL ELECTRIC COOPERATIVE ASSOCIATION/GTZ

National Rural Electric Cooperative Association/GTZ

CARES

Avenida La Reforma 4-47

Zona 10 Guatemala 01010

Apartada Postal 1552

Telex 5312 GU

Klaus Kresse

Past and On-going Research. No submission presented for this report.

Priority Research Topics

Technical

- Handpumps: Complete studies and field/laboratory tests
- Water Supply: Prepare up-dated computer programs as proposed by World Bank
- Slow Sand Filters: Continue studies, application, and demonstration as suggested by IRC, CEPIS, ERIS, etc.
- Waste Water Aquaculture: Continue and finalize research/application as proposed by CEPIS and UNDP/World Bank in Lima

Technical/Environmental

- Expand the existing wastewater lagoon of San Juan, Lima(?) into an international center for study and training/education in the various means of application of wastewater and recycling.
- Develop low-cost treatment of effluents of lagoons.
- Continue study and application of water hyacinth for wastewater treatment in medium to high altitudes.
- Support for further studies of disposal of industrial and domestic waste, economic and technical improvements of landfill, gas utilization, and integrated waste processing for gas and compost production.

Integrated Concepts

- Development of a methodology for integrated upgrading of peri-urban/high-density low-income areas (water supply, drainage, sanitation, solid waste, roads, housing, public and private health/hygiene education, resource mobilization, small-scale industry)
- Preparation of a manual for integrated city engineering, planning and construction supervision for water, sanitation, road construction, power and telecommunications installation, etc.

Other

Preparation of case studies regarding:

- waste management projects
- financial management of water supply including revenue generation, tariff structures, accounting procedures, cost accounting, etc.
- improvement of operation and maintenance of water supply and sanitation organization including development of indicators for successful management.

NETHERLANDS MINISTRY OF FOREIGN AFFAIRS

Netherlands Ministry of Foreign Affairs
Minister for Development Cooperation
The Technical Advisory Board
The Hague
The Netherlands
H.P.J. Van Schaik

The UNDP/World Bank sector issues and proposed research priorities are considered to be comprehensive and very exhaustive. Optimal coordination between sector research institutions will be of great work to share work and exchange results. It may be very useful for the temporary working group to inventory sector research institutions and programs.

- International Reference for Community Water Supply and Sanitation in the Hague.
- Government Institute for Public Health and Environmental Protection in Bilthoven.
- International Institute for Hydraulic and Environmental Engineering Development.
- Agricultural University, Department of Water Purification, Wageningen
- Royal Tropical Institute, Amsterdam.

Past and On-Going Research.

Technical

- University of Wageningen and the International Institute for Hydraulic and Environmental Engineering are carrying out research in anaerobic wastewater treatment technologies mainly for urban domestic and industrial effluents but also for on-site treatment. It is expected that the research will lead to cost-effective applications in developing countries.
- The Ministry, through IRC, supports research activities in slow sand filtration.

Institutional Development

- The Ministry supports, through a World Bank project, a study to recommend improvements for water utility management.

Proposed Research and/or Priority Research Topics. No submission presented for this report.

NUFFIC

India 89-19
Nuffic Room 209
Badhuisweg 251
P.O. Box 90734
2509 The Hague
The Netherlands
P. Santema

India 89-19 comments that water supply activities have been given more emphasis during the IDWSSD and that sanitation and environmental problems should receive more attention. Concerning the proposed temporary working group on environmental pollution, it should address the effect of environmental pollution on water supply and sanitation as well as the effect of water supply and sanitation on the environment.

Past and On-going Research no submission presented for this report

Proposed Research and/or Priority Research Topics:

Water Supply

- Water supply as an element of integrated development
- Consequences of large-scale urbanization expected in the next decades and special problems of fast-growing super cities.
- Operations and Maintenance
- Cost Recovery
- Human resources development (i.e., management and operations and maintenance)
- Community involvement
- Stimulation of political will

Sanitation

- Low-cost technical facilities
- Sanitation as an element of integrated environmental management

OVERSEAS DEVELOPMENT ADMINISTRATION

Overseas Development Administration
Eland House, Stag Place, London SW1E5HD
Telex 263907/8 FAX 01-273

J.D. Harrison
Renewable Energy and Engineering Research Advisor

ODA supports a number of research projects related to water and sanitation through several universities and institutes. ODA indicates that resources are available for additional research, and new research could be shaped to some extent by the findings of the temporary working group on applied research.

Past and On-Going Research

Technical

<u>Topic</u>	<u>Institution</u>
Use of natural coagulants for water clarification	Leicester University
Development and evaluation of water purification technologies	Robens Institute and Imperial College
Fabric prefabrication for slow sand filters	Imperial College and Surrey University
Handpump component development	Consumers Research Laboratory
Rehabilitation of boreholes and tubewells	Cranfield Institute of Technology
Research into Waste stabilization ponds in Kenya	Leeds University
Use of floating macrophytes to remove plant nutrients from treated effluents	Loughborough University
Design and operation of a septic tank system	Loughborough University
Gravel-bed hydroponic sewerage treatment	Portsmouth Polytechnic
Reduced-cost sewerage system	Loughborough University
Water conserving sanitary systems	Brunel University

Environmental/Health

Enumeration of nematode eggs in wastewater Leeds University

Enumeration Techniques for Rotaviruses Leeds University

Environmental/Technical

Low-cost composting of solid wastes Leeds University

Financial

Price Elasticity of Domestic Water demand London School of Tropical Medicine

Institutional Development/Technical

Guidelines for the selection of large water meters Consultant
World Bank

Proposed Research on Priority Topics. No submission presented in this report.

SKAT

SKAT
Varnbuelstrasse 14 CH 9000
Switzerland
Karl Wehrle

Two issues of concern to SKAT are operation and maintenance of water supply systems and simple methods for treatment of drinking water at the household level. SKAT has no financial means to support any research activities but are prepared to participate with their experience and field observations.

Past and On-going Research. No submission presented for this report

Priority Research Topics

Technical

- Operation and Maintenance It would appear that few organizations are in control of operation and maintenance as well as the factors affecting them. No long-term observations are available. Systematic monitoring of selected on-going programs needs to be implemented. Indicators to monitor and evaluate different O&M systems over a period of 5 to 10 years need to be defined.
- Simple Treatment Methods for Drinking Water at the Household Level. These methods have to be appropriate in terms of cost, availability of materials, energy, labor, habits, traditional beliefs, etc. In the first instance a world-wide assessment should be done. A thorough evaluation should show where future research and development is essential.

TANZANIA MINISTRY OF WATER

The Ministry of Water
P.O. Box 9153
Sokoine Drive/Mkwepu
Dar Es Salaam - Tanzania
Telephone: 31433-5
Mr. A.A. Senguo
Head of Planning Unit

The Government of Tanzania created this new Ministry to demonstrate its commitment to the water sector. The Ministry will focus on issues in water supply and sanitation, including the areas of research and development. The Ministry does not have a large enough budget to carry out their proposed research objectives, and will give priority to low cost and appropriate technology approaches to the water sector.

On-going Research:

Technical:

- To assess hydram potential in Tanzania and examine the acceptability of existing hydrams to the rural population
- To study deflouridation technology to remove excess fluorides from water supply

Health:

- To promote the Ventilated Improved Pit Latrine program

Environmental:

- Study among eight countries to examine water balance of lakes for better use of Nile waters
- Study hydrological/geophysical behavior of Lake Nyasa basin

Priority Research:

(Appropriate Technologies Research Programs)

Technical:

- Investigate appropriate technologies such as pumps, windmills, solar power, biogas, and hydropower approaches to water resources development
- Examine water measuring devices (e.g., water meters, rain gauges, current meters)

- Explore water conservation methods such as rainwater harvesting, small dams, underground dams, and charcos.
- Study various methods of water treatment including slow and quick sand filtration, defluoridation, and low-cost household water treatment methods.

Social:

- Assessment of low-cost sanitary coverage programs

Proposed research:

Technical:

- Examine surface and ground water sources, water yield improvement (e.g., watershed management), and reservoir sedimentation techniques
- Study of hydraulic modelling program to examine intake structures, dams and spillways, river morphology and sediment dynamics, and urban storm drainage
- Develop improved technology for the design, construction, operation and maintenance of water sector structures such as dams, canals, floodwalls, pipelines, reservoirs, drainage structures, etc. Also examine soil mechanics to explore the feasibility of such construction

Institutional and Human Resources Development:

- Develop competent technical people to carry out research activities in the water sector

Financial:

- Cost-benefit analysis of water projects aimed at ensuring cost-allocation and cost-sharing
- Research on tariff studies, as well as effective cost-recovery programs in rural and urban water supply and sanitation programs

Environmental:

- Study the overall ecological impact of water resources development
- Research on pollutants contaminating water sources, including techniques for their detection, identification, and quantification
- Study waste water treatment processes in order to improve current treatment methods, as well as increase cost effectiveness and efficiency of efforts.

- Examine how wastes that result from the treatment of contaminated water are ultimately disposed
- Track the pathways of pollutants in surface and ground water sources. Examine the impacts (if any) of physical, chemical, and/or biological action on such pollutants.
- Examine methods other than waste treatment for improving water quality, such as the protection of water supply sources to minimize contamination

UNITED NATIONS CENTER FOR HUMAN SETTLEMENTS (HABITAT)

United Nations Center for Human Settlements
P.O. Box 30030 Nairobi, Kenya
Telex: 22996
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M. Piche
Chief, Building and Infrastructure
Technology Section, Research and Development Division

Urban growth in the developing world over the next decade is an inevitable and important phenomenon of national development. Much of the increase in urban population during this period will be accommodated in slum and squatter settlements. Present-day conditions in these settlements are not conducive to protecting the health of residents. Service levels in these settlements are often worse than those in rural settlements. Little is known as to how these settlements may be effectively served with basic services on a substantial basis. Considerable research and development is required to determine techniques and appropriate institutional frameworks whereby these settlements could be served with cost-efficient services and urban authorities provided with the necessary wherewithal to cope with urbanization

Past and On-Going Research

Institutional Development

- Improving urban policies, programs, and practices through improved techniques for urban management.
- Delivery of basic infrastructure to low-income students: issues and options, HS/101/86/E 1986
- Shelter: infrastructure and services for the poor in developing countries; some policy options HB/OP/87-22 1987

Technical

- Conservation of Drinking Water Supplies: Techniques for Low-income Settlements, 1989
- Low-cost sanitation for high-density low-income settlements--the shallow sewer option--The Design of Shallow Sewer Systems HS/100/86/E 1986
- The reformulation of building acts, regulations, and codes in African Countries HS/81/85/E 1985
- A Review of Technologies for Provision of Basic Infrastructure in Low-income Settlements HS/40/84/E 1984

Financial

- The management of infrastructure and its financing and cost recovery, 1988.

Social

- Community participation in low-cost sanitation--training module HS/94/86/E 1986
- Global report on human settlements Habitat ISBN 0-19-8286662-8 1987

Proposed Research and/or Priority Research Topics

Institutional Development

- Institutional and legislative frameworks that are suited to efficient delivery and maintenance of basic services in low-income urban settlements and means by which such arrangements could be established and corresponding agencies endowed with the necessary skills and capacity, need to be determined.

Financial

- Methods whereby the upgrading of low-income settlements, through the provision of basic services, could be financed and all capital, operation, and maintenance costs recovered, and the realization of potential for public-private cooperation in this endeavor are achieved, merit research.
- Methods of planning and executing sanitation technologies and programs that stimulate demand for sanitation are responsive to local needs, are based on ability to pay, are based on consultative project development: optimize overall investments on infrastructure facilities, justify investments on the basis of life-cycle economic costing and sound cost-recovery programs, warrant research and development.

Other

- Monitoring of project impact. Methodology for assessing health, environmental, and settlement development impact resulting from basic service provision and upgrading in urban poor settlements needs to be developed.

UNITED NATIONS DEVELOPMENT PROGRAM (UNDP)

United Nations Development Program (UNDP)
Division for Global and Interregional Programs
Focal Point for the IDWSSD
One United Nations Plaza
New York, NY 10017
Cable UNDEVPRO NEW YORK
Mr. Frank Hartvelt
302 E. 45th Street
FF1210 1
New York, NY 10017

Mr. Harvelt indicated that the paper on applied research produced by the UNDP/World Bank Water and Sanitation Program (presented in Part I of this report) represents the views of UNDP. Mr. Hartvelt submitted the report of the meeting of the UNDP/World Bank Water Supply and Sanitation Program Advisory Panel, which met in Recife, Brazil, October 6-7, 1988, as additional information. This document outlines the UNDP/World Bank Water and Sanitation Program goal, strategy and activities. The global program strategy will focus on generic issues, particularly social, economic, financial, and human resource development issues that have not been adequately addressed. Its major elements are:

- Applied research,
- Monitoring, planning, and coordination of the Program's activities, and
- Promotion, dissemination, and information exchange.

Past and On-Going Research: No submission presented for this report.

Proposed Research

- Applied research will focus on specific constraints on the delivery of services to the low income groups and will help fill in knowledge gaps that have become apparent. Although some technological questions persist, the major gaps concern social, institutional, economic, and financial considerations. Applied research will absorb about 20 percent of the Program resources.
- As already outlined in Part I, research areas for the UNDP/World Bank Water and Sanitation Program will include:
 - (1) Rural water supply and sanitation.
 - (2) Urban sanitation.
 - (3) Municipal waster management.

UNDP/PROWESS

UNDP/PROWESS
304 East 45th Street
Room FF 12108
New York, NY 10017
FAX: 212-906-6550

These issues have been identified as an ongoing process (since 1983) by the Task Force on Women of the Interagency Steering Committee (a committee grouping representatives of the United Nations associated organizations active in the IDWSSD).

Thus, they are issues of concern and for action by all members of the Steering Committee, but in particular for PROWESS (which was created with the precise intention of answering questions such as those posed below) as well as for INSTRAW, which deals with research issues related to a broader field of women and development.

Priority Research

- Research on defining clear, agreed-upon indicators for fuzzy concepts such as "level of participation" or "women's status", even "use of water" or "adequate water supply."
- Research is needed on methods for collecting data which will speak to these indicators. Practical, inexpensive field methods need development and testing.
- In particular, participatory research methodologies need development and testing, in this context particularly to test their usefulness for data collection, but also as a tool for encouraging community participation.
- Models for feedback methodologies need development (e.g. maximizing local use of data, identifying data that are of use to "central" planners).

Proposed Research

Social/Health

- Further research on participatory methods and their effectiveness, their cost, their management (institutional) implications, their possible relationship with other methods for improving community and particularly women's involvement in large-scale projects.
- Research on different maintenance schemes, types of staff (e.g. men/women), stability of staff over time, effectiveness and how this relates to types of training and community participation context.

- Particular emphasis needs to be placed on urban areas, where participatory methods need to be approached differently.
- Health education, simple research tools to develop health education materials and approaches and to test their effectiveness are needed (e.g., how are health practices affected). Research on most effective institutional framework (e.g., adult education, in-school) and whether health education is a necessary, desirable, and/or sufficient method to "increase demand," will be needed.
- Effectiveness on various methodologies for bringing environmental concerns into WS&S activities (e.g., education) will be tested.
- Research on possible effective roles of children--as actors (e.g., environmental protection, health practices, data collection) and beneficiaries (will they benefit or have added burden? improved health situation?)

Financial

- Various economic questions need to be addressed. Cost effectiveness (e.g., will resources expended for community/women's participation and health education result in long-term savings), economic benefits to the women/community (including time saved and what it is used for), feasibility of reliance on volunteer labor, effectiveness of linkage with income-generating activities, including such logically related activities as vegetable growing, human waste recycling, small-scale forestry, etc.

WAGENINGEN AGRICULTURAL UNIVERSITY

Wageningen Agricultural University
P.O.B. 812916700 EV Wageningen
The Netherlands
Telex NL 45015
Professor Dr. Gatze Lettinga
Department of Water Pollution Control

The field of anaerobic waste water treatment can be considered as a key research related issue.

Past and On-Going Research: No submission presented for this report.

Proposed Research and/or Priority Research Topics

Technical/Environmental

- Anaerobic waste water treatment with a focus on:
 - (1) Sewage treatment, particularly at lower ambient temperatures (10-20° C).
 - (2) Domestic waste water treatment, i.e., on-site treatment using improved anaerobic treatment (UASB-type of septic tank systems), community on-site treatment also using modern high rate anaerobic treatment systems combined with low-cost community on-site sewer systems and proper post-treatment systems, reuse of anaerobic effluent for irrigation and fertilization, gas utilization, etc
 - (3) Application of anaerobic waste water treatment to various types of industrial waste waters, and concentrated slurries.
 - (4) Digestion of solid wastes, i.e., refuse, solid agricultural wastes.
- Development of low-cost post-treatment systems.
- Development of systems for recovering useful raw materials.

WATER AND SANITATION FOR HEALTH (WASH PROJECT)

Water and Sanitation for Health (WASH Project)
1611 N. Kent Street, Room 1001
Arlington, VA 22209-2111 USA
TELEX NO: 5WUI 64552
FAX NO: (703) 525-9197

The WASH project functions principally as a technical assistance project in the sector, and only a small percentage of its budget is directed to research activities.

However, the WASH Project has conducted research (applied studies) in a number of key areas in the water supply and sanitation sector. These activities are listed below. WASH has also provided a list of selected topics that should be considered for research in the 1990s. In addition, WASH has requested that Dr. Daniel Okun of the University of North Carolina and Dr. Steven Esrey of Johns Hopkins University prepare submittals for their observations on needs in the research area to the temporary working group. These submittals are attachments A and B, respectively, to the WASH submittal.

Past and On-Going Research

Financial

- Determinants of willingness to pay for water supply, Haiti, 1985.
- Distribution of water by vending, Honduras/Kenya, 1987.
- Willingness to pay for Water Supply field study (with World Bank), Nigeria, 1988.
- Willingness to pay for water supply O&M costs, Tanzania, 1988.
- Collaboration on Willingness-to-pay for Water Supply (with World Bank), Pakistan, 1987.
- Estimating O&M costs for water supply projects, Côte d'Ivoire, 1988.
- Application of Water Vending Lessons, Guatemala, ongoing.
- Collaboration on willingness to pay (with World Bank), Nigeria, on-going.

Technical

- Comparison of Pumping Technologies, Botswana, 1985.
- Development of Steep Handpump for Rural Water Supply Program, Dominican Republic, 1985.

- Guidelines for Rehabilitation of Rural Water Supply Systems, on-going.
- Development of Steel Handpump for Rural Water Supply Program, Dominican Republic, 1985.

Health

- Water Supply as a Stimulus to Primary Health Care, Togo/Indonesia, 1985.
- Managing Childhood Defecation Patterns, Kenya, 1986.
- Water Supply as a Stimulus to ORS Knowledge in Togo and Indonesia, Togo, Indonesia, 1987.
- Domestic Sanitation and Child Survival, Kenya, 1987.
- Maternal Morbidity Guinea Worm Research, Nigeria, 1988.
- Field Test of Cost-Effective Methods of Guinea Worm Control, Pakistan, 1987.
- Synthesis of Existing Knowledge in the Relationship between Improved WS&S and Health, Ongoing.
- Methodology for Analyzing Costs of WS&S Related Illnesses.

Institutional Development

- Development of Guidelines for Institutional Effectiveness
- Structuring Institutional Responsibilities in RWSS, Ongoing.
- Development of Indicators for Evaluation HRD in WS&S Sector (with GTZ), On-going.

Priority Research Topics

Health

- Evaluation of alternative approaches to guinea worm eradication.
- Study of water quality indicators and hygiene practices in relation to diarrheal disease.
- Approaches to control of internal parasites related to sanitation.

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- Relationship between levels of education and hygiene education materials.
- Demonstration of linkage between water and sanitation and maternal well-being.

Financial

- Methodologies for eliciting willingness to pay for rural sanitation.

Environmental

- Development of program approaches and guidelines for handling solid waste, hazardous wastes, and pesticide control.

Social

- Methodologies for user education in peri-urban areas.

Other

- Follow-up Evaluation of past WS&S projects--technical, financial, health and economic benefits, cost recovery, sustainability.
- Study of relationship of WS&S to productivity and income generation need a wider application of existing studies in schistosomiasis and guinea worm.
- Study of the role of water supply and sanitation projects as a precursor to general community development.

ATTACHMENT A TO WASH SUBMITTAL

Dr. Daniel Okun
Chapel Hill, North Carolina

Dr. Okun offers his observations about past and current applied research activities in the water supply and sanitation sector as well as topics for additional applied research

Past and On-Going Research

Technical

- Water Treatment. The list of new and improved technology for small water systems is long and well-documented including economical construction methods, alternative natural coagulants, simple chemical feeding and mixing, new methods of hydraulic flocculation, etc. Much of the work is summarized in "Surface Water Treatment for Communities in Developing Countries" by Wiley.
- Rural Water Supply. Work on rural water supply, particularly the development of handpumps, has been extensive (World Bank/UNDP and IRC)
- Rural Sanitation. Considerable research has been done, i.e. VIP latrines and dual privies, with results published by WB/UNDP. Low-cost and alternative sewerage schemes have also been extensively studied (work of Morris in Lusaka and WB/UNDP)

Health and Other Benefits

Health benefits of water supply and sanitation programs have been extensively studied, reported by.

- McJunkin, AID's Water and Human Health
- Esrey, Papers in WHO Bulletin
- WASH Technical Report No. 43, Value of Water Supply and Sanitation in Development: An Assessment of Health-Related Interventions

Financial

- A useful start has been made on determining willingness-to-pay and needs to be improved and used extensively (Whittington, Briscoe, and others).
- Research into water vending has just begun, but has yielded valuable insights with regard to willingness-to-pay (Wash

Technical Report No. 45, Water Vending and Development:
Lessons from Two Countries

Institutional Development

- Project failures, whether due too poor implementation, poor O&M, or whatever are traceable to poor quality of the institutions responsible.
 - Post-project Studies, Dworkin, USAID in Thailand
 - Village Water Supply and Health--Lois Monsour
 - Successes and failure in MURS in Paris
 - Regionalization of Water Management, Okun

Proposed Research and/or Priority Research Topics

Technical

- Urban sewerage and Wastewater Treatment and Disposal. Despite lip-service given to the importance of providing sewerage at the same time as water supply, in virtually all urban areas in the developing world people are furnished with pipe water long before sewerage is installed. Investigations need to be made on how sewers can be retrofitted into already built-up urban areas and into how costs for sewerage can be integrated into urban housing programs.
- Another problem is how to meet growing urban water resource needs; research is needed into appropriate methods for reclaiming wastewater for non-potable reuse.

Health and Other Benefits

- When WS&S projects are mounted, evaluations of the projects--including assessments of benefits--are highly desirable. Such evaluations, when accompanying capital projects, involve relatively small additional costs and can contribute significantly to future projects in the same region. Health benefit evaluations would require base-line studies prior to project implementation as well as short-term and long-term follow-up.

Financial

- Willingness-to-pay studies yield valuable information beyond just financial readiness. They help establish priorities, select from various levels of service, and contribute to community participation.
- Research into methods for determining the potential for cost recovery would be richly repaid.

- Many more water-vending studies are needed to illustrate important data for project planning.
- Willingness-to-pay studies for sanitation are more difficult than WTP studies for water supply, and research in that area has hardly begun.

Institutional Development

- The major problem of providing urban sanitation requires studies of institutional, financing, technical and related issues

Environment

- Little data is available that would permit characterizing either the quantity or quality of refuse produced in residences and commercial establishments in urban and rural areas in developing countries.
- Studies on the quality and quantity of refuse generated by various elements of a city, recognizing the potential for salvage and recycling, appropriate methods of collection, and options for disposal need to be evaluated.
- next to proper handling of human excreta, the most important sanitation problem is refuse collection and disposal.

ATTACHMENT B TO WASH SUBMITTAL

Dr. Steve Esrey
The Johns Hopkins University
School of Hygiene and Public Health
Department of International Health
6154 North Wolfe Street
Baltimore, Maryland 21205

Dr. Esrey provides a selected listing of past research efforts in the health area and recommended topics for future research.

A number of past studies and applied research issues and topics related to water and sanitation health issues are outlined below. A number of successes have been achieved and are noted in the area of evaluation and identification of health impacts associated with improved water and sanitation. Some of these successes are related to conceptual thinking about larger areas as well as more micro-level improvements. Also presented are several issues or areas neglected during the past several areas, i.e., the need for behavior interventions to succeed in achieving maximal use of implemented systems and issues related to drinking water quality.

Past Research

Health

- Targeting where health impacts are likely to be (or not to be) achieved: depending on the health and demographic characteristics of the population certain factors can enhance or mask the expected health effect after an intervention.
 - Breastfeeding (Butz, 1984)
 - Education (Esrey, 1988)
 - Crowding (Thacker, 1980; Victoria, 1988)
 - Water Plus Sanitation (Briscoe, 1984; Esrey, 1985 unpublished)

- Separation of water quality from water quantity when evaluating results: the effects of these results can be drastically different; as such they should almost be considered different types of interventions even though both can occur when systems are installed.
 - Bangladesh, (Rahman, 1985)
 - Lesotho (Esrey, 1988)
 - Malaysia (Esrey, 1988)

- Selection and use of indicators other than diarrheal morbidity
 - Nutritional Status
 - (1) Lesotho (Esrey, 1988)
 - (2) Malawi (Lindskog)
 - Mortality
 - (1) Brazil (Victoria, 1988)
 - (2) Bangladesh (Rahman, 1985)

- Trial and refinement of study design and research techniques. Most studies to date have used a cross-sectional approach to evaluation. That is, health status is measured at one point in time, which has usually been at the end or near the end of projects that are working. More consideration should be given to baseline data in future.
 - Case control approach
 - (1) Philippines (Baltazar, 1988)
 - (2) Malawi (Young, 1987)
 - (3) Lesotho (Feachem, writing stage)
 - Longitudinal Studies
 - Malawi, (Lindskog, published)

- Control of confounding variables (multiple regression techniques, more sophisticated techniques of measuring variables, use of other health outcome variables, and attempts at new designs (case control).

Proposed Research Topics

Health

- Behavioral Interventions--We still don't know how effective behavioral interventions are.
 - This involves keeping potable water clean once it is taken from a pure source
 - Encouraging use of more water for domestic hygiene
 - Identifying the culture-specific domestic hygiene habits that are (1) detrimental, and (2) positive, to good health.

- Project Implementation Issues
 - Including an epidemiologist and anthropologist during design and implementation of projects
 - Allocating monies ahead of time for impact evaluation

- Inclusion of additional inputs to be included with the installation of water supplies or excreta-disposal facilities to enhance the effect of each intervention.

- Study Design/Measurement Issues

- Need to measure more than one health outcome in a study
- Need to collect baseline data
- Need to measure population characteristics that provide positive health impacts or prohibit impacts from occurring
- Failure to rule out the possibility of research findings being due to other factors that are unrelated to water or sanitation inputs.

**WEST AFRICAN DEVELOPMENT BANK
BANQUE OEST AFRICAINE DE DEVELOPPEMENT (BOAD)**

West African Development Bank
Banque Oest Africaine de Developpement (BOAD)
B.P. 1172
Lome, Togo
Telex: BOAD 5289
B. Adikpeto
Director, Research and Programming

Although the BOAD does not have specific applied research experience in the water and sanitation sector, it does recognize the importance of the sector and its activities. The Bank feels that during the water decade most countries have put more emphasis on water supply than on sanitation. This may be due to the social nature of this activity, the high investment and implementation costs, and the lack of specific cost recovery mechanisms, as well as the difficulty in mobilizing sufficient resources necessary to implement projects. The Bank is in a position to loan money for financially viable projects and it is within this context that assistance to applied research through the BOAD would have to be foreseen.

Past and On-Going Research: None.

Proposed Research

Could be envisaged through specific projects financed through the West African Development Bank (BOAD).

Priority Research Topics

- Investigate appropriate and socially acceptable solutions to the provision of adequate sanitation to urban and per-urban centers.

WORLD BANK

UNDP/World Bank Water and Sanitation Program Selected Sector Issues and Proposed Research Priorities for the Framework of Global Cooperation

The key issues in the sector which deserve analysis, according to this report, have been summarized in an earlier section. The following is a summary of the proposed UNDP/World Bank water and sanitation program for applied research

Past and On-going Research

Proposed Research

A. Rural Water and Sanitation

1. Institutional Development

The first priority research task will focus on the community management hypothesis by developing generalized models for RWSS institutional frameworks

- a. Formulation of alternative models of RWSS institutional frameworks
- b. Analysis of specific framework elements; studies on community management, private sector, financing.

2. Complete Previous Research

- a. Review existing RWSS planning technologies related to the provision and expansion of coverage (willingness-to-pay for water supply, cost-benefit for RWSS technology choice, improved O&M procedures
- b. Technical Topics
 - 1) Handpumps--complete design and laboratory and field testing on selected village-level operation and maintenance handpumps
 - 2) Water quality--complete and publish technical report on groundwater quality and corrosion
 - 3) Preparation for "Beyond the Decade"
 - (a) Lessons Learned
 - (b) Guidelines for National RWSS Programs

B. Urban Sanitation

1. Sanitation Technologies for Middle-Income Communities

The purpose of this study is to review design and field experience with non-conventional sewerage systems, and assess their sustainability for middle-income and low-income urban communities.

2. Guidelines for Sanitation Standards Setting

The goal of this study is to provide a guide to LDC professionals in the formulation of standards for the design of sanitation service delivery, taking into account local imperatives.

3. Strategic Sanitation Planning

This study is aimed at developing a methodology for defining a strategic framework for identifying appropriate sanitation projects for an area

4. Analytical Model for Urban Sanitation Planning

The study is intended to develop a simulation model to analyze and assess various financial and economic trade-offs in the selection of alternative sanitation technologies.

5. Cost Functions for Sanitation Technologies

The purpose of this study is to generate cost information and functions for key sanitation technologies such as conventional and non-conventional sewerage systems as well as on-site sanitation systems

6. Sanitation Demand

This study has two objectives; the first is to define the determinants of sanitation demand and to determine how to measure and interpret them. The second objective is to develop methodologies for the stimulation for demand for sanitation.

7. Private Sector Roles in the Provision of Water Supply and Sanitation Services

This study will identify the constraints and possibilities for the private sector in the provision of water supply and sanitation services to low-income communities in rural and urban areas. It will also describe the roles that appear appropriate for the private sector and all levels of government.

8. Handbook on Sanitation for Middle and Low-Income Urban Areas

The book will summarize the advances and experience acquired over the past ten years.

C. Municipal Waste Management

Research will address several key issues surrounding municipal solid waste management and resources recovery. This includes the need to strengthen the planning and management capacity of solid waste institutions; define affordable service levels, technology options, and delivery systems for low-income urban groups, better utilize the capacity of the informal sector, and provide environmentally safe disposal options.

Other Priority Research Topics. See Part I of this Report.

WORLD BANK

Infrastructure and Urban Water Supply
World Bank
1818 H Street, N.W.
Washington, D.C.

In the Framework for Global Cooperation referenced in Part I of this report, the UNDP/World Bank Water and Sanitation Program outlined areas of concern and interest to that program. The submittal described herein provides additional perspectives of the Infrastructure and Urban Water Supply (IMNUWS) Division of the World Bank.

The INUWS policy and research work is aimed at helping to resolve some of the critical issues in the sector. The work will be financed through Bank funds and UNDP/World Bank Decade Program Funds. Work financed from the latter source will be primarily aimed at developing information that assist in the achievement of increased sectoral service coverage for the poor in urban and rural areas.

Past and On-Going Research. No submission presented for this report.

Priority Research Topics

- Water Resources. How to ensure that water resources are adequate and available at acceptable costs to meet the growing demands of competing user groups, especially in and around urban areas
- Institutions How to improve the effectiveness of sector institutions generally, and the management and maintenance of facilities in particular.
- Waste Management. How to provide for adequate and environmentally safe collection and disposal of wastewater and reduce the already mounting costs of limited last attention to these matters
- Financing the Sector. How to achieve the levels of financial resources needed to increase the reliability of sectoral access to such resources.

Proposed Research

- Water Resources. Our proposed approach to this issue is to review the evolution of costs in a sample of large urban areas to quantify past and current costs to identify the sources of increased cost--e.g., location of intakes, length of transmission mains, depth of boreholes, pumping and storage requirements, and treatment costs. Costs for providing water for competing uses will be reviewed also. An additional paper will be prepared on pricing for alternative water uses and their relationship to costs in and around the sample cities.

This would be followed by an analysis of potential approaches to reducing the costs.

- Institutions. There is a broad institutional issue with which we are concerned--the investigation of alternative modes of sub-sector institutional arrangements hold the most promise for providing (avoiding) increased incentives (disincentives) for effective performance. We expect to analyze public sector, organized community, private sector, and mixed institutional modes.
- Waste Management. Our work in this area is directed to helping to define a strategic approach to sanitation/waste management issues. We intend to begin with discussion papers on: (1) assessment of Bank experience in these projects; (2) cost recovery, the effects of counter-productive subsidies, and appropriate service standards and affordability; (3) implications of applying the "polluter pays" principle to recover costs, (4) approaches to waste reduction (resource recovery, recycling, treatment, etc.) and; (5) regulatory, pricing, and mixed approaches to environmentally safe water management.
- Financing the Sector The focus will be on traditional concerns, but will also include initial research on fiscal impacts on public institutions of sector funds provided and the impacts of alternative modes of sector finance on the performance incentives of sectoral institutions.

WORLD HEALTH ORGANIZATION

World Health Organization
Community Water Supply and Sanitation Unit/Division of Environmental Health
(CWS/EHE)
20 Avenue Appia
Geneva 27
Switzerland

Past and Ongoing Research: None submitted for this report.

Proposed Research and/or Priority Research Topics

Health

- Epidemiological research on the use of wastewater, sludge, and excreta in agriculture and aquaculture
 - Monitoring and evaluation of the WHO Microbiological Guidelines both where the guidelines are met and where they are not
 - Studies of excess morbidity
 - Studies of excess frequency of microbiological infection
 - Studies on the health effects of protozoa
 - Studies on the more virulent infections as typhoid fever
 - Aquaculture research to propose guidelines with more confidence. Research is to be directed to areas where important trematode (clonorchiasis, schistosomiasis) do not occur and where bacterial infections are of great concern
 - Health impact of excreta use in aquaculture.
- Human exposure control--evaluate the effectiveness of methods applied in wastewater reuse schemes.
- Health and economical aspects of existing intermittent water supply systems.
- Health effects of household water storage.

Social

- Sociocultural research and integration of protective measures in wastewater reuse schemes:

- Public health and user's attitude in relation to wastewater reuse in areas where applied and where it needs to be introduced
- Acceptability of health protective measures
- Social issues related to water supply and sanitation, especially in rural areas.
- Predictive value from social and observational data: measurement of a population's willingness to participate in CWS and hygiene education projects and programs.
- Development and design of intervention process models for replication of water supply, sanitation, and hygiene education programs.

Institutional Development/Human Resource Development

- Design of institutions and resource transfer mechanisms to provide service to low income communities.
- Methodology to assess capacity and the performance of institutions with respect to operation and maintenance of CWS installations.
- Assessment of human resources development needs.
- Design of institutional development, including human resource development.
- Design of legal instruments to enforce public health regulations.
- Organization of community participation in CWS installations.
- Planning institutional development.
- Application of existing HRD models, such as the WHO Dual Focus Approach, the Job Guide Concept, the World Bank Methodology, and others.
- Design of mid-career training program.

Financial/Economic

- Tariff-setting and financial planning for CWS.
- Economic and health aspects of cost recovery, including wastewater reuse.
- Revolving funds and other development mechanisms for CWS.

Technical

- Criteria for design of ponding systems to reduce evaporation losses and to optimize land use.
- Horizontal or up-flow roughing filters for nematode removal.
- Slow sand filters for nematode removal.
- Rapid sand filters for nematode removal.
- Direct chemical treatment of wastewater for nematode removal.
- Develop and improve low-cost, reliable nematode egg-detection methods with high degree of sensitivity.
- Develop and improve low-cost, reliable nematode egg-viability methods for routine application
- Disinfection of wastewater for reuse in agriculture--environmental impact and effectiveness, mainly in terms of nematode eggs inactivation and costs.
- Bacterial removal in waste stabilization ponds under varying conditions of climate, organic loading, etc.
- Simple treatment processes for inactivation of pathogens from sludge originating from stabilization ponds and other wastewater treatment systems.
- Wastewater application technology--research on existing and new irrigation technologies which allow the distribution of minimally treated sewage to crops without clogging delivery devices.
- Steep gradient small diameter sewers (slope of 6 percent to 15 percent) to serve marginal urban areas.
- Integration of latrines with simple biogas systems receiving animal plus human wastes.
- Pour-flush latrines. design of bowls and study of other types of bowl materials such as plastic, cement, and fiberglass.
- Appropriate technology for underground dams to enhance groundwater and to avoid evaporation--assessing potential and design criteria.
- Handpumps: problems of pollution by zinc, galvanized parts, by nitrates and depression of groundwater tables.

- Fluoridation with local compounds such as crude calcium fluoride (fluorite).
- Techniques for excess fluoride removal.
- Practical water treatment solutions to: removal of iron and manganese; treat waters excessively hard or soft; treat aggressive waters.
- Appropriate technology for upgrading water treatment plants to increase hydraulic capacity without the need of civil works.
- Criteria for design of stand-posts (flow and pressure).
- Develop low-cost, easy-to-repair taps for local manufacture.
- Develop reliable and low-cost water meter for local manufacture.
- Development of natural polyelectrolytes to be utilized as coagulant aids in water treatment.

Other

- Methodology to document various CWS processes, such as HRD models, technical improvements, institutional development mechanisms.

Environmental

(List of topics to be presented by the Temporary Working Group on Environmental Pollution.)

15.

WORLD HEALTH ORGANIZATION

World Health Organization
Regional Office for Europe
8 Scherfigsuej
DK 2100 Copenhagen
Denmark
Telex 15348

Mr. O. Espinoza
Regional Officer for IDWSSD

The WHO Regional Office for Europe has provided a priority list of applied research topics which they indicate may appear somewhat sophisticated and high-cost technology oriented, but they feel the suggested activities are aimed toward finding solutions to problems that remain unsolved and are also health oriented. The Regional Office for Europe does not have funds to support research activities but might be able to assist in the identification of funding sources

Past and On-Going Research. No submission presented for this report.

Proposed Research and/or Priority Research Topics

Health/Environmental

- Studies on the health effects of water pollution (toxicological and epidemiological studies).
- Water Conservation Wastewater reutilization vis-a-vis associated health risks, water recycling, rehabilitation of contaminated sources.
- Establishment of monitoring networks for the prevention of accidental pollution of surface and underground sources.
- Drinking water treatment. Reduction of health risks caused by the formation of disinfection by-products.
- Sludge treatment and disposal.
- Marine disposal of wastewater.

Technical

- Use of computers in water and sanitation data management.
- Urban Drainage. Remote sensory equipment and satellite photography used by planners of city wastewater system

8 March 1989

**PRELIMINARY SUMMARY OF ISSUES SUBMITTED
TO THE TEMPORARY WORKING GROUP ON
APPLIED RESEARCH FOR CONSIDERATION**

A. HEALTH

1. **Development of realistic water quality guidelines which do not necessarily call for zero coliform count.**
2. **Development of guidelines for treating polluted surface water with special emphasis on SSF and pretreatment technologies.**
3. **Comparative study of various approaches to hygiene education in relation to cost, organization, and manpower involved.**
4. **Studies of replicable interventions to promote hygiene.**
5. **Comparison of different approaches in hygiene education to school aged children and identification of requirements and potential for strengthening.**
6. **Review of technical solutions facilitating hygiene practices, both in schools and in homes.**
7. **Studies of the factors which determine the quantities of water used for domestic purposes, particularly hygiene.**
8. **Water supplies can be expected to influence diseases other than diarrhea and yet we are largely ignorant of its impact on other infections.**
9. **Review of the effectiveness of knowledge, attitude, and practice studies (KAP)**
10. **The development and the health impact of facilities specifically designed for children such as cheap, locally made chamber pots or children's latrines is an important area of research.**
11. **There is still no scientific consensus as to whether water supply affects endemic diarrheal disease at all, and if it does, whether it achieves this through improvements in water quality or quantity or both.**
12. **The informational content of health education is sanitation programs: what is the balance between health information and advice based on other arguments in favor of improved sanitation?**
13. **Studies on health effects of water pollutants.**

14. **Drinking water treatment: reduction of health risks caused by the formation of disinfection by-products.**
15. **Behavioral Interventions: We still do not know how effective behavioral interventions are:**
 - **keeping potable water clean once taken from pure source;**
 - **encouraging use of more water for domestic hygiene;**
 - **identifying culturally specific domestic habits, both detrimental and positive to health.**
16. **Design and Measurement Issues:**
 - **need to measure more than one health outcome in a study;**
 - **need to collect baseline data;**
 - **need to measure population characteristics that provide positive health impacts or prohibit impacts.**
17. **Water conservation: wastewater reutilization vis-a-vis associated health risks, water recycling, rehabilitation of contaminated sources.**
18. **Health impact of water improvement, sanitation, and health education alone or in combination.**
19. **Evaluation of alternative approaches to Guinea Worm eradication.**
20. **How water and sanitation is directly linked to maternal well-being (improved pregnancy outcomes/productivity).**
21. **Relationship between levels of education and hygiene education materials.**

B. SOCIAL

1. **Strategies for diffusion of appropriate technologies to communities with self-managed or traditional facilities.**
2. **Comparison of different approaches to stimulate community involvement (social marketing, participatory approaches, etc.).**
3. **Payment systems in which beneficiaries bear the financial cost of O&M, particularly for water supply without individual house connections.**
4. **Improved technology transfer methods.**
5. **How can local institutions best be organized for the maintenance of water supplies?**

6. **How can water and sanitation best be paid for without undermining expected benefits?**
7. **Community participation in monitoring and evaluation.**
8. **Indicators of community participation.**
9. **How can sanitation best be promoted?**
10. **Conditions for successful community involvement in O&M research to test viability of alternative methods to insure adequate maintenance including share responsibility between agency and community.**
11. **The feasibility of increasing socio-economic and health impact through community participation.**
12. **Comparison at national level of socio-economic benefits of various types of improvements or levels of service in relationship to number benefited, in order to encourage policies for wider coverage as opposed to high levels of service.**
13. **Methodologies for user education in peri-urban areas (multi-ethnic)**

C. INSTITUTIONAL DEVELOPMENT/HUMAN RESOURCE DEVELOPMENT

1. **How to improve the effectiveness of sector institutions generally, and the management and maintenance in particular: investigate alternative modes of sub-sector institutional arrangements in order to see which holds the most promise of providing (avoiding) increased incentives (disincentives) to effect performance:**
 - public sector;
 - private sector;
 - organized communities;
 - mixed institutional modes.
2. **Identification of effective approaches to community participation in relationship to political and administrative structures.**
3. **Review effectiveness of overseas training programs and post-graduate courses, particularly related to socio-economic issues.**
4. **Ways to develop joint decision making by agency and community about the choice of technology and design of water supply and sanitation facilities.**
5. **Appropriate modes for community participation in water supply and sanitation in urban fringe and slum areas.**

6. **Review appropriateness of socio-economic component in engineering programs in developing countries.**
7. **Provision of employment through water supply and sanitation projects: education and training in contracting and management.**
8. **Evaluation and training: improvement of the evaluation process. Promotion of development and application of methods and procedures for monitoring and evaluation.**
9. **Institutional strengthening of sanitation service delivery. Research is needed to identify and set-up alternative institutional arrangements for service delivery.**
10. **Research into the development of planning inputs and planning methodologies in developing appropriate urban sanitation strategies.**
11. **Analysis of waste management policy issues and options with emphasis on cost recovery, subsidies, recycling incentives, service standards, pollution charges, and waste reduction strategies.**

D. FINANCIAL

1. **Research into methods for determining the potential for cost recovery and cost effectiveness will prove extremely useful.**
2. **Initial research on fiscal impacts on public institutions of sector funds provided, and impacts of alternative modes of sector finance on performance incentives of sectoral institutions.**
3. **Methodologies for willingness-to-pay studies for water supply need to be improved upon and employed extensively.**
4. **Many more water vending studies are needed to illuminate important data for project planning.**
5. **Analysis and development of methodologies for community based financial management, cost recovery, and resource coverage.**
6. **Ability and willingness of communities to pay in relation to income distribution and level of service or type of facility.**
7. **Willingness-to-pay studies for sanitation are more difficult than those for water supply, and research in that area has hardly begun.**
8. **Development of a sound economic and financial framework for the evaluation and selection of integrated waste management/resource recovery systems, both of liquid and solid waste.**

9. **Collecting more field experience and cost data on non-conventional sewer systems for middle income communities.**
10. **Assessment of cost and cost effectiveness of community participation.**
11. **Payment systems in relation to cost recovery and equality.**
12. **Improvements in sanitation investments:**
 - **methodologies for project financing and cost recovery;**
 - **methodologies for economic appraisal of sanitation projects;**
 - **improving cost effectiveness of project implementation;**
 - **improving O&M services and investments.**

E. TECHNICAL

1. **Urban sewerage and wastewater treatment and disposal:**
 - **investigations need to be made on how sewers can be retrofitted into already built-up urban areas and how low-cost sewerage can be integrated into urban housing programs;**
 - **research is needed into appropriate methods for reclaiming wastewater for non-potable reuse.**
2. **Artificial recharge of groundwater. Pilot efforts using radial wells for recharging.**
3. **Development of small-scale desalination units -- simple systems relying on solar energy and using locally manufactured materials.**
4. **Use of solar energy -- expanding markets exist for solar pumps if they can be developed with higher capacities at lower cost.**
5. **Development of cheaper and easier techniques for siting, hand drilling, and rehabilitating boreholes.**
6. **Development of water meters capable of durability and accuracy when used during intermittent water supply.**
7. **Development of guidelines on the choice of pit emptying technology for urban and peri-urban sanitation.**
8. **Development and evaluation of water clarification and purification techniques.**

9. **Hand pump component development.**
10. **Prefabrication for components of slow sand filters.**
11. **Low-cost composting of solid waste techniques.**
12. **Continued development of water conserving sanitation systems.**
13. **Development of guidelines on the safe distance between water supply and sanitation installations, taking into account different hydrogeological conditions.**
14. **Research on simple anaerobic treatment systems with better efficiency than the traditional septic tank.**
15. **Evolution of low-cost and intermediate wastewater treatment technologies in light of specific pathogen removal priorities.**
16. **Research on non-conventional or community-based waste management schemes in peri-urban areas.**
17. **Operation and maintenance: identification of indicators to monitor and evaluate different O&M systems over a period of five to ten years.**
18. **Development of simple treatment methods for drinking water at the household level.**
19. **Assess potential for rainwater harvesting.**
20. **Review and evaluate the experience of local manufacturing particularly the production of handpumps.**
21. **Comparison of the efficiency/cost effectiveness of well construction.**
22. **Comparison of alternative latrine designs for excreta disposal.**
23. **Evaluation of applicability of field test kits in rapid assessment of water quality.**
24. **Improvement in manufacturing large diameter well screens for use in dug wells and improvement in the yield of traditional wells by drilling horizontal screens in thin, but permeable layers.**
25. **Identify suitable strategies for efficient water use on piped water supply systems in urban and rural areas (leak detection, metering, community involvement, etc.).**

F. ENVIRONMENTAL

- 1. Little data is available that would permit characterizing either the quantity or quality of refuse produced in residences and commercial establishments in urban and rural areas in developing countries.**
- 2. Review the established legal framework for environmental protection and test application of legal measures.**
- 3. Waste disposal methods be studied and developed; biogas production and utilization.**
- 4. Sludge treatment and disposal.**
- 5. Marine disposal of wastewater.**
- 6. Investigation of the effectiveness of different water source/catchment area protection methods. Next to the proper handling of human excreta, the most important problem is refuse collection and disposal.**
- 7. Studies on the quality and quantify of refuse generated by various elements of a city, recognizing the potential for salvage and recycling, appropriate methods of collection and options for disposal need to be evaluated.**
- 8. Establishment of monitoring networks for prevention of accidental pollution of surface and groundwater resources.**
- 9. Exploration of field experience with renewable energy for water pumping and water heating.**
- 10. Models for an appropriate regulatory framework including pollution control legislation, environmental quality standards, phased implementation of standards, sanctions for environmental damages, permit systems are need to be studied.**
- 11. Methodologies for environmental and waste management planning and technology selection process require research.**

G. OTHER

- 1. Identify ways to ensure that research results are being disseminated and getting applied.**
- 2. Review of methods to facilitate access to and use of earlier efforts and findings in other countries.**
- 3. Compare different strategies and test new innovative VLOM strategies for rehabilitation (technical, social, organizational).**

4. **Establishment of appropriate models for implementing sustainable water supply and sanitation projects in different types of urban fringe areas.**
5. **Study water and sanitation relationship to general development or as a precursor to general development.**
6. **Study relationship on water supply and sanitation to productivity, need a wider application of existing studies in schisto and guinea worm.**
7. **Review existing approaches for water supply and sanitation and develop new approaches for better integration of complementary activities (cost, social, technical, organizational, manpower, etc.).**

APPENDIX F
LIST OF TWG PARTICIPANTS AT LONDON MEETING

APPENDIX F

LIST OF TWG PARTICIPANTS AT LONDON MEETING

MARCH 16-17, 1989

<u>Name of Participant</u>	<u>Institution/Country</u>
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Mr. Michel Detay	Ministere de la Cooperation et du Developpement/France
Mr. Richard Helmer	WHO/Switzerland
Mr. Ivan Hespanhol	WHO/Switzerland
Ms. Siri Melchoir	PROWESS/UNDP/USA
Mr. Alex Redekopp	IDRC/Canada
Mr. Gehan Sinnatamby	HABITAT/Kenya
Mr. J. Ellis Turner	WASH/USA
Mr. Raoul Vicencio	CSC/UK
Mr. Jan Teun Visscher	IRC/Netherlands
Mr. Armando Caceres	Guatemala
Mrs. Samiha El-Katsha	Egypt
Mr. Gowri S Ghosh	India
Mr. M. Ben Maouloud	Mauritania
Mr. Brian Appleton	WHO (Rapporteur)/UK
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APPENDIX G
AGENDA FOR LONDON MEETING

APPENDIX H
ELABORATION OF RESEARCH TOPICS

APPENDIX H

ELABORATION OF RESEARCH TOPICS

The following is a list of research topics (areas) that should be addressed to overcome obstacles to meeting the goals of increased, sustainable water supply and sanitation coverage. As presented here, the research tasks undertaken for each topic are intended to lead to better understanding of the problems which are to be confronted and practical solutions to overcoming these problems. Specific tasks should be undertaken with these objectives in mind.

SECTION I: EXPANSION AND ENHANCEMENT OF SERVICE

Topic 1.1 Investigate and demonstrate institutional arrangements to achieve accelerated and sustainable service coverage

Purpose To provide a series of model institutional frameworks which have proved appropriate in different circumstances, to help developing country (DC) governments to organize for accelerated provision of WS&S services in a sustainable way

Outcome Documented examples of WS&S sector organizations which have been successful in achieving rapid and sustainable progress. Model structures to suit different local/national conditions, with guidelines on the preconditions for success

Approach This topic overlaps with Topic 3.3. The approach should be similar to that defined for Topic 3.3, and it is recommended that these two topics should be combined

Topic 1.2 Explore ways to rehabilitate existing systems, taking account of the importance of community participation

Purpose To encourage restoration of facilities which have fallen into disrepair or disuse, as an economic alternative to investment in new facilities. To use the opportunity offered by rehabilitation projects to stimulate review of norms and standards. (Topic 1.6)

Outcome Recommendations for measures to improve functioning and use of existing WS&S facilities. Evaluation techniques for diagnosing reasons for malfunctioning or failure and linking the diagnosis with review of technology and levels of service.

Approach The aim should be to ensure that rehabilitation is evaluated before investment in new projects is sanctioned. Research should therefore ensure that valid cost comparisons can be made, including both

capital and recurrent costs associated with new or rehabilitated systems.

Case Studies and demonstration projects need to include maximum community participation. Women's participation will be especially effective in reflecting lessons learned from past problems in a review of future expectations.

Topic 1.3 **Analyze the effectiveness of alternative financial models for WS&S programs, including cost recovery procedures and ways to stimulate development of effective developing country markets.**

Purpose To develop guidance for DC governments and ESAs on options and selection criteria for different funding mechanisms, including measures to stimulate willingness to pay and effect cost recovery in low-income communities.

Outcome Guidelines and documented Case Studies of application of ways of financing the implementation and upkeep of WS&S projects, with particular emphasis on low-income communities

Approach Desk study and literature search to determine what research has already been done and identify possible financial models. Review of options for social tariffs and scope for subsidies to low-income communities

Expert evaluation of identified models and development of Terms of Reference for Case Studies or Demonstration Projects. Separate consideration should be given to financial models appropriate for sanitation projects and for integrated programs.

Initiation of research activities by DC institutions into socio-cultural aspects of cost recovery in low-income communities

Demonstration projects in selected countries, with periodic regional meetings to encourage exchange of information and experiences.

Topic 1.4 **Review and develop methodologies for improving the cost-effectiveness of investment in sanitation**

Purpose To stimulate more rapid implementation of sanitation improvements and reduce the differential between water supply improvements and complementary activities in sanitation. To find ways of increasing community motivation towards the installation and upkeep of sanitation improvements

Outcome Models for integrating sanitation with water supply improvements, including alternative ways of assessing the costs and benefits of sanitation investments Guidelines on participatory planning and financing of on site sanitation facilities, including cost recovery measures. Review of alternative sanitation technologies.

Approach The research is linked to Topics 3.5 and 3.10 and should employ a similar approach to that outlined for Topic 3-10. A set of indicators should be developed for monitoring and evaluating operation and maintenance of sanitation facilities.

Studies should endeavour to develop and demonstrate ways in which women and children can be motivated to press for and initiate sanitation improvements

Topic 1.5 Study methodologies for selecting particular service level norms and water quality criteria, in particular the trade-offs between the quality and quantity of water needed for domestic purposes in different circumstances

Purpose To demonstrate the link between choice of service level and coverage achievable with available resources, and to develop guidelines for the choice of technology and service level in conjunction with the community

Outcome Guidance on appropriate standards and norms for technology choice and service levels to suit local conditions Cost data on the savings achievable through adoption of appropriate low-cost technology, and the influence on coverage

Approach Review of literature and past research, to develop national and regional pictures of variations in norms and standards Analysis of methods used to select technologies and service levels on WS&S projects.

Case Studies in selected countries, to compare progress, sustainability, and per capita costs associated with variations in service level norms and water quality standards.

Assessment of health impact of changes in water quality and quantity (see also Topic 2.2).

Topic 1.6 Investigate ways of encouraging review and use of local norms and standards for service level and water quality and design criteria for WS&S and drainage facilities

Purpose To encourage adoption of standards which will lead to widespread coverage. To bring the community into decision-making in an informed way, so as to match expectations with sustainability

Outcome Linked to the previous topic, this research should develop ways of using the evidence on costs and benefits of different quality and quantity criteria, to ensure that WS&S agencies and beneficiaries opt for appropriate norms and standards It should include development of guidelines for involving end users, particularly

women, in initial choices of technology and service level in an informed way.

Approach Review of existing guidelines (e.g. WHO Water Quality Guidelines) and development of recommendations on appropriate norms and standards to suit differing circumstances, objectives, and environments. Identify a range of options for design standards, linked to sustainability.

Identify Case Studies, perhaps linked to rehabilitation of malfunctioning systems, where opportunities exist for a review of norms and standards. Use a participatory approach, to ensure that those who will be responsible for financing and managing upkeep of installed facilities have a say in the selection of service levels, quality standards, and design criteria.

Use regional workshops, seminars and exchange of experts among developing countries to spread knowledge of coverage and sustainability achieved through choice of appropriate norms.

Topic 1 7 Provide guidance on appropriate ways of mobilizing community support for and participation in the provision of sustainable WS&S in urban fringe and slum areas, with special emphasis on integrated development of water, sanitation, drainage and waste management.

Purpose To provide guidelines for DC governments and ESAs on ways to tackle the problems associated with rapid urban growth, particularly the peri-urban slums. To ensure that investments now being made in these areas are put to best effect in an integrated way, by demonstrating feasible approaches to integrated development.

Outcome Recommendations of approaches for involving the urban poor in structured self-help projects, with properly planned financial and technical support. Documented Case Studies to illustrate the techniques and benefits of integrated development.

Approach Inter-Agency collaboration in the compilation of existing Case Studies and development of model procedures. Evaluation of low-income urban upgrading and housing programs to analyze ways of overcoming constraints such as land tenure; financing and cost recovery; community organizations, official support; and technology choices.

Identification of demonstration projects in selected countries and choice of collaborating institutions for surveys and evaluation.

Development of education and training materials to promote integrated development of WS&S, drainage and waste management.

Topic 1.8 Demonstrate the potential for and benefits of local manufacture of WS&S components

Purpose To reduce costs and improve maintenance of WS&S facilities through local manufacture of components, and spare parts

Outcome Guidance on the types of WS&S technology which are most suitable for local manufacture, the facilities and support which need to be provided to establish sustainable production, and the influence of local taxation policies on the viability of local manufacture

Approach Research has already been carried out into the scope for local manufacture of some WS&S equipment, notably handpumps. Lessons from these studies, and from experiences with local manufacture of pipes, latrines, concrete products, etc, need to be combined in the development of recommendations.

Where scope for new research is identified, studies should be designed to ensure maximum collaboration with indigenous industry in developing countries

Documentary evidence should be compiled to demonstrate the disincentives to local manufacture caused by taxation policies which favor imports of manufactured products rather than raw materials.

Topic 1.9 Investigate ways of integrating low-cost sewerage into urban housing programs, techniques for retrofitting sewers in built-up areas, and appropriate methods to reclaim wastewater and other wastes for reuse

Purpose The technological support for Topic 1.7, providing a range of options for planners and designers of urban programs

Outcome Technical and socio-cultural guidelines on low-cost sewerage and waste management options, including planning and design manuals for technicians and community workers. Recommendations on financing mechanisms

Approach Compilation of existing research and case studies, and evaluation of documented experiences with low-cost sewerage and resource recovery initiatives. Review of lessons learned

Field trials of new techniques, in conjunction with private sector enterprises which may be able to commercialize proven techniques. Monitoring and evaluation of costs and support services necessary for community management of recommended technologies.

Demonstration projects, including maximum community involvement

Production of guides and manuals.

Topic 1.10 **Develop guidelines for training courses, curricula, career structures and incentives, to create and retain enough skilled staff to plan, implement and sustain community-managed WS&S projects**

Purpose To provide guidance on appropriate human resources development (HRD) programs for the sector, taking advantage of global experience in the sector and national experiences in other sectors

Outcome Recommendations for curricula content in schools and specialist training establishments, suggested ways of linking training courses to needs for particular skills, documented experience of successful approaches, particularly ways of retaining trained staff through incentives and planned career paths.

Approach Review comprehensive information available on HRD in the WS&S sector, taking advantage of recent studies by the UNDP/World Bank Program, WHO, WASH, IRC, and others, and assemble a package of recommendations

Compare HRD strategies in other sectors and in private industry, to identify constraints in WS&S sector and develop measures to overcome them

Review existing initiatives, particularly the ITN centers, and seek ways of combining research initiatives with a common strategy. Involve developing country institutions as much as possible in ongoing and new research, to ensure curricula and courses are designed to reflect up-to-date thinking

Topic 1.11 **Investigate ways to adapt known technologies for treatment of saline and brackish waters for use in developing country situations.**

Purpose To make available lower cost, sustainable water supplies for arid areas and areas having access only to saline or brackish waters.

Outcome Designs for and field testing of lower cost treatment systems that utilize saline or brackish waters to produce potable water supplies

Approach Review of existing technologies that can provide treatment of saline and brackish waters.

Collaboration between financing and developing country research institutions, possibly in conjunction with equipment manufacturers, to identify which technologies may be suitable for modification (in design, material selection, or manufacture). Develop applied research programs to modify promising technologies. Field test modified technologies and encourage establishment of production facilities to meet demand

SECTION II: BENEFITS OF IMPROVED WS&S SERVICES

Topic 2.1 Demand measurement

Purpose To develop predictive models of the proportion of households willing to pay for water and sanitation facilities at given levels of service (and levels of consumption), under specific socio-economic and environmental conditions.

Outcome A series of models to assist planners in predicting the outcome of consumer choice of service levels, based on perceived benefits. Guidelines on the adaptation of models to local conditions. Guidance on pricing policies to achieve maximum coverage without prejudice to cost recovery or health benefits. Methods for estimating consumer surpluses for use in cost-benefit appraisal. Guidelines on acceptable levels of service and appropriate design capacity of systems (see also Topic 1 6)

Approach Contingent valuation questionnaires

Case studies of user behavior under different price regimes

Observations of water vending

Multivariate analysis of housing prices (hedonic analysis)

Topic 2.2 Optimization and measurement of health benefits

Purpose To assess how WS&S facilities and hygiene education messages may best be designed to maximize health benefits (and minimize health risks).

Outcome Refined guidelines on health impact measurement. Guidance on the selection of key hygiene practices to be promoted. Links between design criteria, levels of service, and health impact.

Approach Epidemiological studies of diseases for which clear links with WS&S improvements can be established--e.g. guinea worm, trachoma, intestinal helminths.

Case control studies of risk factors for diarrheal disease.

Health impact studies of sullage disposal and drainage improvements.

Topic 2.3 Assessing environmental benefits

Purpose To develop approaches to the appraisal of the environmental benefits of waste disposal, drainage and pollution control measures.

Outcome A series of appraisal methods linked to particular environmental improvements, with indicators for evaluating impacts.

Approach Field studies of impacts of environmental improvements on, for example, the value of property.

Contingent valuation questionnaires.

Topic 2.4 Intersectoral integration

Purpose To evaluate the cost-effectiveness of combining implementation of water, sanitation and hygiene education programs and of integrating these with activities in the health and education sectors.

Outcome Reports on case studies, giving program costs; program impact on hygiene; and impact on the use and performance of WS&S facilities.

Approach Comparison of programs with different characteristics in comparable regions or communities

Experimental design, implementation and evaluation of different types of integrated approach.

Topic 2.5 Demand stimulation

Purpose To identify cost-effective approaches to increasing demand (or, where necessary, reducing unsupportable demand).

Outcome Documentation on the costs and effectiveness of different demand management approaches Guidelines for choice of approach.

Approach Experimental introduction of different approaches in comparable communities (charging systems, social marketing, health education, etc), and monitoring of results.

Opportunist observation of different approaches and collation of experiences.

SECTION III: SYSTEM SUSTAINABILITY

Topic 3.1 Assess incentives/disincentives to improvements in institutional performance in the WS&S sector.

Purpose To determine the constraints which hinder effective performance in the field of operation and maintenance and identify ways of eliminating or overcoming them.

Outcome Recommendations for incentive schemes, or possibly regulatory controls, based on new or improved performance indicators for maintenance and utilization of WS&S systems.

Approach Literature review and synthesis of past studies of institutional performance (including sectors other than WS&S) Outline of options for monitoring and evaluation of O&M and water utilization, particularly for community-managed systems, and including possible regulation and financial or other incentives.

Identification of Case Studies and initiation of selected studies to provide comparative data on alternative strategies/incentive schemes.

Analysis of results and development of recommendations for different circumstances Regional workshops or seminars, to compare experiences and encourage further research.

Publication of findings and guidelines for evaluation and improvement of community-managed O&M.

Topic 3.2 Determine and establish the relative importance of the causes of system failure and ways in which they can be avoided.

Purpose To analyze factors which lead to malfunctioning or breakdown of WS&S systems and assess ways of combatting failure

Outcome Statistical evidence to support corrective measures and assist in the planning of new projects or rehabilitation of existing ones. It is anticipated that categorization of types of failure will help to establish priorities in HRD programs and to develop guidelines on standardization and the stocking of spare parts

Approach Literature review and desk study of evaluations already completed on the functioning of completed WS&S systems Comparison of types of failure linked to level of technology and organizational set-up for maintenance Identification of gaps in available data (e.g lack of information on performance of public latrines)

Selection of new studies to plug gaps Initiation of evaluations, with maximum community involvement, to ensure implementation of corrective measures and lessons for future projects

Regional comparisons to derive guidelines linked to local conditions. Feedback of information to collaborating agencies and links to other research topics

Topic 3.3 **Investigate organizational/operational models for sector institutions to improve their capacity to support the operation and maintenance of installed WS&S facilities**

Purpose To provide guidance for developing country governments and ESAs in planning and implementing sustainable WS&S programs, by establishing a series of models appropriate in rural and peri-urban areas. Models should be designed to make best use of public and private sector capabilities and to take advantage of the strengths of NGOs at the community level where appropriate. They should include consideration of suitable community organizational structures for the upkeep of WS&S systems and should specifically include measures to mobilize women as local motivators and managers.

Outcome The research should be designed to produce a range of options, with the preconditions for successful organization of operation and maintenance. The recommendations will need to be supported by documented case studies and demonstration projects.

Approach Desk study to review existing experiences with different institutional models, identify suitable examples for more detailed analysis, and evaluate lessons to be learnt.

Selection of additional Case Studies if required, and implementation of approved Case Studies.

Comparative review of all examples and development of model structures to suit varying circumstances.

Demonstration projects to illustrate individual components of the recommended implementation models. Regional workshops to encourage widespread adoption of proven successes.

Publication of Case Studies and recommended implementation models.

Topic 3.4 **Develop criteria to establish an appropriate mix between the community and other institutions for the long-term sustainability of WS&S systems**

Purpose To develop cost-effective alternatives to centrally managed operation and maintenance. To derive recommendations for community managed O&M with necessary support provided by sector agencies, and to demonstrate benefits of community-level management in a variety of circumstances.

Outcome Similar to proposals for Topic 3.4, with emphasis on community-level structures. Research findings should be useful not just to DC governments and ESAs, but to NGOs and community organizations.

Approach Review of literature and available experiences to highlight issues in different conditions (rural/urban, advanced/limited community development, availability of skills, cash, materials).

Identification of community-level case studies and local researchers to assist in studies. Participatory research involving NGOs and community members.

Analysis of case studies and development of recommendations

Selection of demonstration projects with full community involvement

Publication of Case Studies and guidelines, including links with the outcome of Topic 3.4.

Topic 3.5 Identify the operation and maintenance requirements of different WS&S technologies, with special emphasis on on-site sanitation facilities

Purpose To develop guidelines on the O&M implications of various technology choices To indicate HRD and organizational support needs as well as cost implications In particular, research is needed on ways of keeping on-site sanitation facilities in a hygienic condition and operating reliably

Outcome Checklists of key O&M requirements (technical, organizational and financial) associated with various available technologies Overview of current approaches to maintenance and special problems of sanitation systems.

Approach Initial desk study and literature review to collect and collate available information, including that of manufacturers. Listing of available technologies with known O&M implications and identification of knowledge gaps. Links with Topic 3 2.

Meeting of researchers who have already conducted studies on parts of the same problem, and agreement on selected case studies to plug gaps Identification of standard indicators to evaluate O&M performance (see also Topic 3 2). A number of agencies are known to have completed or be conducting studies on aspects of this issue, including the UNDP/World Bank Program, WHO, IDRC, IRC, and CIEH

Country-level studies to compare approaches and technologies.

Topic 3.6 Investigate appropriate workable strategies for cost recovery in low-income communities or areas.

Purpose To demonstrate ways in which low-income communities are willing and able to pay for and sustain appropriate WS&S improvements To provide guidance for DC governments and ESAs on the links between community

involvement, choice of technology, levels of service, and cost recovery.

Outcome Appropriate management models for establishing cost recovery, including strategies for community motivation, applicability of social tariffs and short-term subsidy schemes. Organizational structures for establishing direct community financing of O&M.

Approach Review and synthesis of literature and past studies on cost recovery, particularly related to low-income communities. Identification of countries and projects for further Case Studies.

Participatory research and pilot/demonstration projects with the close involvement of women beneficiaries in the organization of community financing of WS&S system O&M.

Evaluation of selected projects to identify constraints and develop possible model solutions to suit different local conditions and technology options

Topic 3.7 Identify ways in which research results can be used to ensure the adaptation of technologies to local conditions

Purpose To develop direct links between R&D programs and intended beneficiaries, so that proven low-cost technologies and approaches are adopted

Outcome Research methodologies which involve maximum participation of organizations in developing countries and which employ community members wherever possible in conducting surveys and introducing new approaches. Ideas for disseminating research results rapidly and widely, to achieve replication.

Approach Identification and evaluation of research programs involving national research organizations and community members.

National get-togethers of research organizations involved in WS&S research, to share views and discuss transfer of concepts and results from lab to field

Identification and testing of ways of transferring research findings on low-cost technology to local enterprises for commercial development, with appropriate safeguards to ensure quality control and standardization of parts and maintenance needs

Topic 3.8 Compare different strategies for raising official and public awareness of the need for maintenance of installed facilities

Purpose To prepare recommendations to assist DC governments and ESAs in promoting greater awareness at all levels of the long-term needs of

WS&S systems. To establish key messages for emphasizing sustainability issues in communities and at all levels in implementing agencies.

Outcome Documented evidence and suggested communication routes for carrying the message to each category of audience. Recommendations for public awareness campaigns through radio, tv and newspapers, and education and training packages

Approach Review of current approaches and identification of successful methods of communicating the sustainability message (note possible links with the TWG on Communication of Information) Analysis of cultural aspects hindering institutional and public recognition of maintenance needs. Comparison of approaches in different countries, including primary and secondary education curricula.

Design of possible strategies and field studies in selected countries to test approaches at community level and in schools. Test seminars for technicians and administrators

Regional meetings involving key officials from different countries, to discuss successful approaches.

Topic 3.9 Determine the best way of selecting personnel, determining training needs, carrying out training and retaining trained personnel.

Purpose To help overcome the serious constraint to progress identified by many developing countries -- shortage of skilled people at all levels, and particularly appropriately trained technicians

Outcome Model HRD strategies for staff recruitment, training and retention to suit different national needs in terms of technology and service levels. Specimen career structures, incentive schemes, training curricula and materials. Comparisons between public and private sector working conditions and remuneration, and between the WS&S sector and other sectors.

Approach Desk study of HRD experiences and documentation in WS&S and other sectors, compilation of successful approaches and analysis of factors influencing success

Selection of country examples to document HRD policies, career structures and incentives in the WS&S sector and comparison with private sector and other public sector agencies. Examination of education and training curricula and materials

Development of model HRD strategies for selected countries and initiation of demonstration projects.

Sharing of experiences through regional workshops/seminars, with support from ITN centers where appropriate.

Topic 3.10 **Examine ways in which health education contributes to sustainability of WS&S systems, including the cost-effectiveness.**

Purpose To test whether appropriate messages communicated by health workers can have a beneficial effect on community attitudes to the upkeep and utilization of WS&S facilities, and how this affects resulting health benefits To identify the key messages and cost-effective ways of communicating them at the community level.

Outcome Guidance on the most important messages (source-mouth recontamination, hand-washing after defecation, hygienic behavior, etc), and communication routes (primary health care workers, project-related education, schools, women's groups, etc) Determination of the extent to which different forms of health education are cost-effective

Approach Desk comparison of alternative approaches to communicating WS&S-related health messages, identifying costs and evaluating benefits where possible.

Baseline studies, using local institutions and community members to conduct surveys, to assess health beliefs and customs in selected environments Comparative testing of alternative ways of delivering health messages, with costs monitored. Follow-up surveys to assess the effectiveness in changing attitudes and behavior

Review of experiences and development of guidelines on cost-effective health education messages to improve WS&S sustainability.

SECTION IV: ENVIRONMENTAL SUSTAINABILITY

Topic 4.1 **Identify which WS&S activities are most at risk from environmental damage to water resources, and prescribe protective measures**

Purpose To provide guidance for planners and designers to anticipate and guard against competing demands on water resources, potential threats from industrial or agricultural pollution, or activities such as deforestation or flood protection

Outcome Identification of sensitive activities (e.g. water intakes downstream of industrial wastewater discharges) and possible protective or ameliorative measures (legislation, technical, or organizational).

Approach Establishment of an expert group to determine the threats to WS&S from other activities and investigate potential ways of combatting the threats* One aim should be to develop a compendium of environmentally sound practices, to be incorporated into manuals, codes of practice, standards and legislation.

*Note: This activity may be undertaken by the proposed TWG on Environmental Pollution (see Section 5 of this report).

Topic 4.2 Determine what environments are most at risk from WS&S activities and what actions are required to protect them

Purpose A reciprocal activity to Topic 4.1, intended to provide WS&S agencies with guidance on ways of ensuring that their programs are implemented in an environmentally sustainable way.

Outcome A checklist for WS&S planners of potential harmful affects of WS&S improvements, with guidance on design approaches which can be taken to minimize damage.

Approach Review of literature and analysis of incidents involving environmental degradation or other hazards caused by WS&S development. Identification of safeguards and protective measures.

Colloquia to discuss interactions between WS&S systems and other activities.

Topic 4.3 Review and develop methods and models for waste management and water resource protection

Purpose To provide guidance on suitable legal and organizational frameworks and technical recommendations for implementing sound environmental management policies

Outcome Assessment of current experience and guidelines on appropriate methods of ensuring effective management of water resources and of solid and liquid wastes. Model strategies to suit different environmental conditions

Approach Review of literature and available research information on management strategies.

Identification of countries/regions for further study and initiation of evaluations in collaboration with national research organizations.

Analysis of experiences and development of model strategies. Review by expert panel and elaboration of separate models for urban and rural areas and for water resource management and waste management.

Initiation of pilot projects to test model procedures.

Topic 4.4 **Identify the potential of and appropriate methods for optimizing reuse of wastewater and other wastes.**

Purpose Linked with the previous topic, and with Topic 3.3, the aim should be to review standards and develop a sound scientific basis for water quality standards for different types of use. Guidance is needed on the cost-effectiveness of various water reclamation techniques, and ways of promoting resource recycling, including safe reuse of sewage solids and household waste.

Outcome Identification of health, technical, economic, social and institutional implications associated with wastewater reuse in agriculture and for recharge of aquifers, and of resource recovery. Guidance on ways to encourage acceptance of such practices by communities and implementing agencies.

Approach Seminars to motivate agencies and to disseminate present knowledge and available guidelines

In-country research on treatment methods, acceptability, epidemiological effects, wastewater application technologies, and effectiveness of methods for controlling human exposure to potentially hazardous health effects.

Literature review and additional research if necessary on long-term effects on soils, plants, and groundwater of wastewater applications. Tests on cost-effective ways of recovering compost from on-site sanitation systems

Topic 4.5 **Investigate how water supply and sanitation can best be integrated into related planning and regional planning.**

Purpose To create awareness of the need for integrated planning, and to develop model approaches for integrating planning of WS&S improvements with other development activities

Outcome Guidance on ways of promoting best management of water resources, and protection of the environment, through improved planning procedures and institutional arrangements. Recommendations for avoiding conflicts between, for example WS&S and agricultural interests in source development and protection

Approach Investigate country/regional examples of integrated approaches, including those based on the river basin as a planning entity. Collect data on planning procedures which link WS&S with agriculture, energy, industry and environmental protection.

Use national institutions to carry out regional studies and develop recommendations for resolving planning dilemmas. Exchange experiences through regional workshops, and evaluate alternative approaches.

Review and make recommendations on the potential of water conservation models as a planning tool.

Topic 4.6 Develop appropriate and cost-effective methods for providing WS&S-related environmental education

Purpose To provide guidance on ways of raising public and official awareness of the need for environmental protection, and so affecting behavioral changes and promoting support for investments in protection programs.

Outcome Recommendations for changes to school curricula, higher education and subject specific training courses, to incorporate environmental issues. Suggestions for social marketing and public awareness strategies.

Approach Review of available materials and approaches for education, training and public information, and evaluation of alternative approaches

Selection of potential case studies at community level, in professional fora, and in the public domain, to test alternative approaches for consciousness raising and measure the effects

Publication of results of studies and discussion in regional workshops, to assist in dissemination of results and refinement of recommendation;