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WATER SUPPLY AND SANITATION IN DEVELOPING COUNTRIES

PROCEEDINGS OF A REGIONAL SYMPOSIUM

AT

COLUMBIA UNIVERSITY

NEW YORK, NEW YORK

JANUARY 14, 1988

EDITORS

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WATER SUPPLY AND SANITATION IN DEVELOPING COUNTRIES

Proceedings of a Regional Symposium
Sponsored by
the Inter-American Association of
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New York, New York
January 14, 1988

Editors:
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January 13, 1988

Dr. Abel Wolman
Regional Symposium
Columbia University
New York, New York

Dear Dr. Wolman:

It is a great honor for the City of New York to pay tribute to you, one of the world's foremost authorities on public health and sanitary engineering, and champion for the protection of the City's upstate watersheds.

Your distinguished contributions as a public servant, professor and international environmental engineering consultant over the past seventy years have helped protect mankind from water-borne diseases and other epidemics that result from unhealthful environmental conditions. Your accomplishments as teacher and writer have inspired young engineers to choose careers that are dedicated to excellence and serving humanity.

We congratulate you, Dr. Wolman, on your long career working to improve the environment for the health and well-being of people everywhere. May you be blessed with many more years of outstanding public service.

Sincerely,

Edward I. Koch
Mayor

ACKNOWLEDGEMENTS

The planning and organization of this symposium was in a sense a foreshadowing of great things to come: diverse groups of local specialists and institutions cooperated with international agencies in a way which was unprecedented and the results were significant and beneficial to all!

The event was amiably hosted by Columbia University. Thanks are due to Associate Dean Steven Cohen, School of International and Public Affairs, and Nancy Degnan and Sandra Achitoff of his staff; and to Dean Allan Rosenfield and Professor Granville Sewell, School of Public Health.

Co-sponsors of the symposium publicized the event among their members. AIDIS is grateful to the co-sponsors and their representatives:

- Dr. Michael Skelly, President
  American Society of Civil Engineers
  Metropolitan Section

- Lawrence Martens, President
  Mr. Dan Hahl
  American Water Resources Association
  New York Chapter

- Thomas McTighe, President
  Dr. Vincent M. Coluccio
  American Water Works Association
  New York Section

- Patricia Powell, President
  Mr. Robert Wasp
  New York State Public Health Association

- John Keegan, President
  Mr. C. Richard Walter
  New York Water Pollution Control Association

- Kenneth Stoller, Deputy Director ERRD
  Ms. Susan Shaw
  U.S. Environmental Protection Agency
  Region II

AIDIS is also grateful to the following United Nations agencies and their representatives who participated in planning the symposium:

- Mr. Frank Hartvelt
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- Mr. Martin Beyer
  UNICEF

- Mr. Wilfrido Barriero
  World Bank

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  World Health Organization/
  Pan American Health Organization

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Special thanks go to the following members of AIDIS who comprised the organizing committee:

- Dr. Vincent M. Coluccio
  Vice Chairman

- Albert Machlin
  Technical Program Coordinator

- Susan Shaw
  Treasurer

As members of AIDIS, they gave generously of their time and talent to make the symposium a success. On behalf of all who benefited by their efforts, I extend to them warm thanks and appreciation.

Terrence Thompson
Regional Director, AIDIS-USA
and Symposium Chairman

FOREWORD

More than eight years have passed since the United Nations General Assembly launched the International Drinking Water Supply and Sanitation Decade, also known as the "Water Decade". The goal of the Water Decade is to provide basic services in water supply and sanitation for all the world's population by 1990.

Most recently two significant conferences were held to report on progress made and obstacles encountered in achieving the goals of the Water Decade, and to encourage and promote the participation of U.S. specialists in multiple disciplines.

One conference, held in Puerto Rico from May 26 to 29, 1987 was attended by some 275 conferess from nearby forty countries and was the first of its kind to be co-sponsored by the leading American professional organizations involved with the provision of basic sanitary services. The lead sponsor was the American Society of Civil Engineers.

A follow-up symposium, which is the subject of these proceedings, was held at Columbia University in New York City, on January 14, 1988, under the lead sponsorship of the Inter-American Association of Sanitary Engineering and Environmental Sciences. The New York sumposium was held on somewhat of a trial basis to test the level of interest and support for the Water Decade agenda among multidisciplinary professionals in the New York Metropolitan Region.

The resounding success of the New York Regional symposium, evidenced by filled-to-capacity conference rooms, is already inspiring symposia on the Water Decade in other regions of the United States.

The proceedings of the New York Regional symposium reflect the collective knowledge of some of the front line participants in the Water Decade challenge, and hence are provided in this volume. These proceedings provide an overview on the conditions and needs in developing countries, and they explore some of the possibilities for better U.S. cooperation with the international community.

It is hoped that dissemination of these proceedings will contribute to greater understanding and participation of U.S. individuals and organizations in responsing to the needs and opportunities in developing countries.

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WORLD WATER PROBLEMS

Enzo Fano[a]

In dealing with issues of water resources development at a global level one may well ask a number of basic questions; is there now or is there likely to be a water crisis in difference parts of our planet? If so, why? Can we prevent it? Can we accurately assess supply and project demand for various consumer categories with any degree of certainty? Can technology help up overcome supply gaps where they exist. What can we expect from improved technologies in the next two or three decades? Can non-conventional sources of supply become a significant factor in the supply/demand picture? Can a change in institutional instruments such as water resources planning methods, legislation and administrative structures lead to greater efficiency in the use of water and thus help to redirect priorities in the use of existing resources? Can quality management be improved and standards enforced so as to protect our health and environment and preserve our precious water resources for future generations?

In any discussion about water, it is important to stress that we are speaking of a fixed total stock. Unlike other natural resources, the total global supply of water can be neither increased (as timber or fish) nor diminished (as petroleum or coal). Since water is continuously being renewed through nature's hydrological cycle, it is potentially inexhaustible. While this is so, locally available supplies can at the same time be quickly depleted or made unusable by inadequate conservation, pollution or over-all careless management.

In theory, the local stock of water could meet greatly expanded human needs. In reality, the traditional sources of water supply, surface water run-off and ground water stores, are inequitably distributed among peoples and countries. Some communities live where regular precipitation gives then an ample surplus at present. Others have far more water then they want or need, but not necessarily in the right place or at the right time. Still others have barely enough water for current needs, and drought is perennial through the wide belt of arid lands.

In short, globally there may be potentially enough water to meet forthcoming needs. But, frustratingly it tents to be available in the wrong place, at the wrong time, or with the wrong quality. And in one way or another, all societies are affected, however rich, however poor.

This general assessment of a world-wide condition becomes a specific reality when one considers:

a. Reasonably safe supplies of drinking water are unavailable for at least one fifth of the world's city dwellers and three quarters of its rural people; in many countries, less than one half of the urban

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(a) Chief, Water Resource Branch, Department of Technical Co-operation for Development, 1 U.N. Plaza, New York, NY 10017

population and less than one tenth of the rural population are served with an adequate and safe water supply;

b. Increasing and unplanned concentration of population and industry in large urban areas strains water supply: this leads to problems of waste disposal which, in turn, degrade the quality of life and environmental health;

c. Proliferation of industrial processes, greater use of energy and increased agricultural activity are causing progressive and chronic degradation of the quality of available water by the increase of toxic compounds and other pollutants: the mutagenic and carcinogenic effects of these substances pose potential threats to human life;

d. Backwardness and relative isolation of rural areas where the great majority of the world population now lives aggravate the difficulty of providing adequate and safe supplies of drinking water, improved sanitation and waste disposal;

e. Expansion of food production in water-short areas and in marginal lands has necessitated rapid development of irrigation and land reclamation, to the degree that water and land resources have been exploited to their limit in many areas;

f. Ever-growing land degradation from such causes as water-logging, salinization and erosion is leading to losses in production potential, investment and employment;

g. Ground water supplies are being exhausted, while both surface and ground water sources are deteriorating in many areas;

h. Water use is often needlessly inefficient and wasteful, considering the possible application of scientific knowledge and the setting of appropriate service levels;

i. Expensive technology for water development to compensate for shortage is straining inadequate resources in many regions;

j. Conflicts about rights and priorities among users intensifies as the demand for available water accelerates.

These problems affect different societies in different ways. The immediate concern may be unpotable water and human waste in the shanty town of a tropical city, multiplying wastes in an industrial high-income country, shortage of water impeding agricultural development in an arid land, watershed destruction and ground water depletion in an entire nation.

One may perceive these as local, regional and national problems. And indeed they are. But while it may be said that arid lands, for instance, have their exclusive set of problems - as have industrialized nations - still, many problems are common to many regions and communities. In many instances, the resolution of these problems would benefit greatly from the sharing of national experience and the rational management of whole river basins that know no national boundary. For this reason, it is useful and practical to view current local and regional problems about this global resource as a global concern requiring co-operation among nations. Without such collaboration, it will not only be difficult to alleviate current shortcomings, but more important, to curb their proliferation and avert a world water crisis.

I trust that the meeting taking place this morning will help to shed light on some of these complex, always fascinating, and often frustrating issues.

DISPELLING A MYTH ABOUT U.S. INTEREST

Terrence Thompson[a]

Today's regional symposium grew out of the International Conference on Water Supply and Sanitation in Developing Nations held in San Juan, Puerto Rico in May 1987. Although 150 of the 275 registrants in Puerto Rico were from the United States, it was nonetheless recommended that regional symposia be held in key cities throughout the U.S. in order to reach an even greater number of Americans.

The Puerto Rico conference was lead by the American Society of Civil Engineers (ASCE) and co-sponsored by AIDIS, the American Water Resources Association (AWRA), the American Water Works Association (AWWA), and the Water Pollution Control Federation (WPCF). In responding to this recommendation, the New York chapters of those associations have banded together with other local groups to organize the first of what is hoped will be a series of regional symposia throughout the country. Columbia University has graciously agreed to be our host here today.

There is a myth among the international circuits that Americans are not interested in water supply and sanitation in developing countries. The 150 Americans who registered in Puerto Rico, and 125 of you here today, have exposed that myth! Americans are intensely interested - at a grass roots level. And we have vast resources and experience to contribute to the cause.

What we Americans lack however are:

- adequate knowledge firstly about conditions, needs and opportunities in developing countries and secondly about how to adapt our solutions; and

- an institutional framework through which to channel our efforts.

There are things that we must learn before we can participated effectively in international programs. But that is not an insurmountable task! For example, until recently few of us knew very much about toxic chemicals in our environment. Now we know quite a lot and many of us are experts on the subject. We taught ourselves because it became important to us. We can learn about developing countries too if we believe it is important.

The Puerto Rico conference and today's regional symposium have begun the process of self-education. Some of the findings and recommendations that were generated in Puerto Rico are presented here for your consideration:

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Human Resource Development

- Academic institutions, in both the developing and the developed world, should add management and public health dimensions to their curricula in sanitary and environmental engineering; and incorporate the concepts of appropriate low cost technology.

- Practicing engineers and engineering educators in the United States should take steps, individually and through their professional associations, to increase their knowledge of water supply and sanitation in developing countries, which will enable them to better educators and more effective collaborators with their counterparts in the developing world.

Technology and Engineering

- Conferees noted that engineering and technology are often viewed as the sole solution to development problems; in reality, a narrow engineering approach can only be successful in societies with good supporting infrastructure.

- It was also noted that engineers are often too concerned with high technology and state-of-the-art solutions - a bias which is especially pronounced in universities and professional societies.

- Solutions to development problems must include considerations of many issues besides engineering. Because of weak physical and human infrastructure in most developing countries, engineers should be more sensitive to nontechnical issues.

- The concept of "state-of-the-art" should be redefined, changing it from a narrow, high technology focus to a broader multidisciplinary approach. The broad approach should be given professional status and acceptance. The concept should include applications of appropriate technologies to water and sanitation development.

Operations and Maintenance

- It was observed that successful O&M programs require a multidisciplinary approach that takes into account human resources development, appropriate technology, and willingness and ability to pay. Good O&M is not simply an engineering exercise nor a funding question. It is a planned program incorporating different disciplines.

- External support agencies and national governments should determine, before funds are committed to a project, whether adequate resources and plans are available to operate and maintain the system.

- For projects in rural areas, planners must incorporate community participation not only in the planning and construction phases, but especially in the operation and maintenance phase. Planners also

need to emphasize the importance of VLOM (village level operation and maintenance) equipment in design.

The complete set of conclusions and recommendations are available in the Conference Proceedings published by ASCE.

Objectives of the Regional Symposium

Today's symposium will address two of the topics covered in Puerto Rico, human resources and technology/engineering, and will introduce a new one: linkages to public health.

The objectives of today's symposium are threefold:

- to inform you about environmental conditions, humanitarian needs, and professional opportunities in developing countries;

- to inspire you to get involved and commit a portion of your talents and energies to the cause; and

- to explore opportunities for further cooperation with the international community.

For over 40 years AIDIS has been dedicated to the concept of international cooperation in the fields of sanitary engineering and environmental sciences. We welcome the broad base of interest that is growing among individuals and through other institutions in the U.S. today. This symposium is but one ingredient in our strategy to facilitate cooperation between the United States and the international community, and we look forward to further joint efforts with all.

INTERNATIONAL ORGANIZATIONS AND THE INTERNATIONAL DRINKING WATER SUPPLY AND SANITATION DECADE

Frank Hartvelt[a]

Circling around the globe in a satellite, we can observe both discouraging and encouraging developments. Discouraging because we still see many water supply systems including handpumps out of order and a lack of sanitation facilities; encouraging because many governments, international agencies and people who are beginning to see a glimmer of hope in the form of more realistic sector policies and programmes, better managed utilities, a new generation of handpumps and sanitation facilities based on proven low-cost community-based approaches.

Indeed it has taken the world community several years to translate the Declarations of Alma Ata (on primary health care) and Mar del Plata (on Water Resources, Water Supply and Sanitation) into tangible and sustainable activities in an increasing number of areas throughout the world.

It is now widely agreed that Decade projects must not only be technically, financially and economically sound but also socially and culturally viable. It is also agreed that we are all part of a Decade process whether we are engineers, doctors, managers, administrators, technicians, health workers, or social scientists, interacting with people who need clean drinking water and sanitation.

We should always keep in mind the extremely important positive consequences of Decade activities as expressed in lives saved, less sick or disabled people, less suffering, and more socially and economically productive people.

I should like to draw your attention to three events which took place around mid-Decade (in 1985-86) which, in our view, are not only a point of reference but also will shape Decade activities in the years to come. Firstly, the 1985 meeting of the Development Assistance Committee of the Organization for Economic Co-operation and Development, OECD/DAC, emphasized the need for an intensified and effective process of country-level aid co-ordination in the sector. To be effective, sectoral consultations and co-ordination should be a joint donor-recipient process, analyzing and improving sector policies, investment programmes and institutional framework. Secondly, the mid-Decade report of the Secretary General of the United Nations on progress in the attainment of the goals of the Decade stressed that organizations of the United Nations system, as well as other international,

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bilateral and non-governmental organizations, should continue to enhance co-ordination of their development assistance activities at the global and national level and support the role of the UNDP Resident Representatives as focal points for the Decade at the country level. Both the Development Assistance Committee of the OECD and the UN Secretary General committed themselves and urged other agencies and governments to focus their attention and programmes increasingly on the following key areas: human resources development; community participation; health and hygiene education; institutional development; linkages between health, water and sanitation agencies; documentation and information. The UN agencies, members of the Decade Steering Committee (chaired by UNDP), are already active parties in this process. There is no doubt in my mind that voluntary agencies (the NGOs) active at the grassroot levels in thousands of small-scale projects all over the world must have been instrumental in making the big countries and major international agencies accept the above areas of focus.

Thirdly, an important international seminar on low-cost rural and urban-fringe water supply took place in October 1986 in Cote d'Ivoire which resulted, inter alia, in "The Abidjan Statement" outlining a five-point strategy (a copy of which is attached). The outcome of the seminar is well summarized in the preamble which reads as follows:

> "Lasting health and economic benefits for the rural and urban-fringe populations of Africa can be achieved through increased community management of water supply and sanitation systems based on proven low-cost technologies. African governments and donors are urged to identify and commit adequate resources and provide all necessary support for the direct involvement of communities in choosing, managing and paying for their water and sanitation systems."

The main elements of the five-point strategy as developed during the Adidjan Seminar are as follows:

1. the role of governments and donors, policies to standardize technology and socio-economic approaches, sustainability and replicability, inter-agency co-ordination;

2. the involvement of communities - especially women in decision making and management; affordability of water supply systems;

3. community water supply as an integral part of primary health care;

4. choice of appropriate technology, in-country manufacture and distribution of handpumps and spare parts;

5. community-based maintenance, supported by a national strategy of standardization of spare parts.

Although the semimar focussed on Africa we believe that its outcome is of great interest to all countries in the world which are committed to make substantial progress in the second half of the International Drinking Water

Supply and Sanitation Decade (IDWSSD) and beyond. As you will appreciate, the importance of the Abidjan Statement does not only lie in its substance, but also in its endorsement by 100 participants representing both developing and developed countries. UNDP, UNICEF, the World Bank and WHO were among the international agencies which endorsed the statement.

In essence the Abidjan Statement records the conviction of national and international policy makers, administrators, engineers and other specialists, that a 180-degree turn from centrally-managed to community-based water supply programmes is now becoming more feasible in technological, financial and social terms. Especially, it gives participants from developing countries ammunition for discussions with their own policy makers in terms of future programmes.

Consequently, the five-point strategy adopted in Abidjan should provide the necessary guidance in the planning and implementation of low-cost rural and urban-fringe water supply programmes.

The worldwide economic and financial constraints experienced in recent years have severely limited government budgets and exacerbated problems of governments in implementing primary health care programmes including water and sanitation. Despite the divergent trends between diminishing resources and advances in health, water and sanitation technologies, products, measures and approached there are ways to disseminate progress. These include (a) a greater reliance on families and communities in promoting the use of their own ingenuity, experience and resources, and (b) the improvement or rehabilitation by local authorities, with external support, of health, educational, agricultural and other essential infrastructure.

It is estimated that at present 1.3 billion people still need potable water and 1.6 billion people need sanitation. By the year 2000 another 1 billion people will be unserved unless public and private forces shift into a higher gear.

The UN system is committing both human and financial resources to expand and improve water and sanitation programmes. In recent years major donor countries have joined our Decade programmes: the Federal Republic of Germany, Switzerland, Canada, Denmark, Norway, Sweden, Finland and Holland. We are optimistic that other donors will join us as well.

UNDP, the World Bank, UNICEF and WHO recently agreed to strengthen co-operation and co-ordination among themselves and with other agencies. These agencies called "The Four", will more and more pool their human resources and, wherever possible, jointly undertake projects using the strengths of each agency. As outlined earlier, based on experience of the first half of the Decade the main elements to expand and improve water supply and sanitation programmes are now known, and perhaps more importantly, agreed upon by virtually all governments of developing countries, UN system agencies, the OECD/DAC countries and other organizations including non-governmental agencies.

In a spirit of full participation of all interested parties in both developing and developed countries UNDP, the World Bank, UNICEF, WHO and other UN agencies have agreed to focus their efforts on the following areas during the remainder of the Decade.

1. Reforms of outdated policies and regulations, sector planning and programme preparation.

2. Design, implementation and evaluation of low-cost demonstration and investment projects or components in other projects. Incorporation of women's participation, community management, hygiene education and other primary health care components wherever possible; inclusion of income generating activities and socio-cultural research, and allocation of resources for these purposes.

3. Human resources development including training to strengthen institutions and communities.

4. Continued operational research and feedback into the above programmes in such areas as local manufacturing geared towards village level operation and maintenance pumps (VLOM) for drinking water and small-scale irrigation, drilling (cost reduction), borehole design and construction, water quality, sanitation in urban-fringe areas (e.g. small-bore sewers), cost recovery, liquid and solid waste management focussing on recycling (tens of millions of dollars can be saved or generated through recycling); and, more generally speaking in management, operation and maintenance.

5. Dissemination of general and technical information.

A dramatic example of the outcome of applied research is the Afridev handpump. Unlike the still popular India Mark II pump which requires three to four strong men and fifteen tools to maintain, the Afridev can be maintained by two women using only one tool.

With the exception of waste management the above objectives are tilted towards rural and urban fringe areas which clearly deserve priority attention at present.

However, the international community may also be forced by circumstances to direct more attention and resources to urban water and sanitation problems in the future as the populations of cities are increasing at an alarming rate.

In conclusion, I should like to extend an invitation to all the academicians, engineers, scientists, administrators and other present here today to join in the effort to expand and improve water supply and sanitation throughout the world.

INNOCENTS ABROAD - CONSULTING ENGINEERS IN DEVELOPING COUNTRIES

MARTIN LANG*

Thanks are due to Mark Twain for the title "Innocents Abroad". It may add a whimsical tone to the talk, but there is a hard kernel of truth in it.

There have been, and there are now, failures in water, wastewater, and sanitation undertakings in developing countries, in equipment, facility structures, facility operation, facility maintenance, facility performance, system performance, and, sometimes, entire program performance. We, in the professional community, should exhibit no elitist condescension when confronting such failures. After all, ten years ago, when I was President of the Water Pollution Control Federation, the United States, which had led the world in developing wastewater technology, was beset by a series of failures of sophisticated, computerized, and expensive wastewater plants. Four years ago, at the annual WPCF conference, I delivered a paper entitled "Don't Repeat Our Mistakes Abroad."

If we asked a shoemaker to build a space ship, he might reach for a piece of leather. Confronted with the failure of a water supply program, an engineer might reflexively seek to provide new equipment or a new process. It is important to diagnose the true cause of the failure, the symptoms of which might be an unreliable or intermittent supply, low pressure, and unsafe quality.

Before making this diagnosis, we should divest ourselves of any simplistic cliches about so-called "developing" countries.

What should we <u>not</u> readily cite as purported causes of performance failure of environmental programs, systems, or facilities?

Lack of qualified engineers, native to the country? Why, some of them have the same degrees, from the same universities, as members of the imported expatriate teams, brought in to help. Furthermore, scanning the authors' names of articles in the Journals of the WPCF and AWWA, and the Environmental Journals of ASCE, shows the impressive contributions of distinguished engineers native to, but no longer resident in, developing countries. A similar review of the advanced post-graduate students in the graduate environmental curricula of most U.S. universities shows in many cases such students constitute, or are close to, a majority. A significant number are on the faculties.

Lack of money? The post-war decades were marked by readily available low cost loans and some outright grants for capital

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construction of new facilities. There seemed little concern that similar provision was not made for operation, maintenance, and renewal thereafter.

Lack of concern for public health and personal well-being? While some people are acculturated to a more stoic altitude toward illness and death, no people rush to embrace them.

Ineptitude in construction? There apparently has been no deterrence to the construction of impressive government buildings, airports, high-rise office buildings and dwellings, highways, and harbors.

Lack of mechanical aptitude to operate and maintain? The prolonged life of the fleets of aged cars and trucks in these countries is a tribute to the skill and ingenuity of local mechanics and artisans in repairing, improvising, and improving, as well as cannibalizing.

Lack of knowledge of theory, process, practice, and current information? Again, a perusal of the relevant Journals will demonstrate the substantial contribution of "developing country" professionals at the cutting edge of research. Thanks to their own initiative, as well as the assistance of bilateral agencies, the local engineers have reasonable access to updated Manuals of Practice.

Is there local unwillingness to pay reasonable rates for water? Just as in the U.S. there is always some reaction to this, sometimes accompanied by grumbling about "birthright water," but the willingness and capability to pay realistic rates is being increasingly demonstrated.

Is there a lack of environmental standards? On the contrary, these countries are frequently encumbered with unrealistically high water and air quality standards, transferred in toto from the U.S., but without the resources to attain them, the capability to monitor compliance, or the legal basis to penalize non-compliance.

Despite these positive answers, do these countries, many still without reliable and adequate potable water supply, need the help of the U.S. professional consulting community? They certainly do!

The failures and deficiencies of environmental programs abroad were rarely purely technological. They were institutional failures of a management which lacked a stable and dedicated cadre of career professionals, whose tenure transcended that of transient politicians, who would be the originators and stewards of long-term plans for reliability, cost effectiveness, self-renewal, self-rehabilitation, and profitable delivery of public service from its own revenue base.

(Significantly, much of this was equally true about some past failures in the U.S. By now, in 1988, there is widespread recognition that water and wastewater programs should operate like reliable, efficient, and profitable utilities, and are not sumps for the disposal of the untrainable residue of political patronage.)

It is of little avail to cite the outstanding engineers and other specialists, native to these "developing" countries, who are now resident in the U.S. or U.K. It is necessary to have management that will cherish their potential, pay competitive salaries to recruit them, and then give them enough professional challenges and rewards to retain them in their home country. This might involve a profound reassessment in some societies which expected younger professionals to accept low salaries and assignments with little professional challenge and standing, and to wait patiently for many years to attain appropriate rank and pay.

I stated that for some of the post-war decades there was ample construction money. However, without a competent managerial structure, could it be spent effectively? The net result was lavish expenditure for new facilities, and a pittance to operate and maintain them - a honeymoon phase for a new plant, after which it might be just "mined out" into junk. Good management would have recognized and provided for the local obligation to operate and maintain in perpetuity after the one-time stunt of hustling the construction funds.

The most useful contribution the U.S. professional firm can make is to go beyond the provision of a specific design and hardware, to also include the creation of a viable, well-managed, institution, to not only deliver water and other life-support services, with staffing by a competent, career cadre, and with the capacity for self-renewal and adaptability to future needs, all without outside subsidy.

This task is usually orders of magnitude harder than designing, providing, and installing pumps and pipe. Fortunately, there is an impressive array of competent consultants, many in this very area, admirably equipped to assume the multi-disciplinary challenge of changing an old organization, or creating a new one, so organized, staffed, equipped, and administered as to profitably and productively persist well into the 21st century. Essentially it is a metamorphosis to a utility or quasi-utility model.

Such broad spectrum consultants can deploy teams to provide whatever combination of advice, assistance, or hands-on participation is required, not only in engineering, but in administration, budget and finance, human resources, operation and

maintenance, computerized billing and collection, rate-making preparation of scopes and specifications, and construction project control.

In effect, the professional consultants should be prepared to deliver "total service" in developing countries to catalyze the eventual creation of a viable, self-sustaining institution.

In addition to the provision of a reliable and adequate supply of pure potable water, this institution should have:

(1) A politically, fiscally, and socially acceptable rate structure, with some minimum "lifeline" provisions.

(2) A system for installing, maintaining, and reading meters.

(3) An effective billing and collection system.

(4) A system for monitoring water quality.

(5) Trained and productive operating and maintenance crews, with capability for emergency response.

(6) Provisions for detecting and minimizing diverted water and/or leakage (non-revenue water).

(7) A public water conservation program.

(8) Adequate response to public inquiries or complaints.

(9) A rational inventory of spare parts and supplies.

(10) A training program for new employees, and to enhance existing skills.

(11) A 'human resources' department charged with recruitment, evaluations, training, retention, discipline, and promotion of personnel.

(12) Above all, a management team which will administer (1) through (12) above, as well as short and long-term planning.

WATER SUPPLY AND SANITATION IN DEVELOPING COUNTRIES

Abel Wolman[a]

I. Introduction: Exactly 40 years ago, the first World Health Assembly met in Geneva. Creation of division of environment. Of 68 countries, two violently opposed the intrusion of engineering into a new medical-public health organization. A familiar pitch. A specification for sermons and speeches -- less than 30 minutes -- no more than two ideas.

H.L. Mencken: There are two things people should never see being made: sausage and laws.

James F. Krier and Clayton P. Gillette: The disservice of technological optimism is its implicit, unexamined claim that engineering can rise above politics.

II. Present Status of Water Supply and Sanitation. 1985 -- Returns from 94 developing countries. Numbers in millions.

	Served	Unserved
Urban Water Supply	672	198
Urban Sanitation	518	352
Rural Water Supply	561	1,029
Rural Sanitation	255	1,355

III. Constraints to Meeting the Decade Hopes.

In order to develop a logical program beyond 1990, a few years ago WHO canvassed 65 countries and more recently some 90 countries to determine their views regarding the forces which prevented the installation of facilities at the rate initially proposed in the Decade Program. Some 20 constraints were listed for country assessment. The overwhelming majority chose only four: low government motivation, skilled manpower deficiency, absence of managerial competence, and, of lowest priority -- money. These provide guideposts for the resurgence of the drive for the amenities beyond 1990.

The recession of the last ten years was another retardant to progress, leaving the poor poorer and the rich richer, while the population continued to increase.

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IV. Beyond 1990: What are the new roads to increased facilities?

a. One most commonly chosen in many of the workshops and conferences is familiar to most practitioners. More emphasis on the same ingredients appears to be the selected route. Imaginative "new" is in low supply. We are captivated by the array of familiar words.

An example, among many others, is in the recommendations of the Consultation held in Interlaken, Switzerland, on October 13-16, 1987. The hosts were the Swiss Development Cooperation and WHO. It was attended by 56 delegates representing some 30 external support agencies.

The bases for discussion by the donor group was provided by an excellent and thoughtful position paper by John M. Kalbermatten and Michael G. McGarry.

Six actions were recommended. All struck the same note, by now almost literary cliches. Although no one could take issue with their logic and wisdom, their implementation is distinguished by their absence. The six actions are recorded here for comparison with other more imaginative and less familiar efforts. These latter may advance the provision of amenities more rapidly than recourse to the orthodox. The recommended series by the Interlaken group:

Institutional and Human Resources Development
Cost Recovery
Balanced Development
Operation, Maintenance, and Rehabilitation
Community Participation and Hygiene Education
Coordination and cooperation

The Consultation recommended that these should be adopted as "the Global Sector concepts."

b. Are there better devices by which the rate of installations would be greatly accelerated? Two such are noted: (i) communication and (ii) marketing. Both are being successfully used in many public and private undertakings.

One provocative approach is to be launched with the assistance of UNICEF, WHO, and other leading international organizations. It is concerned with child health, in a publication entitled "Facts for Life." It is aimed at communicators, not families and is to provide "authoritative expression, at the layman's level, of scientific consensus."

Who are these "communicators"? Educators, the media, newspapers, radio, et al, community organizations, employers, government agencies, health services, political leaders, entertainers, are among those designated as "communicators."

Another route is via a professional group calling themselves "marketing experts," now operating internationally. They service public and private organizations and show successes -- and some charlatan failures. At any rate, their potential should be explored in pushing forward toward the year 2000. Richard K. Manoff, an international practitioner in the marketing art, makes the relevant comment:

> "Public health's orientation then was with engineering, not medicine. --- Such preemptions have characterized public health history. Infatuated with new discoveries, it has always shown a readiness to be seduced by the latest strategy." In our case, by oral rehydration therapy!
>
> The most difficult task of all is, or course, how to reach the family -- the mother, the child, the father! The means here listed will create effectively the catalytic spark!

Perhaps the approach to the hundreds of millions of deprived people has been available for many years in the extraordinary activities of Dr. Y.C. James Yen, familiar to many as Jimmy Yen. He was recently awarded the U.S. 1987 Presidential Award for more than 60 years work in reaching into communities and their people.

For those who do not know of him, at age 94, would have extraordinary pleasure in reading an account of his doings by John Hersey in a Reader's Digest publication. I close with his life long purpose in his own words: "I saw not only their suffering, their misery, but their potential power -- not out of pity, but out of respect."

"OPPORTUNITIES FOR COOPERATION -- SUMMARY OF DISCUSSIONS"

Terrence Thompson, P.E.[a] and Vincent M. Coluccio, Dr. P.H.[b]

A panel discussion was held as part of the day's proceedings for the purpose of exploring possible opportunities for further cooperation between U.S. specialists and the international community. The participants were:

Wilfrido Barreiro, World Bank
Martin Beyer, UNICEF (Moderator)
Guillermo Davila, Pan American Health Organization
Frank Hartvelt, U.N. Development Programme

and

John Jeris, Manhattan College
Martin Lang, Camp Dresser and McKee, Inc.
Terrence Thompson, AIDIS

The following synthesizes possible opportunities raised in the panel discussion and other opportunities discussed in the various technical sessions. This is by no means a comprehensive listing of all possible opportunities. The possibilities are limited only by our imaginations.

Americans can find motivation to participate in international programs in two ways. One is through a humanitarian sense of responsibility, or "noblisse oblige." The other is through the desire for reward -- be it personal satisfaction or increased business opportunities. These two motives are not mutually exclusive. As a wise man once said, "one good thing does not necessarily preclude another."

Public Awareness

Water and sanitation needs of developing countries is the best-kept secret in the United States today. Some 30,000 people worldwide die everyday due to inadequate waste supply and sanitation -- yet few Americans seem to know about it. In recent years, Americans have responded generously to several well organized hunger relief campaigns -- evidence that they would also respond to the world's water and sanitation needs. There is a clear need for public awareness building in this regard.

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(b) Chief of Water Quality Planning, Bureau of Water Supply,
NY City Dept. of Environmental Protection,
44 Beaver St., New York, NY 10004

One group of New Yorkers is doing something about it. The Council on the Environment of New York City (CENYC) trains elementary and high school students to organize environmental improvement projects in schools and neighborhoods. Participating students learn about local and global environmental issues, develop organizing skills, and gain a sense of effectiveness as individuals capable of constructive action.

CENYC's program may inspire others. Professional associations, for example, could also undertake public awareness programs.

Professional Awareness

Professional associations are in a key position to inform their members about conditions, needs and opportunities in developing countries and to channel information about low-cost technologies, community participation, and conducting business abroad. This could be accomplished through conferences, seminars and workshops and through newsletters, journals and other publications. The success of the New York Regional Symposium and ASCE's 1987 Puerto Rico Conference demonstrates that members are interested in this information.

Education

U.S. colleges and universities can better prepare future technical specialists by incorporating into their curricula elements of low-cost technologies, public health, and management. In the panel discussion, it was pointed out by Dr. John Jeris, Manhattan College, that there has been an absence of communication between U.S. universities and promoters of water supply and sanitation in developing countries. He invited the U.N. agencies present at the symposium to open discussions with the universities in this regard.

Training Programs

Local institutions could make contributions to the needs of developing countries through organized training programs. As Martin Lang pointed out, the United States has a wealth of experience in management of environmental programs and hands-on operation of environmental facilities, both rural and urban. Local agencies and utilities could establish training programs for Third World counterparts, or even exchange programs sending employees abroad. This could be done informally or through formal "twinning" arrangements. AIDIS can act as a liasoin to help establish such relationships.

Project Development and Assistance

The U.S. Department of Commerce estimates that the world market for goods and services in the water and sanitation sector is about $5 billion per year, of which the U.S. garners about 5 percent. American firms are disadvantaged to some extent by economic factors such as the strength of the dollar and non-competitiveness of wages. However, we also suffer from a lack of knowledge about how to conduct business outside our boundaries. Several U.S. firms have conquered this obstacle and are succeeding abroad. AIDIS plans to address the issues of competitiveness and business development in future proceedings.

Meanwhile, some exciting possibilities exist at the grass-roots level. The New York State Department of State is exploring opportunities for development and implementation of sanitary projects in the Eastern Caribbean! The DOS has established an effective "Self-Help" program serving rural New York communities with appropriate technology and community participation. Now, the DOS would like to share its success with the developing world. For more information, contact Ed White at the N.Y. State Department of State.

New York's "Self-Help" program has drawn assistance from the Rural Community Assistance Program (RCAP), headquartered in Winchendon, Massachusetts. RCAP provides no-cost technical services to rural communities for water supply and waste disposal projects. RCAP has undertaken several projects in Puerto Rico, in an environmental typical of tropical developing countries. For more information, contact Tom Bates at RCAP.

Both New York's Self-Help program and RCAP are laudable examples of Americans' abilities to utilize appropriate technologies within a context of community participation.

The Role of AIDIS

For over 40 years, AIDIS has been dedicated to the concept of international cooperation in sanitary engineering and environmental sciences. The Association has a network of contacts through some 10,000 members in nearly every country in Latin America. In addition, AIDIS has built a reputation of eminence with international development agencies.

AIDIS has signed cooperative agreements at the national level with the American Water Works Association and the Water Pollution Control Federation, and has assisted those institutions with training and informational programs. At present, AIDIS is working at the national level with AWWA, WPCF as well as the American Water Resources Association, the American Society of Civil Engineers, and the International Public Works Federation to evaluate their international programs and explore opportunities for enhancement and coordination.

At the local level, AIDIS's New York Region hopes to replicate the spirit of mutual cooperation that is enjoys with U.S. professional associations at the national level. We also seek to facilitate internationally-oriented initiatives that may be undertaken by U.S. institutions of any type. For further information contact the Regional Director at the following address: AIDIS/NY Region, Church St. Station, P.O. Box 2606, New York, NY 10008-2606.

APPROPRIATE TECHNOLOGIES IN WATER SUPPLY AND SANITATION DEVELOPMENT

Dennis B. Warner
Deputy Director
Water and Sanitation for Health (WASH) Project

Presentation
to
AIDIS/ASCE Regional Symposium
at
Columbia University

14 January 1988

Before going into the subject of appropriate technologies, I want to pose a question for all of you to think about during my subsequent remarks. I will return to this question at the end of the session. The question is:

> What is an appropriate level of water and sanitation technology in a developing country?

Think about this issue over the next few minutes.

Technology Choice

One of the main problems in water and sanitation development (as well as in any other type of development) is to identify a technology which is suitable for the need. Some of the factors to consider are the following:

- Many choices of technology and levels of service are usually available.
- Examples of innovative technologies and practices often can be found in the community.
- Technologies that serve people and their needs will be accepted.
- The introduction of a new technology usually requires comprehensive supporting efforts.

Basic Issue: TECHNOLOGY IS ONLY ONE OF SEVERAL KEY INPUTS

This issue is illustrated in Figure 1, which shows that water supply and sanitation development is the result of many disciplinary inputs.

Water Supply Technologies

The most basic classification of water supply technologies is that of "source-delivery", as follows:

1. Unimproved Sources

    - o streams
    - o lakes
    - o traditional water holes
    - o springs

2. Improved Sources, Unpiped

    - o open wells
    - o protected springs
    - o handpumps
    - o roof catchments

3. Improved Sources, Piped

    - o public standpipes
    - o yard taps
    - o multiple in-house taps

Another type of classification is to consider the individual operations in a water supply system. Figure 2 outlines the various options, or choices, that may occur in water sources, delivery, storage, distribution, and treatment.

Elements of Service Levels: Water Supply

What are the distinguishing characteristics of water supply systems in the Third World? How do they differ from systems in the United States? The key elements to keep in mind are:

* Quantity
* Quality
* Reliability
* Accessibility
* Cost

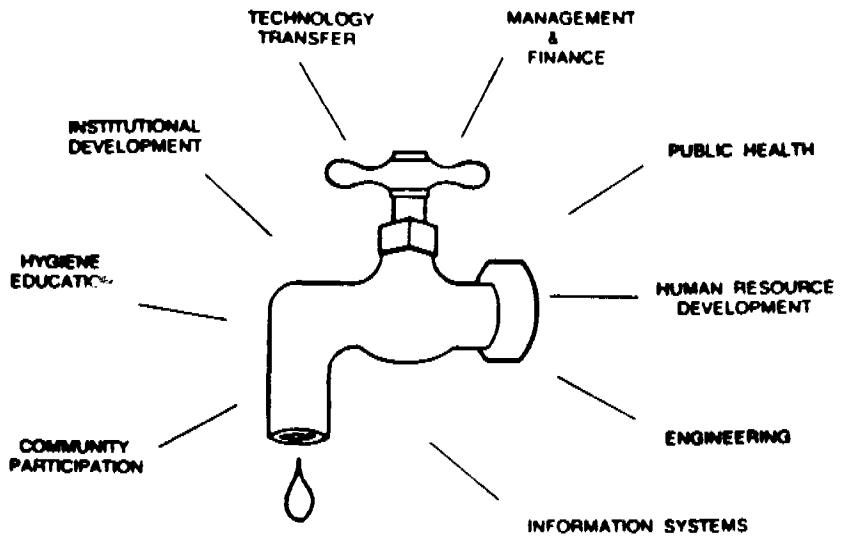

Figure 1. Disciplines Needed for Water Supply and Sanitation Development

Source	Delivery	Storage	Distribution	Treatment
Unimproved	person	none	unimproved public source	none
– river, pond, open well	animal	household pot/jar	public tap	detention/ settlement
Improved	bicycle	household cistern	outside courtyard tap	boiling
-- protected well borehole, intake in stream or lake, roof abatement	car/truck	community tank	insider house tap	chemical disinfection
	pipe			coagulation/ filtration/ disinfection

Figure 2. Technology Options in Water Supply Development

(a) Water Supply Quantity

This element is usually measured in liters per capita per day (lcd) or gallons per capita per day (gpd)

USA: (Residential)

Design range	=	100-200 gpd
National design average	=	160 gpd
Actual use range	=	40-80 gpd
National use average	=	65 gpd

Third World:

Urban:

House connections	=	40-200 lcd
Public standpipes	=	20-50 lcd

Rural = 5-40 lcd (varies from unimproved sources to standpipes)

Rural water supplies can range from unpiped service (water holes, springs, wells) to piped systems with house connections. Sometimes rural systems are two-tier, or dual, supplies, with a small quantity of high-quality, potable drinking water and a larger quantity of lower-quality, non-potable water for other uses. In Thailand, for example, the current Five-Year National Health Development Plan calls for 5 lcd for potable drinking water and 30-40 lcd for other water uses.

(b) Water Supply Quality

Water quality in the Third Word is normally assessed with bacteriological and chemical tests.

USA:

AWWA Standards: (In general, must be free of contaminants harmful to health and have acceptable levels of taste and odor.)

Third World:

Urban	=	national standards (Often based on USA, British, French, or WHO standards. Often violated.)
Rural	=	usually vary from none to WHO standards

Most countries claim to follow WHO standards for rural water quality. WHO recommends a zero fecal coliform count for all types of rural water supplies. Unfortunately, there is a problem inherent in following these standards because it is extremely difficult to maintain untreated water supplies free of fecal coliforms in rural systems. Under certain conditions, such as untreated, unpiped supplies, the WHO guidelines allow some total coliforms, but not coliforms of proven fecal origin. By calling for a level of water quality that is beyond the current means of most governments to achieve, the WHO guidelines have the practical effect of condemning, or at least ruling as unacceptable, the vast majority of water supplies used in the developing world today. Since most untreated rural water supplies (with the exception of well constructed deep boreholes) contain fecal coliforms, strict adherence by a national government to the WHO limits means that most of the rural supplies in the country probably will be in violation of water quality standards.

It would be better for a nation to have a realistic water quality standard based on existing needs and resources. If necessary, some level of fecal coliforms might have to be tolerated until such time as higher-quality water supplies can be provided. In short, water quality standards should constitute a realistic goal encouraging compliance, not an impossible level beyond the means of rural communities to achieve and maintain.

(c) Water Supply Reliability

The key issue in reliability is the duration of system operation. The occurrences of stoppages and periods of system malfunction reduce overall system reliability.

USA: = 24-hr service; always positive pressure in the system; usually back-up pumping equipment available; reliability is improved with back-up equipment

Third World: = 24-hr service possible, but intermittent service and/or seasonal service more likely

Intermittent service is especially hazardous because of alternating periods of pressure and non-pressure. When service is interrupted, water pressure can become negative, thus drawing contaminated groundwater into the system through leaks in the pipelines. Seasonal service is usually caused by changes in water quantity or quality due to droughts, floods, heavy silt loads, etc.

(d) Water Supply Accessibility

Accessibility is usually measured as the walking distance between the house and the source of water.

USA: multiple in-house taps

Third World:

Urban = 0-200 meters

Rural = up to 10 km (or more)

Many rural water supply agencies use 0.5 km (approx. 1/4 mile) as the maximum one-way walking distance. In general, women and children are the primary water carriers in the developing countries.

(e) Water Supply Cost

Cost includes both capital, or construction, elements and recurrent, or operational, elements.

USA:

Construction =) $500/cap
Operations = $1.27/1000 gal (based on 1984 AWWA survey of 300 U.S. water utilities)

Third World: (based on 1985 WHO data)

Construction:

Urban house connnections	=	$121/cap	(range: $60-$290)
Urban standpipe	=	$60/cap	(range: $35-$81)
Rural supply	=	$36/cap	(range: $15-$123)

Operations: = $0.34/m3
= $1.29/1000 gal

The cost of operating water supply systems in the Third World is approximately the same as in the United States. However, it is possible to develop rural water systems with much cheaper operational costs. In Malawi, rural gravity piped systems cost about $15.00 per person for construction, while annual operational costs are as low as $0.30 per capita. These costs are kept low through a combination of factors, including the limitation of projects to gravity flow systems, self-help labor, and active community involvement in system construction and maintenance. The Water and Sanitation for Health (WASH) Project has additional data showing that simple protected wells and pit latrines can be built and maintained in many countries for a total annual cost of $5 to $10 per person.

Sanitation Technologies

In the area of sanitation technologies, the following provides a useful classification:

1. Nothing (no sanitation facility)

2. On-Site Disposal (dry)

   - o pit latrine
   - o VIP latrine

3. On-Site Disposal (wet)
   - o pour flush to soakaway
   - o low volume cistern flush to septic tank

4. Off-Site Disposal (dry)

   - o bucket latrine
   - o vault and manual removal
   - o vault and vacuum truck

5. Off-Site Disposal (wet)

   - o low volume flush, septic tank, and small bore sewer
   - o high volume flush and conventional sewerage

Let's consider several typical sanitation technologies. A VIP latrine, for example, consists of nothing more elegant than a simple pit in the ground within which waste material is deposited. The pit keeps the harmful pathogens away from people and minimizes access by insects and vermin. A screened vent pipe allows the escape of gases from the pit and simultaneously traps and holds the flies and other insects that have come in contact with the waste matter.

Another common sanitation technology is the pour flush toilet. This contains a slab with a water seal toilet bowl into which a few liters of water are manually poured after each use. The additional water flushes out the wastes and then forms a water seal in the toilet bowl to prevent insects and gases from passing into or out of the chamber below the slab. A pour flush toilet can discharge directly into a soakaway pit or into a septic tank which in turn can discharge into a drainfield or into a small diameter sewer.

Small diameter sewers offer cost advantages over conventional sewers. Technically, small diameter sewers are used to remove only effluent from septic tanks, sewage vaults, and other types of sewage holding tanks. By removing effluent and leaving behind solids, small diameter sewers can extend the effective holding capacity of sewage tanks and reduce the need for frequent emptying. One effective application of small diameter sewers is to interconnect a series of household sewage vaults such as are found in many of the non-sewered areas of the Middle East. Small diameter sewers have cost advantages over conventional sewers because they have smaller diameters, flatter slopes (no solids to transport), and shallower trenches.

The transport of sewage also can take place by means other than pipes. Figure 3 shows a tractor-drawn sewage tanker for use in areas where household vaults are used to collect and hold sewage. The figure shows an upgraded solution proposed for Giza City in Egypt where many household sewage vaults typically are emptied by hand bucket and then manually carried to the nearest irrigation drain for disposal. The upgraded tanker reduces contact between the worker and the sewage wastes, allows faster operation, and encourages the evacuation of more vaults in a working day. An even simpler, but still improved, system is shown in Figure 4, which depicts a donkey-drawn cart containing all of the the essential characteristics (cleanliness, cost reduction, and speed) of the tractor-drawn tanker -- but in lesser degree.

The main point to keep in mind is that there usually are several technologies applicable to a given situations. As found in a WASH Project study of the unsewered areas of Giza City in 1982, for example, existing sewage collection technologies included modern pumper trucks, manual bucket systems with horse-drawn carts, and hand-carried buckets. Figure 5 shows the range of technological options found in Giza.

Elements of Service Levels: Sanitation

For sanitation systems, the are four primary considerations:

* Cleanliness
* Reliability
* Convenience
* Cost

In the developed world, cleanliness generally refers to closed drainage conduits and to sanitation facilities with waterproof and washable surfaces. In the Third World, on the other hand, cleanliness may mean open drains and surfaces of non-washable, but clean, thatch or mud.

Similarly, reliability often takes on different meanings between the developed and less-developed worlds. Whereas 24-hour service may be the required standard in the industrialized countries, simply having a sanitation system that operates for some part of the day, every day, may be an acceptable level of reliability in some developing countries.

Convenience is very heavily influenced by local culture and traditional practices. In the U.S., we insist on having our toilets within our houses. In other countries, a sanitary latrine in the compound is the height of local modernity. For a sanitation system to be successful, it must take into account local sensitivities. The

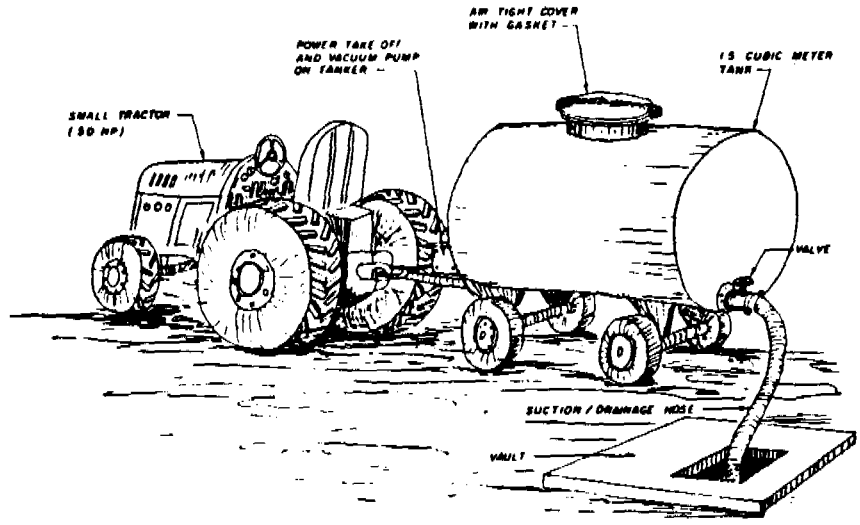

Figure 3. Tractor-Drawn Sewage Tanker

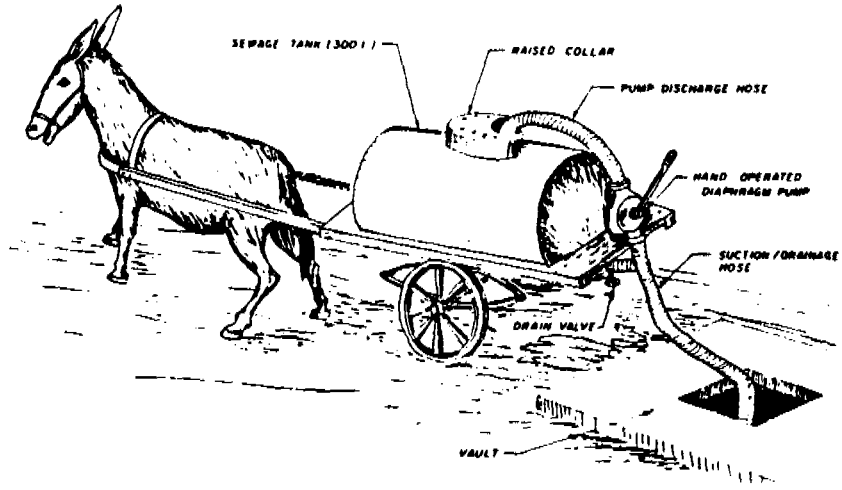

Figure 4. Donkey-Drawn Sewage Cart

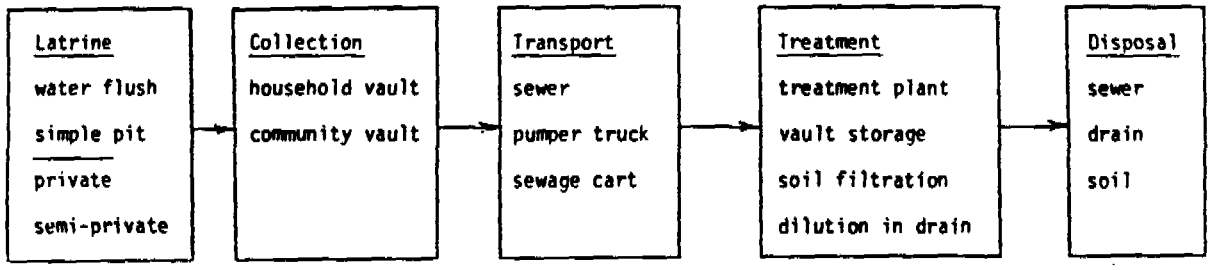

Figure 5. Wastewater and Excreta Disposal Options in Giza City, Egypt

concept of privacy, for example, may vary greatly from country to country, and even within countries. Many Ethiopian villagers do not like indoor latrines, preferring instead to defecate outdoors. Moreover, in Tropical Africa it is not uncommon for men and women to use separate latrines.

It is in comparing sanitation costs that the greatest differences can be found:

USA:

Construction = > $1000/cap

Operation = > $1.25/1000 gal

Third World:

Construction:

Urban sewerage = $150/cap (range: $80-$480/cap)

Urban other = $120/cap (range: $20-$345/cap)

Rural = $25/cap (range: $15-$70/cap)

The sanitation systems included in "urban other" are septic tanks and vaults connected to sewers. Rural sanitation systems include pit latrines and pour flush toilets.

Water and Sanitation Population Coverage: The Challenge for the Future

Although the International Drinking Water Supply and Sanitation Decade has brought about significant improvements in expanding services in the Third World, much still remains to be done. At mid-Decade (1985), WHO reported the following population coverage figures:

Water Supply:

	1980	1985
Urban	73%	75%
Rural	32%	42%
Sanitation		
Urban	40%	59%
Rural	13%	16%

These figures show that rural water supplies and urban sanitation have made the greatest improvements over the first five years of the Water Decade. Rather than suggesting complacency, however, these figures should serve to point out the enormity of the challenge still facing

water and sanitation engineers and all other development professionals. The challenge, while difficult, is not impossible. It is worth noting that in 1925 more than 80 percent of all U.S. cities over 100,000 population had no form of sewage treatment. Today, only three generations later, all American cities of this size process their sewage.

Returning to the original question posed at the start of this presentation -- "What is an appropriate level of water and sanitation technology in a developing country?" -- we now can try to formulate an answer. As you all are suggesting, there are many types and levels of technologies that may be appropriate in a given situation. One way to understand the question is to look carefully at what is often considered the long-term goal:

Long-Term Goal = To provide levels of service equal to those in industrialized countries

Unfortunately, this long-term goal is largely irrelevant because it is not achievable within our lifetimes and, more importantly, may not even be necessary for public health and economic progress. It is important to remember that the main problems of water and sanitation services in the Third World are not technological, but rather are institutional, political, educational, and attitudinal. Therefore, let us try to propose a more realistic immediate objective:

Immediate Objective = To provide an affordable and sustainable level of service that improves public health protection and adds to the quality of life of the consumers

The main idea here is to work for change and to make the change positive and permanent. Over time, small incremental changes will result in major developmental effects.

PROJECT DEVELOPMENT AND IMPLEMENTATION

DARYL ACKERMAN, P.E.
GANNETT FLEMING WATER RESOURCES ENGINEERS, INC.

Major water projects require a comprehensive plan to be most effective, and this is especially important in developing countries. A comprehensive approach to the water system development process achieves the most efficient use of materials, labor, and financial resources, but, more importantly, can result in effective projects which have a long service life and in an overall system which can be self-supporting. Although this is recognized by most international funding agencies and developing countries, it is still necessary to stress the need for planning and management of water supply projects to obtain the results desired of the comprehensive plan. The Antigua Water Project is an example of such a comprehensive project, and the development and implementation of this project is described below.

Project Identification

The need for financial assistance to improve the Antigua water system was identified by the U. S. Agency for International Development (USAID), which commissioned a pre-feasibility study to investigate the water system, identify the general scope and description of the improvement project, and estimate the required financing needs. The Antigua Water Project was funded by USAID, and Gannett Fleming was selected to develop and implement the project. The decision to assist Antigua was made at an important time, because many water system facilities were unserviceable and because a severe drought had struck the island.

Antigua Background

The Caribbean island of Antigua, located about 270 miles east-southeast of Puerto Rico, was discovered by Columbus in 1493, but the Spaniards found it too dry and it was settled by the English in 1632. Now an independent country, Antigua is a favorite destination of tourists, attracted by the sunshine, 365 beaches, and dry climate.

The Antigua water supply system provides water service throughout the island to about 80,000 persons, 30,000 of those through individual metered service connections and the remainder through unmetered public standpipes. The dry climate that attracts tourists causes water supply problems. The reliability of the water system was severely tested during a severe drought in 1983 and 1984. Surface water storage, including the 1.1 billion gallon Potworks Reservoir, was depleted by March 1984, and groundwater provided the only supply. Groundwater production, about 0.50 million imperial gallons per day (imgd), was inadequate to satisfy Antigua's water demands, which are normally about 1.50 imgd. At that time, water service in many areas depended on deliveries by tank trucks, which carried water imported by barge from nearby islands.

Quality of water supplied to the system was good, but all water treatment plants required immediate improvements and renovations. The water system is complex, with 11 surface water supplies, about 100 wells, 3 water treatment plants, 15 service levels, 26 raw and treated water pumping stations, and 22 distribution storage reservoirs, and many facilities had become disused or difficult to use. Water service was often interrupted due to source, transmission, and distribution facility deficiencies, as well as electric power outages. The annual 13 percent increase in the tourist economy, and related expansion of hotels, restaurants, and commercial establishments, resulted in increases in water facility needs and in water demands, and future increases to 8.0 imgd are anticipated.

Project Development

In March 1984, Gannett Fleming began a 3-year contract with the Antigua Public Utilities Authority to develop and implement the Antigua Water Project. The project, financed by USAID, was intended to provide both immediate and long-term water system improvements with several goals in mind: to upgrade water system facilities and management, to provide an adequate supply of safe and potable water to existing and future customers, and to establish a technically and financially viable water utility. To satisfy these goals, the project was intended to expand water production, increase transmission and storage capacity, improve water quality, establish a financially sound management structure, and generally establish planning, operation, and maintenance that satisfies future water needs.

The comprehensive project that was developed to satisfy these goals involved a wide range of consulting skills in several different fields. An immediate need was to procure equipment and materials to provide the basic inventory necessary for efficient operation; lack of equipment had hindered operations. Another immediate element was a groundwater program - the Authority needed the capability to drill new wells and maintain existing wells. New equipment and training were required to develop groundwater to reduce the source of supply shortage caused by the drought. Design of facility improvements was a major project element, and the initial months were spent gathering basic data to define the construction projects. Source of supply, water quality, and facility inventory data were incomplete and sometimes nonexistent, so recording and reporting procedures were needed. In addition, an overall system master plan was needed to insure the coordination of new facilities with existing facilities and to provide technology that was appropriate to Antigua. In the area of organization and management, an immediate need was to establish the Antigua Public Utilities Authority as the policy-making body for the water system in place of direct government ministry supervision, and to provide advisors to work with Antigua personnel to provide modifications to policies, procedures, and structure which would form a foundation for the long-term benefit of the system. The project also concentrated on institutional assistance, which required a variety of advisors in financial management, operation and maintenance, master planning, water quality, mapping and records, and training. After these project elements were identified and defined, detailed task assignments were prepared, personnel were assigned, and schedules were developed to implement the project.

Project Implementation

The areas of effort involved in the implementation of the Antigua Water Project fall into four general categories - management, operation and maintenance, capital improvements, and planning. Several examples show how the various task elements desired in the project interacted in each general category.

In the management area, the Authority's first detailed organization chart was developed to show desired lines of water system responsibility, authority, and accountability. The existing organization structure was first defined and then used as a basis for developing modifications which would make the Antiguan operation more effective, but not "Americanize" it. The structure reflected the existing personnel and relationships, but also allowed for desired changes, taking into account the types of people the Authority was likely to attract to new positions. Job descriptions and qualifications were prepared for each supervisory position, and additional persons were sought to fill newly defined positions.

Accounting systems were established to monitor and control inventories, finances, spare parts, labor and materials, and utility personnel were trained in the use and benefits of the systems. Some areas which are taken for granted in this country can be a source of problems, and proper accounting resolved these. For example, new customers were frequently connected and not metered and many customers were not billed for water service. A procedure was established to provide application forms for new customers, meters and setting materials, a work order system, crews to set the meters, and new billing accounts.

Operation and maintenance was reinforced and improved with an advisor in Antigua for 2-1/2 years, culminating in the preparation of an operation and maintenance manual which documented system operating procedures and maintenance requirements, many of which were developed and established during the project. The groundwater program provides an example of the interrelationship between tasks in operation and maintenance. In order to provide a sound basis for the ongoing groundwater program, project funds were used to procure a well drilling rig, a flatbed truck, two pickup trucks, two portable generator sets, an electric welder, an air compressor, well casings and screens, submersible pumps, meters and electrical equipment and controls. A master well driller and mechanic were provided to advise and train the well drilling and pump installation crews, but not to directly supervise them. Pumping tests were conducted and existing wells were rehabilitated to provide about 1.00 imgd, and 26 new wells were drilled to provide an additional 1.20 imgd. A program and procedures were established for utility personnel to prepare an inventory of the location, size, depth, and equipment needs at over 100 wells; to begin regular monitoring of well water levels and salinity; and to establish well casing elevations. Periodic formal training sessions reviewed the basic principles of well drilling and well construction, and these sessions were supplemented by field instruction and on-the-job training. The groundwater program also included hydrogeologic inventories and investigations to provide basic data on groundwater availability, with initial work by our hydrogeologists and later by a cooperative training effort with Antigua's new hydrogeologist, hired during the project.

Capital improvements consisted of renovations and new construction to increase the capacity, reliability, and efficiency of the water system operation. Almost an entire year was spent gathering basic data and confirming our understanding of the system operation. Programs were established for Authority personnel to record daily supply rates at all treatment plants and weekly supply from all wells, to monitor water quality, and to develop a basic inventory of water system facilities. A good understanding of system operation was important in order to coordinate improvements with existing facilities, especially since the existing system was so complex for its relatively small demand. Many existing facilities were constructed with little overall planning whenever funds were available, resulting in a large number of facilities and complex operation. The capital improvements in the Antigua Water Project were intended to simplify system operation and maintenance, and the initial months were spent defining the system needs that could be satisfied by construction work. The various project elements, operating considerations, design concepts, and construction procedures were developed in cooperation with Authority personnel and USAID and approved prior to final design. The final project, which was bid in several phases, consisted of a new water treatment plant, renovation of an intake and two water treatment plants, three centralized well field pumping and treatment facilities, a booster pumping station, two distribution storage reservoirs, and 4 miles of 16-inch pipeline, at a total construction cost of about $5,200,000. Fulltime construction inspection was provided for all project construction to insure that specifications were followed so that a long service life could be expected. Training continued as part of the capital improvements, because Authority personnel rehabilitated one water treatment plant assisted by one of our advisors, and because suppliers and our advisors provided training during installation and startup of equipment and facilities.

In the area of planning, one of the major elements was the preparation of a time-phased Master Plan for the future development of the water system to meet future water needs. Again, the initial months of the Master Plan preparation were spent developing programs for basic data collection by Authority personnel. In addition to gathering data previously discussed, we reviewed the system in detail with the operations superintendent to prepare an accurate and up-to-date water system map. At the same time, we assisted the Authority in defining record keeping needs and developing a drafting and records program, including defining staffing needs and procuring necessary equipment and supplies, so that water system records and mapping could become more detailed, accurate, and up-to-date. Information developed in the Master Plan was used in other parts of the project - to establish procurement needs, to direct groundwater efforts, to define water quality needs, and to define capital improvements and operating considerations. Operating procedures were established for conjunctive use of surface water and groundwater, using surface water when it's available and reserving groundwater use for dry periods. The time-phased improvement plan provided a comprehensive plan for facility improvements through the year 2020, including recommended immediate steps to take regarding site investigations and acquisition, consolidation of service levels and control gradients, and a continuation of institutional improvements. The Master Plan was developed in cooperation with Authority

personnel, which provided a source of training in water system planning for them, and was accepted as their plan of action.

The above examples show how the various engineering and institutional elements were intertwined throughout the phases of the Antigua Water Project. This planned interaction supported the comprehensive nature of the project and allowed the results to satisfy the identified needs.

Implementation Concerns

The successful outcome of a comprehensive project, especially in developing countries, requires attention and sensitivity to many areas that are understood to be part of the underlying framework of projects in more developed countries. These concerns relate to procurement, communications, organization and staffing, local input and awareness, policies and procedures, institutional change, and personnel motivation, for example. Procurement involves defining local needs and appropriate technology within any funding restrictions, and, most importantly, obtaining documentation of host country ability to pay suppliers, providing proper documentation and personal contacts to expedite processing and receipt of shipments, and arranging transportation and storage of delivered materials. Without this attention, suppliers would hold shipments and delivered goods would sit unattended on the dock.

Good communications and speed are critical to efficient decisions, especially when the suppliers and staff support are in the United States. For the Antigua project, telephone, air freight, and express mail were a necessity, and this meant renting office space that already had telephone service to avoid the several month wait for telephone installation. Efficient and effective communications were essential to coordinate this project and to discuss alternatives and needs with on-site and Authority personnel.

A good knowledge of host country organization and staffing is important to facilitate the project. Changes in the organizational hierarchy occurred, with different government ministers overseeing the water utility, and changing personalities in staff positions often meant review and reevaluation of project elements. Project delays were minimized by a good understanding of the personalities and the organization, and by our local associate who provided much of this knowledge.

A key to project success is local input, because the completed facilities, procedures, and programs must be self-supporting financially, organizationally and operationally. For example, careful consideration of local needs resulted in the remodeling of many structures for new uses and in the limited use of costly and complicated electronic controls. The remodeled structures saved project funds and provided a sense of constancy amidst the change, and the appropriate control technology reduced dependency on foreign suppliers and maintenance. The project concepts often provided for continued staffing of most facilities, because the opportunity for public employment, especially in a self-supporting water utility, is a desired national goal.

Policies and procedures are often formalized from existing actions or developed anew from the consultant's experience in similar situations. Early in the Antigua Project, procedures were developed within the utility and the government for acquiring rights-of-way, because Authority personnel acknowledged that lack of formal documentation in the past caused continuing problems for management and operating personnel.

Progress in completing capital projects is relatively easy for the consultant, because the procedures are familiar, but achieving changes in institutional and organizational areas is more difficult. Even though the utility and the consultant agree on the desired changes, it is difficult to overcome the existing inertia in order to proceed with and maintain change. Change must come from within the organization, and the consultant must patiently work with the system. Change occurs slowly, and it is important for funding agencies to plan on long-term funding, in operation and maintenance or other institutional areas, to establish the desired changes.

The long-term nature of institutional change also has an impact on the consultant's personnel. They are often frustrated by the seemingly endless stream of delays and problems, and they may begin to adapt to the local work environment rather than to continue to press for change. It is important for the consultant to provide motivation for on-site personnel, and rotation of personnel may be necessary to maintain satisfactory progress.

These concerns and others must be considered during the planning and implementation of a water supply project to insure that the results satisfy the established goals.

Conclusion

The Antigua Water Project resulted in completed facilities which satisfied immediate and long-term needs; improvements in water supply, quality, and service; a better-trained utility staff; improvements in organization and financial management; and a master plan to guide water system development in future years. The comprehensive approach used for project development and implementation was a major factor in achieving these results, which satisfied the original goals of the funding agency and Antigua.

AIDIS CONFERENCE, COLUMBIA UNIVERSITY, JAN. 14,1988

Sten H. Vermund, MD, MSc

Water-related infectious disease in developing countries

The complex subject of water and infectious diseases in developing countries is the story of dozens of infectious agents each in a given ecological venue. The transmission strategies of these infectious agents, tend to achieve an equilibrium consequent to the process of natural selection. An agent needs adequate host numbers, such that an excessively toxic or virulent agent is not likely to prosper over the millenia. These balanced equations include a substantial burden of human death and disease, of course. Disruption of historic equilibria may make the human disease burden even greater. Some of the world's grandest engineering projects have caused expansion of water-related parasitism, a preventable consequence of neglectful planning.

To put into perspective the relationship between water and infectious diseases, I will borrow the superbly organized schema of Professor D.J. Bradley first presented in a classic study of domestic water use in East Africa (White, Bradley, White, 1972), and further developed in Bradley, 1974, and Bradley, 1977. The schema groups all water-related illness into five transmission categories, as listed in the headings below. This brief presentation seeks to give current examples of water-related infectious diseases that are of particular interest to engineers working in tropical, developing countries.

1. Water-borne infections

The epidemic potential of cholera and typhoid largely relates to the ease with which they are harbored and transported in water. Dr. John Snow and the Broad Street Pump is a familiar story in which a mid-nineteenth century cholera epidemic in London stopped coincident with the removal of the implicated well's pump handle and with a local panic which led to most healthy residents leaving town! Unfortunately, little opportunity for either family relocation or use of alternate water sources exists in most of the rural Third World, such that poor conditions of water and sanitation may persist for many years. Water-borne infections can be eliminated only with substantially improved water quality. Protected water sources, filtration, and chlorination are the common means of improving quality, usually cost-effective only in larger towns. Rural environs can nonetheless achieve

substantial improvements in water quality with source protection and seeking of ground rather than surface waters. Elimination of fecal contamination of water and food stuffs is a challenge even in the more advanced developing nations. Chile, for example, has a comparatively low infant mortality rate in the mid 20's (Grant, 1987), yet has a persistently high typhoid fever rate in its capital city of Santiago.

Cholera is in its 7th historic pandemic, one far more extensive geographically in the jet age than any previous pandemic. Africa now seems to be endemic for cholera from which it was spared in pandemics which occurred before the age of rapid intercontinental transport. Little prospect for control of transmission of water-borne infections exists aside from provision of clean, safe drinking water.

A number of preventive strategies, main stays of UNICEF's "GOBI" program (Growth monitoring, Oral rehydration, therapy (ORT), Breast feeding, and Immunization) can alleviate the unhappy consequences of unclean water supplies even before provision of such supplies. In particular, breast feeding offers the infant and even the young toddler the prospect of a clean safe, nutritious fluid and food supply. We should make every effort to resist unethical infant formula marketing practices in parts of the world where the water supply is impure and where parents cannot afford to buy adequate amounts of powdered infant formula. ORT can be life-saving for the cholera victim or the infant with "weanling diarrhea." While clean water and breast feeding serve a primary preventive role by reducing infection, ORT nonetheless can save lives by secondary prevention, reducing harmful consequences once infection has occurred.

2. Water-washed infections

Water quality is desirable but, in some Third World circumstances, may be prohibitively expensive. Many salutary benefits emerge from provision of increased water <u>quantity</u> without improved microbiological quality. A number of skin and eye conditions are reduced merely with provision of sufficient water for personal hygiene. Trachoma is caused by <u>Chlamydia</u> in Third World countries. Misery and blindness are obviated where water supplies are adequate. Skin ulcers from scabies (a parasite mite), impetigo (from <u>Streptococcus</u>), or a host of tropical fungi reduce quality of life and may even lead to death from complications of sepsis.

Few of us appreciate that many diarrheal diseases, particularly the bacillary dysenteries, can be reduced by increased water quantity. This presumably eventuates from increased hand washing, ablution after defecation, washing of food-stuffs, and general personal hygiene.

3. Water-based diseases

The term water-based is meant to imply that disease can come from water which may be safe bacteriologically. Yet the water-based presence of invertebrates which are instrumental in the life cycles of several parasitic worms can make the water hazardous. Schistosomiasis, for example, is a disease from a worm living in a human's bladder wall or intestinal wall. Eggs shed in urine or feces hatch in water, penetrate a snail intermediary host, further develop, and emerge from the snail in a form able to penetrate human skin in contact with infected waters. As water developments expand, so do snail populations. The Gezira irrigation plan in the Sudan has been described in a collection of papers in a 1987 issue of Journal of Tropical Medicine and Hygiene. Irrigation led to expanding schistosomiasis, which was subsequently largely controlled with sound public health engineering principles.

Recent attention has been focussed on Guinea worm or dracunculiasis. With no non-human reservoir, guinea worm is theoretically eradicable from the face of the earth, like smallpox. The adult worm lives beneath the human skin, preferring the extremities. Upon water contact, the well-adapted worm bursts through the skin blister, releasing larvae which enter a tiny crustacean termed the cyclops. Maturation within the cyclops occurs and the larvae become infectious to humans who ingest the cyclops in their drinking water. A fine review of dracunculiasis is available from Hopkins (1983) which puts the disease in perspective as a debilitating scourge whose elimination is a desirable corollary of the International Water Decade. Former President Jimmy Carter and former Centers for Disease Control head William Foege have joined to make guinea worm eradication a major agenda item for the Carter Center at Emory University.

4. Water-related insect vectors of disease

Perhaps the worst consequence of a water engineering project would be to expand vector breeding sites. Malaria kills more children in Africa in 3 weeks than the AIDS epidemic has killed in the United States from 1979 through 1987. Well researched

knowledge of the breeding habits of a local Anopheline vector mosquito can help avoid expansion of breeding sites. If a road is built, borrow pits can be filled. If a dam is built, manipulation of water levels may be used as they were in the Tennessee Valley Authority schemes of the 1930s. Use of shade trees in some ecological circumstances or elimination of shade trees in other circumstances, may reduce breeding of selected vectors. Here, entomologic, epidemiologic, and engineering expertise must be married.

A second example is the ease of expanding the vector breeding capacity of the Simulium black fly whose larvae require well-oxygenated fast running water. This vector of the filarial worm Onchocerca spreads the notorious "river blindness" whose severe dermatitis and eventual ocular damage lead to the abandonment of some of West Africa's finest riverine agricultural zones. Now the focus of the World Bank/WHO sponsored Onchocerciasis Control Program, incidence is declining in West Africa. We must be highly motivated not to expand breeding opportunities for the black fly in our dam run-off sluices and in fast running streams. Ironically, a fast moving stream is less hospitable to many snail intermediate hosts for the Schistosoma spp, so that any engineering intervention focussed on irrigation or water supply may find complex competing risks.

5. Diseases of defective sanitation

A number of parasites can be controlled by proper fecal disposal, without improved water supply. Mature Hookworm larvae in warm, moist soils can penetrate human skin to continue their life cycles. Defecation by humans of hookworm eggs into the warm, moist soil then continues the cycle. In Loiza, Puerto Rico, I saw a nidus of transmission in which only the smallest children were defecating in a beach-side shower, while everyone else defecated properly in the nearly pit latrine. Hookworm, however, was being transmitted to all users of the beach-side shower merely from the feces of the young children deposited at the shower. Here, clean water was abundant and can even be considered have facilitated hookworm transmission. A fine reference is Feachem et al, 1981.

Evaluation of the impact of water and sanitation programs is a subject which time does not allow us to discuss, but a critical review by Blum and Feachem (1983) is listed in the bibliography.

A final note to this brief presentation on the challenging field of control of water and

sanitation-related disease is to remind us all how dependent control efforts are on proper financing, which in turn depends on a political will on the part of donor countries, as well as a desire to make efficient and honest use of funds in recipient nations. Smallpox eradication cost a total of about $250 million (Breman and Arita, 1980). Guinea worm eradication would cost only a fraction of a single $1.5 billion Trident Submarine. The annual budget of the New York City hospital where I work exceeds the annual national health budgets of the world's least developed nations, including Mozambique, Ethiopia, Bangladesh, Chad, Haiti, Vietnam, Burkina Faso, and others. War, too, takes its public health toll as we see in our own involvement in Nicaragua (Garfield, Frieden, Vermund, 1987). I urge you, in conclusion, to expand your own scientific background in the area of Tropical Public Health, especially infectious disease control. At the same time, I believe you should continue participating in the public debate. I personally welcome the day when a shift occurs in the United States' current role as a middle level donor, well behind the rate of "giving" of many European countries, to one with a more humanitarian and selfless orientation.

Thank you for inviting me to this topical and important AIDIS Conference here at Columbia University.

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WATER SUPPLY, SANITATION AND HYGIENE AS FACTORS OF HEALTH AND WELL-BEING

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(The presentation by Martin BEYER was based on this excerpt from the UNICEF Programme Guidelines for Water Supply and Sanitation.)

1.0 SCOPE

1.1 This summarizes the reasons why improvements in water supply, hygiene and environmental sanitation are important measures contributing to the goal of child survival and development that UNICEF is advocating and describes the context within which UNICEF co-operation is provided in this sector

2.0 EFFECTS OF WATER AND SANITATION ON CHILD HEALTH

2.1 Among all populations in the world, infants and young children are most vulnerable to sickness and death related to water, faeces and inadequate hygiene. In most developing countries, the majority of deaths among young children results from the vicious circle of disease, especially diarrhoea, and malnutrition. A major link in this chain of disease and death is poor environmental sanitation, including inadequate and unsafe water supplies, the lack of safe disposal of human wastes, unsafe household hygiene (including food handling practices), and lack of personal hygiene among children and adults.

2.2 Such conditions lead to infestations of a variety of intestinal parasites which further reduce the actual absorption of nutrients from the already meager food supplies and thus heighten malnutrition. Malnutrition among pregnant and nursing mothers – resulting inter alia from poor sanitation – reduces nutrients available to their babies. So does the heavy and wasteful expenditure of time and energy invested by women in drawing water from distant – and generally contaminated – sources.

2.3 Twelve major causes of illness and death from five categories of water-, faeces- and other environment-related diseases account for over 12 million deaths each year. A large proportion of these deaths are among children aged five years and under, and result from dehydration caused by diarrhoea (often complicated by pre-existing malnutrition)

2.4 In addition, nearly half of the population of the developing world suffers from worms and other parasites, some 500 million people suffer from trachoma (which often leads to blindness), and significant numbers have other forms of eye, ear, nose and skin infections all associated with poor personal hygiene.

2.5 In high rainfall areas, surface water may be easily available but polluted, and water may be scarce in the dry season. Thus the populations living there are also vulnerable to the diseases related to contaminated water and/or inadequate water supply.

2.6 It has been estimated that some 50% of all cases of water-related disease in East Africa could be prevented if water supply were "excellent". Note, however that, in addition to comprehensive improvements in water supply and sanitation facilities, carefully planned health education and genuine community mobilization are also required if the behaviour changes necessary to achieve significant reductions in disease are to be realized. Table 2/1,1 suggests a series of preventive strategies for each category of disease transmission.

2.7 Many other common, environmental-related diseases cause either high death rates and/or very long periods of serious disability along with economic and social hardships for entire populations over large areas. Many of these are transmitted by insect vectors. Included are: African sleeping sickness, river blindness and malaria (one of the most wide-spread of them all). Some of these diseases can partly or temporarily be contained through medication. For some there may be a future hope to develop vaccines. In some instances specific vector control measures are possible. In all cases, environmental health measures can contribute to reducing the prevalence and effects.

2.8 Each control method has its advantages and disadvantages with varying levels of effectiveness and efficiency. Such factors must all be taken into consideration when assessing health problems associated with water and sanitation, and in deciding upon appropriate control measures. Hand washing, improved food and water handling, and protection against insect vectors are essential elements for the prevention of diseases.

Table 2/1,1

Preventive strategies against the transmission of water-related diseases

Transmission mechanism	Preventive strategy
I Water-borne	Improve water quality. Prevent casual use of other unimproved sources.
II Water-washed	Improve water quantity. Improve water accessibility. Improve hygiene.
III Water-based	Decrease need for water contact. Control snail populations. Improve quality.
IV Water-related insect vectors	Improve surface water management. Destroy breeding sites of insects. Decrease need to visit breeding sites. Remove need for water storage in the home or improve design of storage vessels.

(Reproduced from "Evaluation for village water supply planning", Cairncross S. et al, John Wiley, 1981

Sanitation

2.9 Sanitation should not be treated just as an annex to water supply, nor should it be considered only in relation to water supply programmes. The tendency to do this results from the fact that many communities give priority to water supply because of its convenience, and for this reason it may well be necessary to begin with it. But objectively the disposal of excreta and household waste, and aspects of personal hygiene such as hand washing, are even more directly related to health status than is water supply. Not only is excreta a source of pollution of water, but it also contaminates food independently through flies and other insects, hands, poultry, pets, dust, etc. Crawlers tend to put bits of exposed household waste into their mouths. It is an important objective to bring communities to a realization of the dangers of contamination through faeces and waste matter, and to support measure to reduce it. Other services in addition to water supply should be used to promote this e.g. health, education, and development.

2.10 The contamination of food is responsible for a high proportion of cases of infant diarrhoea. Non-diarrhoeal food-borne diseases are also important, including botulism, tapeworm infections and tuberculosis. In addition, fish and plant-borne trematode infections are endemic and constitute serious public health problems in some areas.

2.11 Other environmental risks to the health of young children include the living facilities (housing, the climate, the state of the soil and vegetation, the occurrence of vectors and other external factors acting on the human body.

Measuring the health impact of water and sanitation improvements

2.12 Although intense research is going on in different parts of the world, using a number of different indicators, it remains difficult to assess the actual impact on health of improvements in water supplies and sanitation. This is due to the difficulty of separating out the effects of other influences. Uncertainty stems from incomplete knowledge of the epidemiology and etiology of the water-, dirt- and faeces-related diseases as well as a host of socio-economic factors.

2.13 One of the most recent overviews of such studies sums up the results of 67 studies from 28 countries:

> "The median reductions in diarrhoea morbidity rates are 22 percent from all studies and 27 percent from a few better-designed studies. All studies of impact on total mortality rates show a median reduction of 21 percent, while the few better-designed studies give a median reduction of 30 percent. Improvements in water quality have less of an impact than improvements in water availability or excreta disposal. More research is needed...."(*)

(*) S. A. Esrey, R. G. Feachem and J. M. Hughes: "Interventions for the control of diarrhoeal diseases among young children: Improving water supplies and excreta disposal facilities", Bulletin of the World Health Organization, vol.63, No.4, September 1985.

2.14 The International Centre for Diarrhoeal Disease Research (ICDDR,B), Bangladesh has made a number of studies in its Teknaf practice area. The impact of clean water and use of sanitary latrines can only be marginal for some categories of diarrhoea, which are transmitted person-to-person or by clothing or household objects (fomites). Neonatal mortality (during the first four weeks of life) is little affected because it depends mainly on the situation of the mother and the conditions of pregnancy and child birth. Post neonatal mortality (1 - 11 months) was substantially reduced, especially by the use of a latrine. Higher rates of diarrhoea were associated with open defecation by young children in the family's living area, lack of handwashing by mothers before preparing foods, and access to garbage by young children. (*)

Other (non-health) considerations

2.15 Direct protection against communicable diseases, disability and death are not the only justifications for improving water supplies. Vast amounts of time and human energy are wasted on carrying heavy loads of water over long distances. (**)

2.16 It is, traditionally, the lot of women and children (especially girls) to fetch water. Their bodies, already weakened from insufficient food, repeated infections and infestations, diarrhoea, or too frequent child-bearing, are further taxed by these tedious chores. (***) They are denied opportunities for more creative activities, for generating income, learning new crafts and attending school, as well as for necessary periods of rest. Child care is interrupted and nutrients

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(*) - Rahman, M. et al. "Impact of Environmental Sanitation and Crowding on Infant Mortality in Rural Bangladesh". The Lancet, July 6, 1985, p 28 - 30.

- ICDDR,B "Final Report of the Water and Sanitation Intervention Study: Teknaf, Bangladesh, 1980-83, June 1985, 93 p.

- Clemens, J.D. "An Educational Intervention for Assessing Water-Sanitation Behaviours to Reduce Childhood Diarrhoea in Urban Bangladesh: Application of the Case-Control Method for the Development of an Intervention", ICDDR,B 24 p.

(**) A recent World Bank study argues that these factors - largely the amount of time taken/wasted in collecting water - are in fact the principal economic justification for investing in water supply and sanitation improvement programmes. See section 3/3.

(***) For example, women often have to walk two to three hours or more each day to obtain water, burning up 600 calories or more per day: this may be a third of their nutritional intake! The energy consumed increases even more during pregnancies, resulting in low birth weights with consequent risks for the well-being of the baby.

which should go to nursing infants are used up. Babies are born with low birth-weights and are susceptible to upper-respiratory infections, diarrhoeas and other illnesses.

2.17 Likewise, the carrying by children, particularly small girls, of heavy loads of water (which is mostly contaminated anyway) can cause lasting deformations of their spinal column and pelvis. The long hours at these daily chores also limit many children's attendance at school.

2.18 In many communities, households have to buy water from vendors. Such direct economic costs can absorb up to 30% of total household cash income. Measures which improve the availability of water, reduce its unit cost and (hopefully) improve its quality can therefore be of very direct benefit to the consumers.

2.19 Women are thus often the most interested and ready to participate in community water supply improvement schemes, given the incentive and the opportunity to do so.

3.0 WATER REQUIREMENTS

3.1 Drinking and cooking are priority uses for water, after which come needs for hygiene - washing hands, bodies, food, utensils, clothing, etc. Forty (40) litres/day/person is usually taken as the optimal planning level for rural household water supply. However many countries have to begin with an intermediate planning level of 20 l/day/person. Even if groundwater is available for the higher figure, it requires more wells and pumps. One pump for 150 people @ 40 l has to raise 6,000 l, requiring some six hours of continuous work. At the other extreme, if 500 people (100 families) depend on one pump, it will have to be used for 10 hours to provide even 20 l/person (500 x 20 l = 10,000 l). If water seal (pour flush) latrines are being introduced, they will need 4 - 5 litres/day/person in addition to the 20 litre level (Section 3/5). Table 2/1,2 shows some typical rates of water usage and requirements. Reference Note R8 deals with water quality.

3.2 Most populations have, in fact, developed/adopted life-styles which reflect the normal availability of water in their environment. It has been noted that:

> "Populations with less than 10 litres per capita per day tend to reserve most if not all water for drinking and cooking. Over that level, however, more water may be available for breaking the faecal-oral cycle and controlling skin and eye infections." (*)

(*) Isely, R., "Low cost water supply and sanitation technologies: community participation and health and socio-economic outcomes - an analysis of interrelationships", issued by WET/UNICEF, New York, 1985.

Table 2/1,2

Typical water usage and requirements

Typical domestic water usage

Type of Water Supply	Typical Water Consumption (litres/capita/day)	Range (litres/capita/day)
Communal water point (e.g. village well, public standpost)		
- at considerable distance (> 1000 m)	7	5 - 10
- at medium distance (500 - 1000 m)	12	10 - 15
Village well		
walking distance < 250 m	20	15 - 25
Communal standpipe		
walking distance < 250 m	30	20 - 50
Yard connection		
(tap placed in house-yard)	40	20 - 80
House connection		
- single tap	50	30 - 60
- multiple tap	150	70 - 250

Various water requirements

Category	Typical Water Use
- Schools	
. Day Schools	15 - 30 l/day per pupil
. Boarding Schools	90 - 140 l/day per pupil
- Hospitals	
(with laundry facilities)	220 - 300 l/day per bed
- Hostels	80 - 120 l/day per resident
- Restaurants	65 - 90 l/day per seat
- Mosques	25 - 40 l/day per visitor
- Cinema Houses	10 - 15 l/day per seat
- Offices	25 - 40 l/day per person
- Railway and Bus Stations	15 - 20 l/day per user
- Livestock	
. Cattle	25 - 35 l/day per head
. Horses and Mules	20 - 25 l/day per head
. Sheep	15 - 25 l/day per head
. Pigs	10 - 15 l/day per head
- Poultry	
. Chickens	15 - 25 l/day per 100

(Reproduced from "Hydraulic Rams - the state of the art: Tanzania" Schiller E. (ed), IDRC Ottawa, 1985)

4.0 INTERRELATION WITH ECONOMIC DEVELOPMENT ACTIVITIES

4.1 Inadequate water supply and sanitation result in a weakened labour force and reductions in intellectual capacity and personal drive, hence significant economic costs to both individual households and the society.

4.2 When water supplies are inadequate for domestic uses, supplies are often also lacking for irrigation, food processing and the rearing of livestock. It has often been found that some of the increased quantities of water made available through water supply improvement schemes are in fact used for such "other" purposes, to which the community attach high priority.

4.3 Planning for water supply in any community must take account of the total water requirements and the broader uses which can – and will – be made of the facilities. Benefits for food production, nutrition and the family economy should be envisaged and may be explicitly promoted. For example, wherever there are surplus quantities of water available from water points, watering small plots of land for family food gardening can be considered, the main constraint on size being the work required to raise the water. (UNICEF experiences from Chiapas in Mexico, Nepal, Senegal, Mauritania, etc.)

4.4 Similarly for sanitation, many societies traditionally conserve valuable human wastes through composting and aquaculture and have introduced bio-gas production, rather than simply disposing of human, animal and vegetable wastes. Such possibilities should be promoted, to the extent possible and appropriate, in any sanitation improvement programme. This has, however, proved to be difficult in many countries on account of taboos related to the handling of excreta.

4.5 In addition, water supply improvements are very tangible and, when well organized, may represent the first occasion when a community has been truly mobilized to co-operative action. In such cases, the programme sets a valuable precedent and can indeed serve as a "leading edge" for further community-based social and economic development. A well-prepared water programme provides experience in the key elements of community participation: community discussion and decision making, participation in planning, contribution of labour and local resources for construction, arrangements for protecting the installation from pollution, community responsibility for maintenance. Women would be involved because they are specially concerned, and they may be responsible for maintenance. Clean water helps to prevent diarrhoea, and is therefore related to ORT. Making possible better personal and household, food hygiene and clothes washing can strengthen interest in latrines and in cleaning up the village. Waste water may be used for gardens. Primary health care may be presented for community support as bringing similarly tangible benefits, especially if it makes accessible some basic essential drugs. Countries where water and sanitation, used as an entry point to mobilize communities initially around a felt need, has led on to other programmes, include Benin, Chad, Egypt, Liberia, Kenya, Laos and Sudan.

WOMEN, WATER AND SANITATION

Notes for presentation at AIDIS Symposium
Columbia University, 14 January 1988
by Siri Melchior
Programme Manager, PROWWESS/UNDP

I have been instructed to be inspirational - this may be difficult, but let me at least try to be a little provocative.

Some Depressing Facts

Billions of dollars, tens of billions, soon hundreds of billions, have been spent on water and sanitation services in developing countries, particularly during the International Water/Sanitation Decade. Yet, unidentified sources claim that, if you took an aerial photograph of the world's handpumps, only 20% would be functioning at any one time. This is difficult to prove or disprove. However, organizations such as WHO and OECD have figures of around 50% breakdown of handpumps after three years. With few exceptions, estimates I have seen for individual projects show figures of that order of magnitude: latrines not used, pumps broken, more than half the time. Why? Reasons include: hardware which is inappropriate to the villagers' needs, difficult to maintain, or which the Government thinks the villagers are supposed to maintain, and the villagers think the Government will maintain.

One statistic one sees repeated everywhere, even in the pamphlet announcing this symposium, is that 80% of disease in the Developing World is caused by impure water and poor hygiene. Yet the health impact of improved services at this point remains controversial, with some international assistance organizations going to the point of cutting funding for water/sanitation, at least in part because health improvements cannot be demonstrated. In-depth country reports seem to indicate that a major reason for this is that even if you have tap water in houses, unhygienic handling of water, between tap and mouth may pollute the water. Why? Little notion of principles of hygiene is one major reason.

Great strides have been made in developing and accepting low-cost technologies (e.g. handpumps) with the unheard of result that estimates for the cost of providing water and sanitation are actually decreasing as the Decade progresses: From an estimate of 600 billion US dollars at the beginning of the Decade, to 300, or even 150 billion, if you count on massive community inputs, in kind and in labour. However, even these reduced estimates are higher than available funding. What is the result? Many are beginning to think communities must be responsible for more of the costs, both of maintenance and startup costs, since outside funding is not enough.

The Reaction

The mainstream of the international community assisting water/sanitation projects has been ruminating on the above facts. As a result there has been what by all accounts is a radical change in thinking, within the last few years: a realization that a technical solution is not enough, and that at least part of the solution, so as to avoid indefensible waste of resources, is to encourage the software aspects, and in particular community participation, and health education. This shift in thinking, incidentally, is not unique to the water/sanitation sector, and in fact may be just the latest example of the realization that community participation is critical, if projects are to emphasize sustainability, not just installation of hardware.

What is Community Participation?

"Participation" (why not "partnership"?) means that communities take both some of the responsibilities (contributing cash, labour, materials and ideas) and decisions (where, when, what they want, even whether they want it). "Community" - the community means those who will ultimately benefit from the project, and who can therefore be expected to be most knowledgeable and committed. Most likely, that is not only the local leaders. Communities usually are not homogeneous, with everyone thinking and doing alike. The community may consist of men/women, adults/children, rich/poor, Hindu/Muslim people, each having different resources, attitudes, vested interests, problems. In water/sanitation, it happens that it is women, and to an extent children, who are the ones usually most affected. As some engineers I know say: "This is a woman's sector". Women are the ones who use the water, they are the ones responsible for household hygiene. In other words, community participation is not community participation without women. Yet, even when project planners try to "involve" women, they will complain: "We held a meeting, but the women did not come." That is, methodologies for obtaining women's participation are not well known.

Rather than trying to prove to you the importance of women within community participation with horror stories of what happens if you do not involve them, let me give you some success stories - what can happen if you do involve them. I will talk to you in the hope that you agree with another engineer I know and frequently quote, who says: "I want to have women's participation, not because I love them, but because otherwise my projects do not work.

PROWWESS to the Rescue

I shall talk of our experiences with PROWWESS, not because we are the only ones doing something in this field, but because this is what I know best.[1]

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[1] There are other organizations with expertise in this field; as an example, I could mention INSTRAW (International Training Institute for the Advancement of Women) which has developed a training package for policy makers and voluntary organizations on this whole issue.

PROWWESS (Promotion of the Role of Women in Water and Environmental Sanitation Services) is a programme of the United Nations Development Programme, funded by Norway, Canada, Finland, USA and UNDP. It was started in 1983 and is headquartered in New York. It currently has eleven ongoing field projects, which demonstrate how one can involve women in water/sanitation projects, and the value this has for the water/sanitation projects.

We provide:

- funding for country projects (usually in tandem with a "hardware" project;

- advisory services (particularly training in participatory methods, social research methodologies) either from our own staff or from a roster of consultants;

- documentation (both on country specific experience, as well as general, such as methodologies for participatory training, participatory data collection, etc.)

Our approach:

- Usually link up with a hardware project, act as a link between it and the community, frequently by teaming up with local grassroots non-governmental organizations or local sociologists who often have their own methodology;

- Enhance the local methodology with experiences and methodology from other countries; how to involve the community women in needs, planning, implementation, evaluation and documentation;

- Choose projects which demonstrate a high likelihood of being sustainable, replicable and documentable (and they do).

Countries with full ongoing field projects:

Bangladesh	Egypt	Kenya
India	Sudan	Zimbabwe
Indonesia		Lesotho
Sri Lanka		
Thailand		

Nine more are being developed, and others have received partial assistance, e.g. help for evaluation, or for project development.

Let me give just two examples.

Lesotho - here we are working within a World Bank executed rural sanitation project, which is funded by UNDP. It is a pilot project, which

is expected to develop an approach, with local people themselves constructing and paying for their latrines. PROWWESS pays for and backstops various "software" components: a health education adviser (who happens to be a man), a women's liaison officer and training activities and materials. We have helped conduct many of the activities, particularly training. Since PROWWESS involvement started in April 1986, what are the results? According to the project manager, one of the best results is that, by training together extension workers and officials at higher levels from different ministries (Agriculture, Health, etc.), a much more participatory approach to the villagers has been adopted (although not yet fully assimilated - old didactic approaches die hard). Furthermore, the fact that we train a heterogeneous group actually has given a team approach, rather than the vertical and dissociated approach that plagues so many development projects.

Since many men migrate to work in mines, many households de facto are headed by women. Yet, here as elsewhere, women did not usually participate actively in the traditional village meetings, called Pitsos. In fact, villagers would previously often come to the meeting expecting little of interest to appear, and therefore they would use it as a social occasion where they could drink beer. However, by discussing the matter beforehand with villagers, by bringing up sanitation project decisions at the pitsos, and by creating small working groups where women could speak out, the meetings are now too interesting for villagers to use them only for social purposes, and outcome is used for the project management.

You may think this is "process" oriented talk, rather than hard facts, and indeed it is - our approach is that when you talk of human resources development, you also talk of human resources at the village level, and when you talk of institution building, you should also talk of institution building, and management at local level - a village is an institution.

However, we also have other data which may seem more concrete to you - the project has overshot its targets in terms of building of latrines, and, I repeat, they are built and paid for by the villagers. Incidentally, many of the construction teams are composed of women - they are found to charge lower prices, and they don't disappear to go to the mines when business slows down.

Furthermore, the project approach has been accepted as the national one, and UNDP has taken over funding of the software component as part of its mainstream funding.

We are presently looking at ways of evaluating the project. Significantly, the original plan was to count the number of latrines, and whether they were being swept. We would like to add such items ("soft" but measurable) as health knowledge and attitudes, effectiveness of the enhanced Pitsos in dealing with problems, and villagers' views of the latrines (e.g. since they originally stated they would see an advantage in

having latrines that did not smell, do they actually feel the latrines installed are aesthetically pleasing?)

Kenya - together with other donors such as UNIFEM (UN Voluntary Fund for Women) and PACT (Private Agencies Collaborating Together), PROWWESS has funded a local non-governmental organization, called KWAHO (Kenya Water and Health Organization) working together with the IBRD/UNDP Handpump Testing Programme and SIDA (Swedish International Development Authority), which is funding installation of water points, at this point for a population of around 25,000 in the Kwale District. IBRD/SIDA orignally asked for the assistance of KWAHO to improve sustainability, and also because they realized the villagers were highly sceptical of the new project, as they had already seen other water projects in their villages which left them worse off than before - wells cemented over so they could not reach the water when pumps broke down. KWAHO facilitated the creation of village water committees, which although frequently headed by a man, must include women, who are usually also chosen as treasurers. Water minders are chosen by the committees, and these are always women. Thanks to the wonderful lightweight and easily-maintained new pumps (Afridev), these water-minders are able to operate and maintain the pumps. For all the approximately 100 water points constructed so far, maintenance funds have been collected ($100-800 per village of approximately 300 people) and in about 50 per cent of the cases, bank accounts have been established, which the women, although illiterate, administer. Only communities which collectively agree to those conditions actually participate, and in October 1987 they took charge of the pumps, at an official ceremony. A major spin-off of the project has been the development of many income-generating activities, in some cases with village committees incorporating as NGOs. We still have to see what happens over the long term, but we feel at least the structures are in place. Again, institution building at the local level has taken place.

Selection of Lessons Learned from PROWWESS Projects

- It is essential that women not be addressed in isolation - the men of the community must be accorded their role. If this is acknowledged, the men will be very supportive of women involvement, contrary to the belief of some.

- A major obstacle to the involvement of women is that they are overworked and have little money. Many projects rely on essentially volunteer work by women. While women are often willing to provide this, and even to pay for services, income-generating activities are a necessary adjunct to most projects, preferably developed in parallel rather than subsequent to, water/sanitation projects. Introduction of appropriate labour-saving technology is equally desirable.

- One major methodology to achieve participation is to train extension workers in participatory techniques. Such training should be repeated - a one-time session is not enough to overcome deep-seated didactic methods.

- A key to success is support and understanding at management policy level of this participatory process - a willingness to recognize and rely on "software" expertise, to appropriate budget and other support for it, and to allow the "hardware" work plan to be influenced by the software.

- If there are "hand-out" projects and "participatory" projects working in the same area, problems of equity may arise, as in the short term, communities may prefer the hand-outs.

- In all PROWWESS field action projects, there is some component of cost recovery, mostly for maintenance, but also for capital costs. In all projects (where we are far enough along), there are significant signs that the methodologies used are being replicated and applied elsewhere, e.g. a pilot project methodology being adopted nationally.

- Each project is different from others, yet "echoes" can be perceived. The factor which seems to predispose projects to success is : true participation (from beginning to end, both on decisions and responsibilities. Partial, half-hearted participation only leads people to turn away from this approach. The community should preferably be able to choose whether it wishes to participate, and choose its own community contact person and local committee.

- The expertise to develop community/women's participation exists, in most areas. Local NGO's, local sociologists or health workers, are good candidates. One of the major skills such NGOs, or village committees, need is managerial skills, including in particular financial management, book-keeping (at the very simple level of the village collection of dues) and skills in overcoming conflicts (misuse of funds etc.)

- Methodology to prove the results is more difficult to come by ("hard" data on "soft" developments) but is being developed, as a priority for PROWWESS.

What Everyone Should Do

At the beginning of the Decade in 1980, community participation was indeed mentioned. Women were also mentioned: due attention should be given to the role of women. However, that was as specific as it got in the Mar del Plata Action Plan. As I mentioned earlier, there is a revolution going on in this thinking, and at least the intellectual vanguard has changed dramatically in the past few years. Certainly, recent policy instruments go a great deal farther than the original

plans. The October 1987 meeting in Interlaken of major donors recommended for all community water/sanitation projects:

- Objectives of projects should go beyond mere installation of hardware, to more social and behavioural issues.

- Project documents should specify:

  - a budget for women/community participation activities and for hygiene education
  - what expertise should be used (and it was noted that much expertise does exist, for example in the form of NGOs)
  - what plan and methodology will be used.

Let me give a few examples to demonstrate what I mean. I draw on my experience, seeing numerous project documents for funding or implementation by the group of UN agencies involved in water/sanitation.

A document may mention the problem of maintenance: Only 50% of handpumps installed still are estimated to be functioning in a given country. The project document proposes to overcome this problem in the future, by promoting community participation (women not mentioned). However, this is just mentioned once or twice, with no details given, whereas the work plan, budget and expertise for the hardware (e.g. seven engineers) are described fully.

In another example, a project has been ongoing for three years and different types of hardware have been developed and chosen. In the next phase, 25% cost (cash) contribution from villagers is foreseen. To achieve this, project management will rely on introducing a "software" component. This would be a tall order, even if the software had been developed and tested during the first phase.

My point is: good hardware is a sine qua non. The development of easily maintained, locally produced, efficient pumps is essential, and is being done. However, development of community/women participation is also a sine qua non. There is no reason to believe it requires less expertise, time, or even funding for that matter, than the development of hardware. Yet in the past there has been little interaction between "hardware" and "software" expertise. I urge you to try to break this barrier down. But choose your software people as carefully as you would select your hardware people - experts do exist and you do not have to rely on an anthropologist straight out of university.

Finally, I recognize as a problem that impossible demands all of a sudden are placed on "software", as if by adding software as an after thought, one could guarantee maintenance or cost recovery. This is probably unrealistic. On the other hand, if accountability in projects were to go beyond installation, to sustainability, then these aspects should become an integral, expected part of the programme, and could then lead to the hoped-for results.

INTERNATIONAL TRAINING NETWORK

Wilfrido Barriero *

The International Training Network for Water and Waste Management is a joint initiative of bilateral and multilateral development agencies in support of the goals of the International Drinking Water Supply and Sanitation Decade. Its principal objective is to promote needed improvements in both the effectiveness of water supply and sanitation investments and the extension of service coverage, particularly to low-income population groups in the urban fringe and rural areas of developing countries. For a majority of the estimated 1.9 billion people who lack adequate service, conventional piped water supply systems and water-borne sewerage are not affordable in the foreseeable future. Thus, more investments must be directed toward the use of lower cost technologies that are cost-effective and affordable, easily maintainable, and culturally acceptable to this user population.

The Network, established in late 1984, will have Centers hosted various institutions in developing countries, reflecting the broad spectrum of issues and the multidisciplinary approaches to planning the use of low-cost technologies. Each Center will plan and carry out education, training, research and information dissemination activities on low-cost appropriate water supply and sanitation techniques. It is envisaged that the existing education and training programs of institutions who participate with the Network will be strengthen with an increase focus on appropiate low cost technologies, concepts and approaches.

The activities of Network Centers will involve decision-makers, program planners, practicing and student engineers, consultants, and field staff working at the community level. The main tasks of a Center will be:

(a) to inform decision-makers, and educate and train participating student engineers and other field staff, about low-cost appropriate technologies and approaches;

(b) to promote the introduction of a multi-disciplinary approach emphasizing sociocultural and health considerations, in the planning, implementation, and maintenance of water supply and sanitation systems;

(c) to support the collection and active dissemination of information on low-cost technologies and their successful applications; and

(d) to undertake research leading to further improvements in the cost-effectiveness, large-scale implementation, and replications of basic water supply and sanitation

* Chief, International Training Network for Water and Waste Management, The World Bank, 1818 H Street, N.W., Washington, D.C. 20433.

programs.

The Network was launched with an ambitious objective of ultimately establishing 15 Centers. Thus far, the Network has established five Network Centers--the African Medical Research Foundation in Kenya (AMREF), Cipta Karya and the Bandung Institute of Technology in Indonesia, and the All-India Institute of Hygiene and Public Health and Anna University in India--and has reached an advanced preparation stage in proposals for five others. These and others to be established will become focal points for teaching/training/research in water supply and sanitation.

The Network has also designed workshops for instructors from Network Centers and cooperating institutions on the teaching of low-cost appropriate water supply and sanitation. These workshops are aimed at building capacity within the Network Centers to design and implement various types of instructional programs utilizing the information and training materials disseminated by the Network. In addition, training courses, workshops and seminars have been conducted in developed countries such as United Kingdom, Canada, and Switzerland, for consulting firms as well as different levels of staff working the sector.

During the past years, the Network, which is acompant of the UNDP/World Bank Decade Program, and other bilateral and multilateral agencies, have prepared a comprehensive set of materials for the education and training of selected audiences about the purpose and potential benefits from the application of low-cost technologies, concepts and approaches. These materials incorporate the results of research and development and field experience of the World Bank, United Nations Children's Fund (UNICEF), and other agencies on the use of low-cost water supply and sanitation technologies and approaches. They consist of forty-five (45) slide-sound shows with instructor's and participants' notes, three (3) films, various technical handbooks on project preparation, and other selected publications. The materials are intended for various audiences such as decision-makers, practicing and student engineers, professionals in health, urban infrastructure planning and related fields, and for field personnel, community workers, and Network Center staff. The English version of the materials has been produced and is now available for distribution. The French version is in its advanced stage of production and will be available in spring 1988. The materials have been translated into Spanish and are in the preliminary stage of production. The Spanish version will be available before year-end 1988. Plans are underway to produce versions in Chinese, Bahasa Indonesia, and Portuguese.

The responsibility of providing management and technical support for the Network rests with the Water and Sanitation Division at the World Bank's Infrastructure and Urban Development Department. The Division is responsible for: identifying Network Centers and providing technical assistance to governments and donors in preparing

proposals and detailed work program; providing technical and managerial assistance to Network Centers; preparing additional training modules; organizing trainers workshops and courses; monitoring progress of Network Centers; and supervising production of training materials for dissemination.

For more information about the Network or the training materials, contact the Coordinator, International Training Network, Water and Sanitation Division, Infrastructure and Urban Development Department, 1818 H St., NW, Washington, DC 20433.

INTER-AMERICAN ASSOCIATION OF SANITARY ENGINEERING
AND ENVIRONMENTAL SCIENCES

REGIONAL SYMPOSIUM:

- Water Supply and Sanitation in Developing Countries -

January 14, 1988 at Columbia University

0 - 11:00 **REGISTRATION**

0 - 10:30 **OPENING PLENARY SESSION** Room 1501

Moderator: E. Fano, Chief of Water Resources,
U.N. Department of Technical
Co-operation for Development

. Welcoming Remarks	Howard Apsan, Associate Professor, School of International and Public Affairs, Columbia University
. Background and Objectives of the Symposium	T. Thompson, Regional Director, AIDIS
. Role of International Organizations in Water Supply and Sanitation	F. Hartvelt, Sr. Programme Officer, United Nations Development Program
. Role of the Professional Community	M. Lang, Senior Consultant, Camp Dresser & McKee

0:30 - 11:00 **BREAK**

. Coffee

. Informational Displays

11:00 - 12:30 **CONCURRENT SESSIONS**

TECHNOLOGY AND ENGINEERING Room 1501

Moderator: G. Kupchik, Professor Emeritus, Hunter College

FILM: Water Supply and Sanitation: Problems and Solutions — World Bank

. Alternative Technologies — D. Warner, Deputy Project Director, WASH Project

. Project Development and Implementation — D. Ackerman, Project Manager, Gannet Fleming Water Resources Engineers, Inc.

PUBLIC HEALTH Room 1512

Moderator: V. Coluccio, Chief of Water Quality Planning, NYC Bureau of Water Supply

FILM: Prescription for Health — International Development Research Center (Ottawa)

. Waterborne Disease — S. Vermund, M.D., Department of Epidemiology and Social Medicine, Albert Einstein College of Medicine

. Improved Water Supply and Sanitation — M. Beyer, Sr. Policy Specialist, UNICEF

HUMAN RESOURCES

Moderator: C. Williams Thompson, Women's Health Specialist, Room 1510

FILM: Water Supply and Sanitation: Solutions and People — World Bank

. Community Participation and the Role of Women — S. Melchior, Programme Director of PROWWESS Project

. International Training Network — W. Barreiro, Project Officer, World Bank

12:30 - 2:00 **LUNCHEON** - DAG HAMMERSKJOLD CENTER, 6th Floor

Moderator: A. Machlin

. Lunch

. Remarks by Charles Morse, President AIDIS-USA

. Address by Dr. Abel Wolman
Professor Emeritus,
The Johns Hopkins University

2:00 - 3:30 **REPEAT CONCURRENT SESSIONS**

TECHNOLOGY AND ENGINEERING Room 1501

Moderator: S. Shaw, Environmental Engineer, USEPA

PUBLIC HEALTH Room 1512

Moderator: G. Sewell, Clinical Professor, Division of Environmental Sciences, School of Public Health, Columbia University

HUMAN RESOURCES Room 1510

Moderator: M. Brewster, Economic Affairs Officer, UN Department of Technical Co-operation for Development

3:30 - 4:00 **BREAK**

. Refreshments

. Informational Displays

4:00 - 5:00 **CLOSING PLENARY SESSION**

Moderator: M. Beyer, UNICEF

. Roundtable Discussion on Opportunities for Cooperation	Panelists: T. Thompson, AIDIS M. Lang, Camp Dresser & McKee J. Jeris, Manhattan College F. Hartvelt, United Nations Development Programme W. Barreiro, World Bank G. Davila, Pan American Health Organization
. Closing Remarks	A. Rosenfield, M.D., Dean, Public Health, Columbia University

5:00 - 6:00 **SOCIAL HOUR** - 15TH Floor

. Wine and Cheese Reception

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