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# TOWARD AN ASIA BUREAU WATER AND SANITATION POLICY STATEMENT

## WASH WORKING PAPER NO. 6

### SEPTEMBER 1981

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**WATER AND SANITATION  
HEALTH PROJECT**

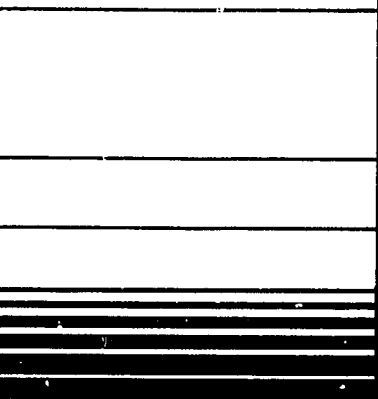


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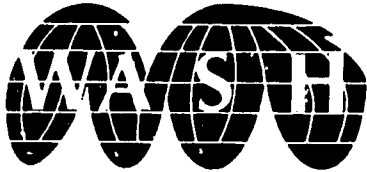


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Prepared For:  
**the Office of Health, Population and Nutrition**  
**of the Asia Bureau**  
**Agency for International Development**  
**under C - Task No. 98**

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FOR HEALTH PROJECT**



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October 5, 1981

Dr. George Curlin  
ASIA/TR  
Room 606, SA-18  
AID

Dear Dr. Curlin:

I am pleased to submit fifteen copies of the paper produced by Mr. James Thomson as a contribution to a water and sanitation policy in the Asia Bureau. This paper has been distributed as background to the participants in the upcoming conference in Chiang Mai and will be the basis for essentially all Dr. Isely will have to say in his opening talk.

Let me thank you for your help in preparing it and that of your entire staff. I hope we can be of further help as this matter evolves.

Sincerely yours,

Dennis B. Warner, Ph.D., P.E.  
Director  
WASH Project

DBW/RS  
Enclosures

cc: Mr. Victor W.R. Wehman, Jr.  
S&T/HEA

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AND  
SANITATION POLICY STATEMENT

Prepared for the Office of Health, Population  
and Nutrition of the Asia Bureau  
Agency for International Development  
under C-Task No. 98

Prepared by:

James F. Thomson

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## PREFACE

This paper has been prepared by WASH as a discussion piece, one that will hopefully lead to the formulation of a water and sanitation policy statement by the Asia Bureau. It is in no way that policy statement itself. The discussion and controversy emanating from the issues raised may result in a more nearly formed notion of policy. At present, only tentative thrusts can be made.

The author of this effort, Mr. James F. Thomson, worked long and hard under a short deadline. He is to be congratulated on the quality of his product. Others provided support, encouragement, and contributions that were indispensable. They include Asia Bureau staff, George Curlin, Donald McCorquedale, Howard Keller and Hal Rice; Office of Health personnel Gene McJunkin and Victor Wehman; and WASH staff Dennis Warner, Ray Isely, and John Tomaro. The total effort was therefore by a team and the resulting text a consensus.

## CONCLUSIONS

Evidence for the following conclusions is reviewed in later sections.

1. Despite a significant body of negative studies and failed projects, there is enough positive in the history of water and sanitation programs to warrant accentuating the positive roles of water and sanitation in primary health care.
2. Improved water supply and sanitation are basic human needs for millions of people, particularly the rural and urban-fringe poor, who live in conditions which are well below even modest standards of water quality, quantity and accessibility and of sanitary excreta disposal.
3. Greater quantities of safe water, improved excreta disposal and better habits of personal and household hygiene can reduce the prevalence of diarrheal diseases of fecal origin in most of the conditions which prevail in the developing world.
4. Improved water supply and sanitation are not likely to eliminate diarrheal diseases; equally, diarrheal diseases are not likely to diminish substantially without improvements in water supply and sanitation.
5. Existing technology is adequate to meet virtually all needs for improvements.
6. Complementary inputs of user education and community involvement are essential to achieve full benefit of technology.
7. The dismal record of health education in relation to primary health care programs is best explained not by any deficiency in underlying assumptions about the role of human behavior in health and disease, but by striking deficiencies in the methods applied and the commitment of appropriate resources by governments.
8. The implementation of water supply and sanitation projects in conjunction with primary health care programs offers an excellent opportunity to incorporate the complementary inputs necessary for successful water supply and sanitation projects.
9. Water supply and sanitation activities provide a very good focal point for the development of community-level primary health care.

10. Although there is no body of experience which fully addresses the complex quantitative relationships between the costs and benefits of improved water supply and sanitation, there is sufficient qualitative evidence to suggest that substantial benefits can be achieved through well-conceived projects.
11. Despite the apparent simplicity of conceptual relationships between improved water supply and sanitation and reductions in fecally transmitted diseases, these relationships are exceedingly complex and can be measured only through tedious study. Studies of the past have been difficult to design and execute and as a result, to interpret; studies of the future will fare no better.
12. The current Asia Bureau health strategy should reflect the expressed needs of the developing countries for improved water supply and sanitation, and should be consistent with Agency policy in support of the U.S. commitment to the International Drinking Water and Sanitation Decade.

## RECOMMENDATIONS

1. The Asia Bureau should amend its health strategy to include promotion and support for water supply and sanitation activities as a disease prevention measure.
2. The Asia Bureau should promote and support projects which:
  - a) reflect a strong host country commitment,
  - b) strengthen host country institutions,
  - c) closely link water supply and sanitation to primary health care development,
  - d) insure appropriate use of technology and adequate provision for operation and maintenance, and
  - e) are based on full community participation.



## AGENCY POLICY AND STRATEGY

United States support for health programs in the developing countries stems from its commitment to help meet basic human needs and establish a greater degree of social equity among the poorer populations, particularly the poor of rural and peri-urban areas.

The development assistance policy of AID, the principal provider of U.S. assistance, is basically to foster equitable growth by supporting programs which help fulfill basic human needs and contribute to overall development.

The health sector policy, with its base in the overall development policy and in the legislation governing health assistance, recognizes that health status is a significant factor in the quality of life of individuals and that health is a major factor in the development process. Health sector policy focuses on four basic components, as stipulated in the legislation, and provides general guidelines for programming (AID, 1980).

Top priority is given to primary health care which includes family planning. In addition to family planning, primary health care programs are expected to include:

- prenatal care and obstetrical assistance;
- childhood immunizations and certain other vaccinations;
- basic medicines;
- first aid;
- health education on nutrition, oral rehydration, management of simple respiratory and eye infections, and hygiene and sanitation;
- efforts to establish baseline and service data for evaluation and planning.

Support for such programs includes help to finance training, health education materials, planning and evaluation, key commodities on a limited basis, administrative and logistics support and research. Financial support will generally be directed at those aspects of primary health care which are closest to the level of small communities. Capital support may be provided but only under unusual circumstances.

Components of water supply and sanitation programs should include:

- attention to wastewater and excreta disposal as well as adequate water supply;
- appropriate technology;
- adequately trained workers at all levels;
- adequate administrative capacity at national, regional and community levels;
- strong national support for operation and maintenance as well as initial construction;
- long term financial plans for operation and maintenance;
- cooperation and collaboration at national and international level;
- appropriate standards for water quality;
- local community participation.

Among components which are eligible for AID financial support are:

- construction and rehabilitation of water supply and sanitation facilities systems;
- education activities to improve hygiene;
- training;
- activities that foster developing country ability to plan, design, implement, operate, maintain and evaluate projects;
- encouragement for local manufacture of hardware.

In water and sanitation-related disease prevention and control, AID supports comprehensive malaria control programs and operations research programs in onchocerciasis and schistosomiasis control.

With regard to health planning, AID advocates training collection, analysis and use of information; and collaboration in special studies.

U.S. collaboration in health activities in the Third World responds to an increased expression of interest in health by the countries of the Third World. Some of the aspirations of

developing countries have been reflected at the U.N. Conference on Water in 1976 at Mar del Plata, Argentina, and the International Conference on Primary Health Care, at Alma Ata in the USSR in 1978 (WHO, 1978). Developing country aspirations for the greater extension of primary health care and for improved water supply and sanitation are issues of basic human needs and social equity and, as such, have become components of the North-South dialogue.

The U.S. has expressed commitments to provide increased support for programs of primary health care and improved water supply and sanitation in response to the perceived needs of the developing countries as expressed at the two international conferences.

AID has a fundamental responsibility to promote programs which are responsive to the U.S. commitments. The policy and strategy provide an ample framework for a meaningful response.

## CURRENT ASIA BUREAU HEALTH STRATEGY

The current strategy focuses on the reduction of infant and child mortality rates. The suggested intervention is a "secondary prevention" approach built around early case detection and oral rehydration pursued in the context of a system of selective primary health care at the village level. That selective primary health care system is also intended to address the problems of malnutrition and pregnancy-related mortality.

The strategy recognizes the threat of diarrheal disease among infants and young children and acknowledges that control of bacteria and diarrheal viruses is the solution to the problem of diarrhea. It also acknowledges that safe water, improved sanitation and "sanitary education" are required in any approach to control.

The strategy advocates early case detection and oral rehydration as the most cost-effective approach to the diarrheal disease problem. Oral rehydration is a valuable tool in the management of severe diarrheal cases; however, it does not address the root cause of the problem. It is an important curative measure to reduce mortality but has no preventive effect on reduction in the case rate. Consequently, it offers us only a partial solution to the long-term problem.

The basis of the comparative cost-effectiveness assumption is also open to some question. The multiple factors affecting mortality and morbidity from diarrhea make the establishment of true cost-benefit relationships difficult, if not impossible. A narrow focus on a curative intervention neglects the potential benefits of a preventive approach to the long-term problem. The value of a water supply and sanitation intervention is greatly increased when the potential for reduction of illness in non-fatal cases and for the production of cross-sectoral benefit in nutrition and other socio-economic areas is considered.

The current strategy does not preclude water supply and sanitation activities but it clearly discourages their inclusion in current health programming (in contrast with earlier support in Thailand and the Philippines) and the potential offered by the Primary Health Care concept for the enhancement of the health benefits from such activities.

The Asia Bureau should consider amending its current strategy to include the promotion of water supply and sanitation activities. Such an amendment would make the strategy consistent with the expressed needs of the developing countries, with the commitments made by the U.S., and with the current legislation as reflected in Agency policy.

## THE RELATIONSHIP BETWEEN PRIMARY HEALTH CARE AND IMPROVEMENTS IN WATER SUPPLY AND SANITATION

"Primary health care is essential health care based on practical, scientifically sound and socially acceptable methods and technology made universally accessible to individuals and families in the community through their full participation and at a cost that the community and country can afford to maintain at every stage of their development..." (WHO, 1978). Simply put, primary health care is an approach to the improvement of health at the community level, consisting of a series of simple actions and accomplished with minimal personnel and material. Conceptually, it includes, as a minimum:

- education concerning prevailing health problems and the methods of preventing or controlling them;
- promotion of improved food supply and storage and proper nutrition;
- an adequate supply of safe water and basic sanitation;
- maternal and child health care, including family planning;
- immunization against the major infectious diseases;
- prevention and control of locally endemic diseases;
- appropriate treatment of common diseases and injuries; and
- provision of essential drugs.

Community participation is emphasized as is ultimate self-reliance. The Conference recognized the multisectoral nature of health development and agreed that the success of any strategy for primary health care will require the full commitment and cooperation of all sectors of government.

It is significant that the primary health care concept recognizes safe water and basic sanitation as elements of essential health care to be incorporated into a community-based program. There is some ambiguity with regard to how safe water will be dealt with. It may be placed among those "other sector" activities with which health sector activities must be coordinated at all levels or it may fall into the group of single-purpose programs which may be integrated into primary

health care activities. It is to be suspected that it will not be dealt with in like manner in all countries.

Whether safe water supply and sanitation activities are integrated into primary health care or coordinated with it, there are several advantages which primary health care can bring to activities to improve water supply and sanitation. Past experience has clearly indicated that the health education and community participation components of water supply and sanitation programs and projects have seldom been sufficiently developed to achieve the maximum health benefits of facilities installation. Primary health care could go a long way in helping to overcome these deficiencies. At the same time water supply and sanitation activities could, in many instances, serve as the community focal point around which community-based primary health care activities could be developed.

In many instances there are simple solutions to problems of water source contamination. Extensive technical expertise is not always required to protect a spring or protect a dug well or improve the conditions of a pit privy. Much can be accomplished with some minimal technological skill at the community level. Locally based primary health workers could be instrumental in helping communities make decisions as to what they need and how much they are willing to pay for it--decisions that are important in the improvement of water supply and excreta disposal. User education, emphasizing maximum beneficial use of improved facilities, is a logical part of primary health care.

The recognition of the multisectoral interrelationship and interdependence of health, social and economic development and the establishment of coordination mechanisms should insure that no agricultural water project would proceed without due consideration for domestic water needs where they exist or that public-supported housing projects include adequate water supply and sanitation facilities. It would be naive to think that the coordination contemplated in primary health care will flourish overnight but it also does have the potential for real gains.

The translation of primary health care, as conceived, into action will depend on individual governmental policies, and plans which set priorities and targets and define operational frameworks. Those policies and plans should, among other things, clearly establish the relationship between primary health care and water supply and sanitation activities. Whatever that relationship may be, care should be taken to develop a comprehensive approach which will develop the maximum benefit from water supply and sanitation improvements.

## ISSUES

1. Can water supply and sanitation be justified as a health intervention?

In spite of methodological problems, and ambiguous and contradictory findings, a preponderance of the evidence supports the relationship between improved water supply and sanitation (including health education) and long-term reduction of water-related disease. The evidence indicates that improvement in any one component (water supply, excreta disposal or health education) by itself is unlikely to produce a maximum benefit, but the three applied together do reduce disease substantially. Facilities for improved water supply and excreta disposal and new-found knowledge and understanding of personal and household hygiene provide little or no benefit unless they are properly used.

Limitations on the present state-of-the-art constitute a very real barrier to quantitative predictions about incremental relationships and render quantitative evaluation of incremental improvements impractical at reasonable cost. This does not deny that benefits accrue.

2. What are the technology problems that limit the effectiveness of a water supply and sanitation intervention?

In most cases there is relatively simple and inexpensive technology available to improve both water supply and excreta disposal. Frequently, simple solutions, such as an improved, protected spring or well, can get people away from grossly contaminated traditional sources and reduce disease transmission. One important lesson from experience is that technology which cannot be operated and maintained by a local community is not likely to be of lasting benefit. There is an associated need to convince decision-makers that less than "state-of-the-art" interventions may be appropriate.

There are instances where simple technology may not be fully effective. Bangladesh is a case in point. High iron content in groundwater makes that water objectionable to the local population. That factor, combined with complex cultural patterns, has limited potential benefits from handpump installation on shallow wells. Fortunately, such cases appear to be few but they require more complex technological solu-

tions, including social mobilization to resolve the problem and extensive research is required in such special situations.

3. Is Water supply and sanitation an affordable investment?

Except in the unusual circumstances like Bangladesh, the facilities for improving water supply and excreta disposal are not excessively expensive. Initial per capita capital costs are about \$25-\$40 for water supply in rural areas and about \$20 for excreta disposal (World Bank, 1980). It will be argued by many that these estimates of average costs are too high, but if amortization and annual maintenance and operation costs run ten percent of capital costs, then annualized per capita costs will be in the range of \$4.50-\$6.00, a figure higher than some other health intervention costs; but the potential for long-term lasting benefits tends to minimize the difference. In addition, payment for water is a widely accepted social norm.

4. How can the primary health care network be used to enhance the potential of water supply and sanitation?

The primary health care system offers an excellent entry-point into the local community. Two important ingredients of the water supply and sanitation mix have been too frequently neglected in program implementation. Adequate attention has not been given to user education and, as a consequence, some of the advantages of improved facilities have been lost because people did not know or were not convinced of proper use habits. Secondly, the lack of community participation in the development of local improvements has often resulted in the installation of facilities which could not be operated or maintained by the community or for which the community felt neither the need nor the responsibility. The primary health care worker is frequently in an advantageous position to promote both community participation and user education.

5. How can programs of detection and early treatment of diarrhea and dehydration be expanded to address the broader effects of repeated diarrhea in the community?

Early detection and treatment are important in saving lives, but they do not address chronic growth failure nor do they reduce disease incidence. It is generally agreed that, in the absence of prospects for an effective diarrheal disease vaccine (or vaccines), im-



proved water supply and sanitation combined with hygiene education offers the best possibility for the long-term prevention and eventual control of most diarrheal diseases.

6. Should the promotion of improved water supply and sanitation be a part of Asia Bureau health strategy?

The developing countries have expressed a need. The international community has established a Decade for Water Supply and Sanitation. Other donors, particularly Sweden, Denmark, and the Federal Republic of Germany, have increased their support substantially as have UNDP and UNICEF. The U.S. has made a commitment to increase its support. The Agency has provided for that support in its established health policy. Asia Bureau strategy should be responsive to this commitment.

7. How should water and sanitation programs be funded?

Although water and sanitation activities have strong implications for primary health care and are perceived within the Agency as health activities, they have cross-sectional overtones, particularly in agriculture and rural development. Agricultural projects that provide water for crops and livestock should include a focus on the probable domestic use of this water and plan for protection of water sources and handling of health problems related to pollution. Likewise the adverse effects of irrigation and hydroelectric projects on the transmission of disease such as schistosomiasis should be considered. The implications for intersectoral planning and financing are profound.

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## Annex 1

### HEALTH PROBLEMS RELATED TO POOR WATER SUPPLY AND SANITATION

The poor health status of people in the developing countries is indicated to some extent by an average life expectancy at birth of 51 years, or, about 30 percent less than in the U.S. The average in nine AID-assisted countries in the Asia region is about 52 years, ranging from 45 years in Bangladesh to 68 years in Sri Lanka. Six countries (Bangladesh, Burma, India, Indonesia, Nepal and Pakistan) have average life expectancies less than the developing country average.

Low life expectancy at birth generally reflects high rates of infant and child mortality. About one-half of all deaths in developing countries are in children five years of age or less; 10 to 15 percent die in their first year of life and some 30 percent die before age five.

The principal causes of high infant and child mortality are gastrointestinal and respiratory infectious, measles and malnutrition. It has been shown (Puffer and Serrano, 1971) that in children under five years of age in a study of 30,000 deaths in 17 projects in Latin America and the Caribbean from 23 to 55 percent of the deaths beyond the perinatal period were due to fecally-related diseases.

Children under five years of age are particularly vulnerable to the compound effects of these causes. Gastrointestinal disease, or diarrhea, contributes to malnutrition (Scrimshaw, et al., 1968) through loss of appetite, increase of food waste and a loss of calories through both ends of the gastrointestinal tract; undernutrition makes the gastrointestinal tract more vulnerable (Suskind, 1975) and the food waste goes on. The waste by the reduction of the absorption of nutrients alone is estimated to be as high as 30 percent in acute cases.

Diarrhea, and the dehydration associated with it, may be responsible for as much as 30 percent of the deaths in children zero to four years of age in some parts of the world (Satge, 1970). Thirty percent of childhood deaths in the Gambia can be attributed to diarrhea (McGregor, 1970). Case fatality rates from one to four percent during the first two years of life have been shown (Morley, 1973, p. 172). Mortality in hospitalized young children may be as high as 30 to 40 percent. Death rates are lower in older children but infants of low birth-weight frequently have a higher rate. A case study in the Punjab, India, reported a death rate of 3,446 per 100,000 infants from acute diarrheal disease (Scrimshaw, et al., 1968).

Diarrheal diseases were classified as the leading cause of death in Paraguay (1971), Guatemala (1970) and El Salvador (1970). "All forms of dysentery" was the most frequently noted communicable disease in Pakistan (WHO, 1974).

Intestinal parasitic diseases also contribute to the sickness burden of the developing world. They are less likely to be the cause of acute illness or death but they are frequently chronic and debilitating. Ancylostomiasis (hookworm) is productive of anemia in both children and adults, and heavy *Ascaris* loads in small children may significantly interfere with intestinal absorption of nutrients (Jelliffe, 1968). Incidence of these is often very high and their distribution is widespread. WHO estimates that in 1971 there were 650 million cases of ascariasis (roundworm), 350 million cases of amoebiasis, 350 million cases of trichuriasis (whipworm) and 450 million cases of ancylostomiasis (Smith, 1979).

A case study of the work force at three construction sites in West Java, Indonesia showed 85 percent to be infected with hookworm (Basta and Churchill, 1974). Studies in Sri Lanka, Bangladesh and Venezuela showed average infection rates in pre-school children of between 50 and 70 percent for both ascariasis and trichuriasis. At the age of six years, over 90 percent of the children in Sri Lanka, Bangladesh and Venezuela were infected with intestinal worms (Van Zijl, 1966).

All of these diseases are of fecal origin. They are readily transmitted through the unsanitary conditions which prevail in most of the world. They are closely linked to deficiencies in water supply and excreta disposal. Some of them are transmitted through fecally-contaminated water; the water serving as a vehicle carrying the disease organisms along the anus-to-mouth pathway. Other diseases are spread by direct contact with fecal contamination, especially through contamination of left over foods, weanling preparations, infant formula, even oral rehydration solutions; some are spread thorough both the waterborne and the direct-contact route.

The fecal origin of these diseases indicates that any substantial reduction in their prevalence probably will depend on the interruption of their spread from anus-to-mouth. Since they are all water-related it is reasonable to expect that improved water supply and sanitation should play a major role in any reduction. The elimination of contamination from a water source, or the substitution of an uncontaminated source, will lessen the likelihood of waterborne disease transmission. The availability of greater quantities of water for personal and household hygiene will create more favorable conditions for the reduction of those diseases which are spread by direct contact. Sanitary disposal of human waste will minimize the potential for the spread of fecal contamination.

Also among the prevalent diseases of the developing world is a group of infections of the body surface, both the skin and the eyes and ears. These diseases, including trachoma, scabies, leprosy, skin sepsis, conjunctivitis, otitis externa and endemic typhus, are infrequent causes of mortality but they contribute heavily to the burden of suffering in some areas. Over 90 percent of the people in the New Guinea highlands were found to suffer from skin infections at some time each year (Feachem, 1973). In Ankole, Uganda, 70 percent of pre-school children had skin ulcers, scabies or fungus infections. Trachoma is endemic in much of the developing world. It, and associated infections of the eye, are estimated to affect 400 to 500 million people, of whom some two million are blind (WHO, 1979). All of these diseases can be expected to respond to improved personal hygiene associated with increased availability of water.

All of these water and sanitation-related diseases reduce the productive potential of people infected by them. The poor, particularly the women and children, suffer most from their effects. Their access to safe water and satisfactory excreta disposal is generally limited; they lack adequate information on the impact of the unsanitary conditions in which they live. They can neither adequately protect themselves from these infections nor can they cure them. The women bear an additional burden in reduced productivity potential because of the time and energy frequently spent in obtaining water.

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## Annex 2

### RELEVANT EXPERIENCE

There is no doubt about the linkage between public health and water supply and sanitation. Snow (1855) effectively demonstrated that relationship when he removed the pump handle from a cholera-contaminated well and stopped a cholera epidemic. Other evidence is less dramatic but equally instructive.

Studies made in California show that making more water available for personal hygiene tends to reduce by half the frequency of Shigella infections, a common cause of diarrhea throughout the world, (Hollister, et al., 1955; Watt et al., 1953).

A study in Georgia related the prevalence of Shigella infections to the proximity of the source of water supply (Stewart, et al., 1955). Higher prevalence was found where water was less accessible. The conclusion was reached that the easy accessibility of water for personal hygiene needs to be considered along with the purity of water in the control of fecally spread diseases.

In another Georgia study, the improvement of excreta disposal facilities produced a significant reduction in Shigella infections (McCabe and Haines, 1957).

An extensive study in Kenya (Fenwick, 1966) to examine the impact of an environmental sanitation program, including water supply improvements, was flawed by methodological difficulties which made much of the data hard to interpret but, nonetheless it did demonstrate a clear-cut reduction in Ascaris (roundworm) infections, which were six times more common in a control area than in the area of the improvement program.

Another study (Schliessmann et al., 1958), in Kentucky demonstrated a significant reduction in morbidity rates for shigellosis and ascariasis with improved sanitation.

Questions have been raised concerning the methodology of all of these studies. They suffer from sampling defects and uncontrolled independent variables. However, the independent findings are mutually reinforcing and, when considered together, do indicate the direction if not the true magnitude of benefits which accrue from improved levels of sanitation, including water supply.

It is difficult to separate the effects of improved sanitation from those which derive from improved socio-economic status. However, it is evident, even in studies where methodological problems have been encountered, that morbidity rates, and rates of gastrointestinal bacterial and worm infections are

lower in higher income groups which have improved levels of sanitation. There seems to be no evidence, however, that higher socio-economic status without improved sanitation has any marked effect on the prevalence water-related diseases.

The impact of improved water supply and sanitation on the incidence of typhoid in the U.S. and in England further supports the belief that such improvements can produce significant health benefits in reducing diarrheal disease.

A series of studies of diarrheal diseases in seven developing countries (Van Zijl, 1966) showed a 50 percent reduction in Shigella isolations in Sudanese communities with readily accessible water; total diarrheal incidence was little changed, however. In other countries, reduced diarrhea rates were associated with "piped water supplies." (Piped water supplies in this instance, and in many other studies, does not mean house connections in every house.) Much diarrhea remained where there were no other sanitary improvements.

A U.S. Department of Health, Education and Welfare study (1968) examined skin and enteric diseases in six Indian communities in Arizona before, during and after the installation of sanitary facilities in selected homes in each community. Disease rates were significantly lower in the selected homes after installation. The greatest health improvement occurred in houses which received more facilities (more than one indoor faucet, a sanitary privy, a bath or a shower). A decrease in skin disease was evident early in the study but an increase occurred later. This leads to speculation that education on proper use, operation and maintenance is essential to obtain sustained benefits.

A study in the Barbanki District of Uttar Pradesh, India (Misra, 1971) examined the effect of improved water supply and health education in seven villages. The findings show a progression of diarrheal incidence from high where the water source was an open well to medium where the source was a community standpost to low where the source was a private water tap. (It is not specified whether the private tap was inside the house.) In addition to diarrhea and dysentery, randomly selected persons served by tap water were examined for typhoid, scabies, conjunctivitis and trachoma. The reduction of morbidity over a four-year period was great. In a similar but unpublished study in Gorakhpur District "piped water" produced similar results.

Not all studies have shown a beneficial relationship between improved water supply and sanitation and health. An AID supported study (1978) in Guatemala, conducted by the University of North Carolina and the Institute of Nutrition of Central America and Panama, showed no decrease in diarrheal morbidity related to improvement in water supply. Questions have been raised about the conclusions (AID, 1980) and an alterna-



tive analysis, showing a reduction of diarrhea, has been presented. An independent appraisal of the study design, implementation and results is reported to have found that the study does not permit any valid conclusion regarding benefits from improved water supply.

An AID supported study in Guatemala of the effects of improved water supply and sanitation and health education on diarrheal morbidity, malabsorption, and hygiene-related behavior failed to demonstrate any effect of these improvements on diarrheal morbidity (AID, 1978). Because of dissatisfaction with these conclusions, an alternative analysis was employed that revealed a reduction in diarrhea. Inadequacies in the data itself and flaws in the alternative analysis plan tend however to mitigate this interpretation of the data. An independent review panel appraising the entire study, concluded that the data do not permit interpretation of a positive effect of the water supply, sanitation and associated improvements on diarrheal morbidity.

Evidence with regard to cholera in Bangladesh indicates that water supply improvements, in the form of tubewells, do not reduce the transmission of Ogawa/El Tor Cholera. Sommer and Woodward (1972) showed that close proximity to tubewells was associated with lower classical/Inaba Cholera attack rates in 1969 but had no influence on attack rates of Ogawa/El Tor Cholera in 1970.

Again in Bangladesh, Curlin et al. (1977) found that drinking tubewell water was not associated with a reduction in overall diarrhea rates nor in rates of cholera or shigellosis. This study points up the complexities of hydrology and cultural patterns in Bangladesh which mitigate against any single-purpose intervention.

Another study in Bangladesh (Khan et al., 1978) showed lower rates of cholera among people who used water from tanks (open, unprotected common reservoirs) when compared with those who used water from rivers and canals, whereas the use pattern of shallow tubewells did not seem to influence the rate of cholera. It is suggested that the use of water from tanks might reduce the incidence of cholera if the tanks could be protected.

Other studies in Bangladesh (Spira et al., 1977; Hughes et al., 1977) evaluated the role of water in the transmission of cholera. Among the findings were some seemingly contradictory ones:

- o Cholera vibrio isolated from all types of water sources but more frequently from rivers and canals than from tanks and tubewells.
- o Tubewells and tanks less frequent in positive neighborhoods than in negative ones.

- o Families in positive and negative neighborhoods equally likely to use a single source for both drinking and bathing.
- o Families in positive neighborhoods significantly less likely to use a single source for cooking and washing clothes and utensils.
- o Families with cholera significantly more likely to drink water from a tubewell.
- o Attack rates in families drinking from a positive source or those drinking from a negative source not significantly different.
- o Individuals drinking from positive sources not more likely to be infected than those drinking from a negative source.
- o Individuals using a positive source for cooking, bathing and washing significantly more likely to be infected than those using only a negative source for those purposes; and
- o Insignificant differences between those using a positive source for both drinking and other uses and those using a negative source for drinking but positive sources for other uses.

Although these findings provide more evidence of the complexities of endemic cholera in a grossly contaminated environment such as Bangladesh, they nonetheless suggest some rather startling conclusions:

1. There is a gradation in numbers of cholera cases emanating from various areas: from tubewell areas which are nearly always negative, to tank areas which are frequently negative, to areas near rivers, canals, and ditches that are nearly always positive.
2. Where one bathes, washes, and draws water for cooking is far more important than where one drinks...a finding that explains the lack of any negative effect of drinking tubewell water on cholera incidence.

Fully supported is the need for social research, as recommended by Curlin, et al. (1977), so as to define methods of delivery and patterns of use of water, and satisfactory and acceptable means of excreta disposal which when combined might reduce the transmission of cholera.

The study of improved water supply and sanitation in the reduction of cholera in the Philippines presents a somewhat

different picture (WHO, 1971). In four communities, judged to be similar except for sanitary facilities, reductions during a three-year period of between 69.6 percent and 71.3 percent in the cholera incidence were obtained by improving water supply, waste disposal or both. All three communities showed significantly lower incidence than did a control community in which no improvements were made. The study concluded that "improvements in water supply or waste disposal facilities, or a combination of both, can produce a significant reduction in the cholera incidence in a community. Furthermore, infections that gain access to such communities show less tendency to spread and produce secondary cases. The incidence of infections in the three communities with sanitary improvements, however, showed no significant differences. Apparently only a certain level of reduction in cholera incidence by sanitary measures is obtainable, beyond which any further sanitary improvements give only small returns." (No mention is made of a health education component in the sanitary improvements.)

A follow-up of the Philippine study (Azurin and Alvaro, 1974) extends the data for two additional years and concludes that the provision of sanitary excreta disposal can reduce the incidence of cholera by up to 68 percent; safe water supply up to 73 percent. Where both are provided the reduction rises to 76 percent. (It should be noted that in the community with improved water supply less than 50 percent of the residents had piped house connections. In the combination with sanitary improvements piped water was delivered to ten standposts located so that no house was more than ten meters from a standpost.)

In India (Subrahmanyam, 1951), sanitary improvements were made in the form of borehole wells, latrines and an educational effort to convince the local populations of the value of clean water and improved excreta disposal. It was observed that there was notably less cholera in districts which had sanitation programs and that the death rate from cholera was less in towns with piped water than in rural areas of the districts where there was no piped water.

Experience therefore indicates that while the improvement of water supplies, both in quality and quantity, is probably a necessary condition of improving health, it is not a sufficient condition to produce spontaneous benefits by itself. The complementary inputs of improved excreta disposal and user education are essential to insure maximum benefits. It is also important that facilities be designed and located so that additional problems of wastewater drainage are not created.

The lack of community involvement in decisions regarding improvements is probably the greatest problem in project implementation. Community perception of needs is seldom considered. The voices of women, the traditional bearers of water in many societies, are seldom heard. Most often central authorities decide what to do, where to do it, do it and move on. The

community is left with little appreciation of potential benefits and no sense of responsibility for the improvement.

The absence of adequate user education has frequently been a factor in the failure to achieve maximum benefits from improved facilities. Proper use is not always instinctive; it must be learned. Women do not automatically see that time saved in providing water for the household can be converted into time better spent in child care or other productive activities such as home gardening for better family nutrition.

Neglect of operation and maintenance activities has limited the effectiveness of many projects. These activities are frequently the responsibility of the central authority and are given insufficient attention.

The bureaucratic placing of the responsibility for water supply facilities is frequently a constraint. Responsibility is generally placed in a central authority which focuses largely on the construction of new water supply facilities. Central authorities seldom have responsibility for excreta disposal in rural areas; rarely do they provide adequate user education to insure proper use of newly-constructed facilities.

Central authorities are generally outside Ministries of Health and, in most cases, there is little coordination with health programs which could be used to enhance the benefit potential of new facilities. There is seldom meaningful coordination with other development sectors whose activities might have impact on domestic water supply.

The wide range of technology available is capable of providing any level of improvement desired. Problems in the past have been more closely related to the manner in which technology was used rather than with the technology itself. Technology selection has been made without due regard to the perceived needs of the community or the ability to operate and maintain the facility. Systems have failed when the community had no sense of responsibility and provisions for operations and maintenance were inadequate.

The sanitation problem in the developing world is characterized by the large numbers of people, particularly the rural and urban-fringe poor, who live in conditions which are considerably below even modest standards. High standards will not be achieved in a quantum jump but through a continuum of improvements. The first step in this continuum is to provide services which are certainly not inferior to existing ones. Sanitation problems are basically the results of poor hygiene habits, unsatisfactory water sources, poor site selection for services and construction deficiencies. Existing technology, when used appropriately, can provide improvements which meet acceptable standards at costs which are not prohibitive (AID, 1979).

It is obvious from the documented experience that it is extremely difficult to show a quantitative relationship between improved water supply and sanitation and health. The measurement of health benefits is complex and the control of the many variables which affect health presents formidable methodological problems.

There is also no body of experience which addresses the complex relationships between the costs and benefits of water supply and sanitation. Attempts have been made (White et al., 1972) (Carruthers, 1973) (Warner, 1973) (Saunders and Warford, 1976) but the results have not been definitive. Given the present state-of-the-art, it is unlikely that the deficiencies in methodology for benefit-cost analysis will be overcome except through long and costly studies. The absence of clearly defined cost-benefit relationships however need not necessarily be a bar to the development of well-conceived water supply and sanitation projects.

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