

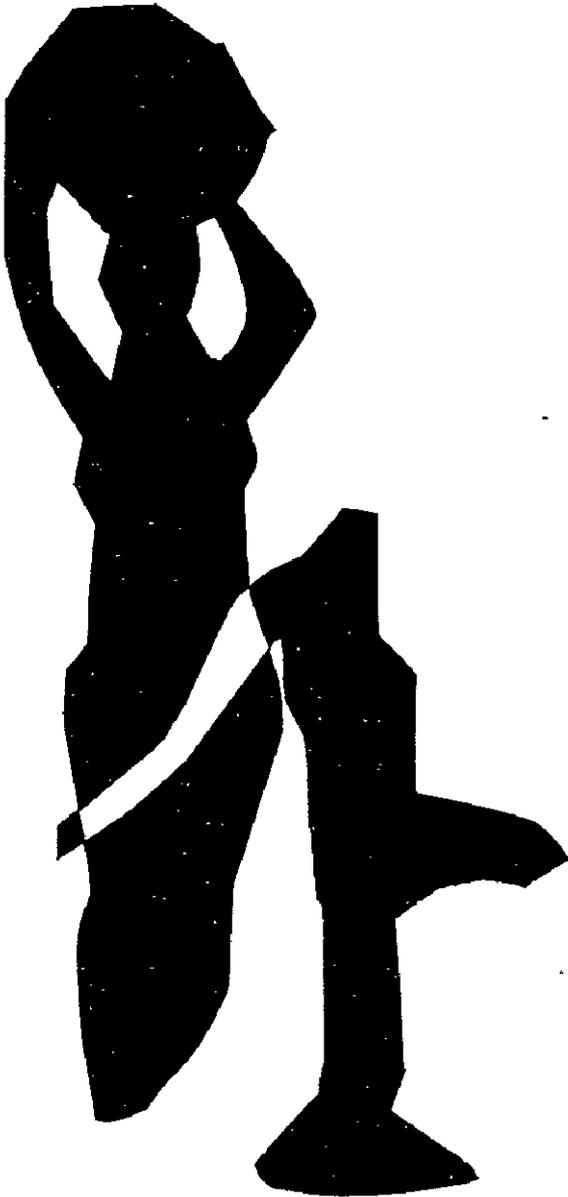
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THE IMPACT OF INTERVENTIONS IN WATER SUPPLY AND SANITATION IN DEVELOPING COUNTRIES

Proceedings of a Seminar held at the
Pan American Health Organization
March 25-26, 1980, Washington, D.C.

**U.S. Agency
For
International
Development**

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**Editor, James D. Lindstrom
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Editor's Note:

This volume was prepared from a recording of the two-day Seminar. Due to a breakdown in the recording equipment during the first hour of the Seminar, these *Proceedings* do not include the Call to Order, by Frank Butrico; the Welcome, by Joseph C. Wheeler; the Seminar Introduction, by Sander M. Levin; and the Opening Remarks, by Daniel A. Okun.

The edited text of each paper was reviewed by its author. The Editor accepts responsibility for the text of the discussions.

Preface

The International Drinking Water Supply and Sanitation Decade was formally inaugurated by the United Nations General Assembly on November 10, 1980. As part of the Agency for International Development's (AID) preparation for the Decade, the Office of Health sponsored the multidisciplinary seminar, *The Impact of Interventions in Water Supply and Sanitation in Developing Countries*, for AID staff and others in the Washington development community. Hosted by the Pan American Health Organization, the well-attended meeting and brisk discussion reflected widespread interest throughout the Agency in drinking water supply and sanitation development activities. The seminar brought together a panel of highly qualified and internationally respected technical experts who exchanged their ideas and experiences with the assembled participants. We are publishing these *Proceedings* for our colleagues in AID missions and others who are similarly interested and were unable to attend the seminar. The seminar and its *Proceedings* should also prove timely in the ongoing process within AID of generating guidelines and policy in the sector.

Many people and several organizations were responsible for the success of the seminar. To Frank Butrico and David Donaldson of PAHO goes appreciation for the site and the hospitality provided by PAHO throughout the two-day meeting. The active participation of Joseph Wheeler, Sander Levin and Stephen Joseph demonstrated the commitment of AID senior leadership. The speakers deserve a special note of thanks as do Daniel Okun and Gilbert White, who chaired the seminar and who were outstanding moderators and discussion leaders. James Lindstrom should be acknowledged for editing the seminar *Proceedings*, as should Logical Technical Services and the Office of International Health, who with Dr. Lindstrom coordinated the logistics for the seminar.

John Alden
Director
Office of Health
Bureau for Development Support
Agency for International Development

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- John W. McDonald, Jr. *Ambassador, Department of State and U.S. Coordinator for the U.N. Drinking Water and Sanitation Decade.*
- F. Eugene McJunkin *President, Environmental Services Corp.*
- Daniel A. Okun *Kenan Professor of Sanitary Engineering, University of North Carolina.*
- Robert J. Saunders *Chief, Telecommunication Division and Economist with the World Bank; co-author of Village Water Supply, Economics and Policy in the Developing World.*
- Joseph C. Wheeler *Deputy Administrator, AID.*
- Anne U. White *Geographer, co-author of Drawers of Water; Domestic Water Use in East Africa.*
- Gilbert F. White *Professor Emeritus, University of Colorado; Fellow, National Academy of Science; and Chairman, Commission of Natural Resources, National Research Council (NAS).*

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Water Supply and Health: An Overview

F. Eugene McJunkin, Ph.D., President, Environmental Sciences Corporation, Chapel Hill, N.C.

"Water contributes much to health." - Hippocrates

Prologue

On May 10, 1979, a DC-10 at Chicago's O'Hare Airport lost an engine on takeoff. In the ensuing crash, 275 persons lost their lives. News coverage was intense throughout the world. DC-10's were temporarily grounded at great expense.

During the same hour that the DC-10 crashed in Chicago, six times as many children under five years of age died of diarrhea in the developing world. Imagine the publicity if a DC-10 crashed every 10 minutes, 24 hours a day, 365 days a year. Yet an equivalent number of children die each year of largely preventable diarrhea, without public notice.

Diarrhea

The World Health Organization (WHO) estimates that 500 million diarrheal episodes occur each year in children under five in Asia, Africa, and Latin America (WHO, 1975). Three to four percent of these end in death (WHO, 1979; also see Rohde and Northrup, 1976 and Barker, 1975).

These illnesses are the result of poverty, ignorance, malnutrition, and poor environmental sanitation, particularly inadequate water supply and sanitation.

HISTORICAL DEVELOPMENT OF OUR UNDERSTANDING OF WATER SUPPLY AND DISEASE

Introduction

Our understanding of the relationship between water supply and sanitation and disease can be conveniently divided into (1) the wisdom of the ancients, (2) natural experiments, (3) sanitary revolution, (4) biological plausibility, (5) studies of epidemic disease, (6) studies of endemic disease. All these categories of course overlap.

Wisdom of the Ancients

Numerous savants of the ancient world related water and health. For example, Hippocrates was remarkably accurate in his observations on goiter and water supply. Several ancient religious codes endorsed hygienic practices which even today remain appropriate.

Natural Experiments

The industrial revolution and the rise of large urban populations requiring public water supplies during the 19th century were often accompanied by massive epidemics, many of which could be considered natural experiments.

The classical epidemiological study by Dr. John Snow of an 1854 outbreak of cholera in London was a pioneering effort of scientific understanding. Over 700 deaths from cholera occurred in St. James Parish in a 17 week period. Snow's detailed study showed that most of the victims had used water from the Broad Street Pump and, further, that a leaky sewer which passed adjacent to the well for the pump drained the house at No. 40 Broad Street, site of the original cholera case. Remarkably, Snow's study pre-dated Pasteur's germ theory of disease by one decade and Koch's identification of the causative organism, Cholera vibrio, by three decades.

A serious epidemic of cholera occurred in Hamburg in 1892 when unfiltered water from the River Elbe was supplied to the city. In that outbreak Koch succeeded in isolating Cholera vibrio from the river water. Hamburg and the contiguous town of Altona both drew water from the River Elbe and discharged sewage to it at a number of points. The water of Altona—being downstream from Hamburg—was initially the more polluted but Altona filtered its water through slow sand filters and Hamburg did not. In the course of a few weeks 18,000 persons in Hamburg were attacked by the disease and 8000 died. The death rate from cholera in Hamburg was 13.4 per 1000 of the population; Altona suffered much less, the death rate being 2.3. Almost all of the cases that occurred in Altona had drunk Hamburg water. In Hamburg itself there was a block of tenements housing some 400 persons; these tenements were supplied with Altona water and the inhabitants escaped untouched.

Sanitary Revolution

The work of Edwin Chadwick in England, Lemuel Shattuck in Massachusetts and others fostered a sanitary revolution in these countries in the latter half of the 19th century. Diseases associated with poor sanitation and crowded environments decreased in numbers even without planned interventions, curative medicine, or immunizations. Lifespans increased. (McKeon and Record).

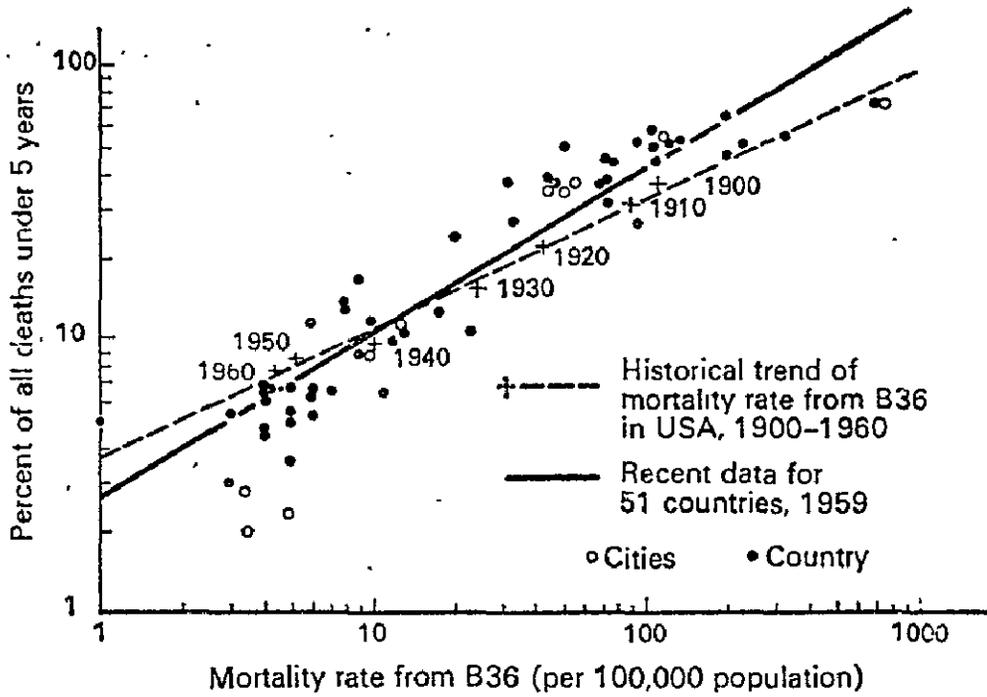
It can be argued that many LDCs are repeating or on the verge of repeating western history in this respect. The following examples are illustrations.

Cvijetanić (1965) shows the similarity of decline in enteric disease in the U.S. and in 51 developing countries if the time scale is adjusted. (See Figure 1).

A study of the fall, (65 percent) in typhoid mortality in 20 American cities following introduction of water supply filtration bears a remarkable similarity to the fall in typhoid mortality, (63.6 percent) in 14 Indian towns following introduction of water purification a half-century later than in the U.S. cities. (See Tables 1 and 2).

In the Punjab some 15 years ago, the infant death rate from diarrhea in the second six months of life was 56 per 1000. A half-century earlier in New York City, the rate was precisely the same (Rohde and Northrup, 1976).

Figure 1



LEVELS OF HEALTH AND MORTALITY FROM B36
(B36 comprises gastritis, duodenitis, and colitis
except diarrhoea of the newborn.)

Source: Cvjetanović, B. et.al. (1965) Milbank
mem. Fd Quart., 43, No.2, 240:

Table 1

**REDUCTION IN TYPHOID FEVER DEATH RATES
IN AMERICAN CITIES FOLLOWING THE FILTRATION
OF THEIR PUBLIC WATER SUPPLIES (AVERAGES FOR FIVE
YEARS BEFORE AND FIVE YEARS AFTER FILTRATION)**

City	Average Typhoid Fever Death Rate		Per cent reduction in typhoid fever death rates which followed the filtration of the public water supply.
	Before Filtration	After Filtration	
Albany, N.Y.	109	28	74
Charleston, S.C.	106	62	41
Cincinnati, O.	56	11	80
Columbus, O.	83	17	78
Harrisburg, Pa.	72	33	54
Hoboken, N.J.	18	13	28
Indianapolis, Ind.	46	28	39
Lawrence, Mass.	110	23	79
Louisville, Ky.	57	24	58
New Haven, Conn.	40	25	38
New Orleans, La.	39	26	33
Paterson, N.J.	29	9	69
Philadelphia, Pa.	63	20	68
Pittsburgh, Pa.	132	19	85
Providence, R.I.	19	13	31
Reading, Pa.	53	35	34
Scranton, Pa.	25	10	60
Springfield, Mass.	22	22	0
Washington, D.C.	55	31	43
Wilmington, Del.	35	24	31
Weighted averages	60	21	65

Source: Johnson, George A. "The Typhoid Toll." *Journal American Water Works Association*.
3 (2): 249-313. 1916.

Table 2

**AVERAGE SPECIFIC DEATH RATES FOR FIVE YEARS
PRIOR TO AND AFTER THE ESTABLISHMENT
OF WATER PURIFICATION PLANTS IN THE STATE OF
UTTAR PRADESH, INDIA**

Towns	Year of establish- ment of purification plants	Average death rates							
		Cholera		Typhoid		Dysenteries		Diarrhoeas	
		Before installa- tion	After installa- tion	Before installa- tion	After installa- tion	Before installa- tion	After installa- tion	Before installa- tion	After installa- tion
Roorkee	1953	0.01	0.00	0.37	0.04	0.25	0.14	0.77	0.38
Ghaziabad	1954	0.04	0.00	0.12	0.08	0.21	0.19	0.15	0.02
Etawah	1951	0.39	0.03	0.04	0.00	0.45	0.08	3.27	1.62
Orai	1945	0.30	0.13	0.21	0.11	0.25	0.06	1.56	0.48
Gorakhpur	1954	0.04	0.02	0.07	0.06	0.76	0.72	1.11	0.42
Banda	1950	0.43	0.06	0.42	0.21	0.21	0.14	0.26	0.10
Bahraich	1951	0.34	0.00	0.12	0.03	0.26	0.15	1.13	0.65
Hardoi	1954	0.29	0.00	0.22	0.02	0.22	0.13	0.49	0.28
Basti	1954	0.13	0.01	0.52	0.00	0.15	0.08	0.09	0.01
Mirzapur	1953	0.11	0.00	0.01	0.00	0.98	0.62	0.62	0.27
Moghulsarai	1949	0.86	0.06	0.25	0.03	0.18	0.03	0.18	0.17
Sandila	1954	0.20	0.57*	2.46	0.05	0.84	0.70	1.07	1.03
Deoria	1954	0.04	0.00	0.11	0.06	0.02	0.04*	0.01	0.03*
Vrindaban	1943	0.60	0.16	0.10	0.37*	0.72	1.12*	3.76	2.86
Average for 14 towns		0.27	0.07	0.22	0.08	0.39	0.30	1.03	0.59
Percentage of reduc- tion in the death rates		74.07		63.63		23.08		42.72	

* Figures asterisked do not show a decline

Source: Zaheer, Mohd, Prasad, B G., Govil, K K., and Bhadury, T. "A Note on Urban Water Supply in Uttar Pradesh." *Journal Indian Medical Association*, 38 (4):177-182. 1962.

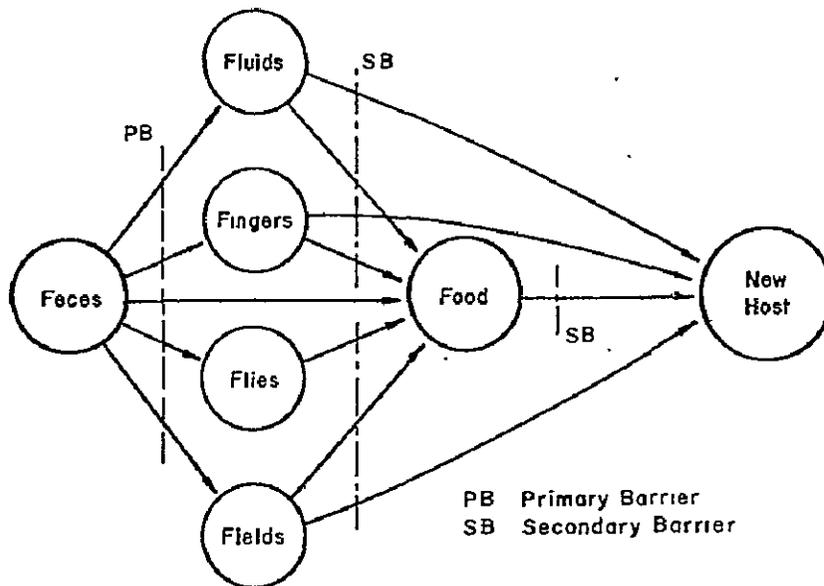
Biological Plausibility

Although the London cholera studies by John Snow are considered epidemiological classics (and appear as examples in most standard epidemiological textbooks), they had little impact on the current practices. Only after Pasteur, Eberth, Koch, et al., identified the causative pathogenic micro-organisms did full acceptance come -- aided immensely by Koch's "postulates" for confirming that a bacterium was indeed the agent of a specific disease.

This of course led to identification of the "portal of entry" of the micro-organisms to the human body. Many of course were through the mouth to the gastroenteric tract, carried by water or food.

It could be conclusively demonstrated for such diseases as cholera and typhoid that fecal-oral routes were predominant in transmission of the disease. (See Figure 2). Then any intervention which broke the fecal-oral cycle could be effective. Obviously keep feces out of water, milk, food, etc. and/or destroy or remove pathogens in water, food, soil, or on hands through treatment, cooking, or cleansing.

Figure 2



TRANSMISSION OF DISEASE FROM FECES
(Adapted from Wagner and Lanoix, 1959)

INTERVENTIONS

Interventions for controlling waterborne transmission include:

a. Water Supply:

- (1) Selection of uncontaminated courses, e.g., wells from deep aquifers.
- (2) Treatment of raw water, especially chlorination.
- (3) Replacement of contaminated water supplies by more convenient, reliable, safe supplies.
- (4) Protection of water sheds.
- (5) Water quality surveillance.

b. Sanitary Excreta Disposal:

- (1) Protection of water supplies.
- (2) Protection of environment.
- (3) Support of water supply and excreta control activities.

c. Health Education

- (1) Personal and community hygiene.
- (2) Protection of environment.
- (3) Support of water supply and excreta control activities.

TRANSMISSION OF WATER-RELATED DISEASES

Table 3 summarizes the more important water and excreta-related diseases. For convenience they are categorized in terms of appropriate interventions:

(1.A) Waterborne-Microbiological Diseases:

Basically, these are the diseases in which the pathogens are in the water and, when ingested at a sufficient dose, infect the drinker. The majority of these pathogens reach the water through contamination with human excreta and ultimately enter the body through the mouth, hence, the term "fecal-oral transmission." Many fecal-oral diseases are readily transmitted through other means, for example, fecally-contaminated food or hand to mouth. Thus, not all typhoid, for example, is necessarily waterborne.

The more important of these diseases include amebic dysentery, shigellosis, cholera, diarrheas (non-specific etiology) E. coli enteritis, enteric virus, hepatitis, norwalk and rotavirus, (viruses are further delineated in Table 4) and typhoid fever.

TABLE 3

WATER AND HEALTH

I. WATERBORNE DISEASES
(Transmitted by Ingestion of Contaminated Drinking Water)

A. MICROBIOLOGICALA.1. *Fecal-Oral Pathways

<u>Disease or Syndrome</u>	<u>Remarks</u>
Amoebic Dysentery (Amebiasis)	Epidemics mainly by water, endemic spread by water, food, and hand to mouth contact. Resistant to chlorination.
Ascariasis (Giant roundworm)	Usually soil-borne but also waterborne on occasion.
Bacillary Dysentery (Shigellosis)	Also by food and milk, flies, and direct contact.
Balantidial Dysentery (Balantidiasis)	Epidemics mainly by water. Endemic spread by water, food, and flies.
Campylobacter enteritis	Only recently recognized.
Cholera (Classical and El Tor)	Classical waterborne disease, now pandemic. High fatality in untreated cases.
Coccidiosis	Rare, mild.
Diarrheas (Including Weanling Diarrheas) and Gastroenteritis	Clinical syndromes of varied etiology, generally unidentified, especially in LDCs, where frequently listed as the leading causes of death. Primarily fecal-oral.
<u>E. coli</u> (Enteroinvasive) (Enteropathogenic) (Enterotoxic)	Growing understanding of role in diarrhea of children and of travelers.
Enteric viruses	Many are pathogenic. Role not well understood. May cause diseases of central nervous system.
Giardiasis	Receiving increasing attention. Resistant to chlorination.
Hepatitis (Infectious Type A)	Viral disease. Several transmission routes including fecal-oral. 30,000 cases in 1955-56 New Delhi outbreak.

A. MICROBIOLOGICAL (Continued)

<u>Disease or Syndrome</u>	<u>Remarks</u>
Hookworm and strongyloidiasis	Normally larvae in soil penetrate bare skin, usually of foot. May also be transmitted in water.
Hydatid Disease (Echinococcosis)	Transmitted by ingestion of infective eggs in water and food contaminated by dog feces.
Non-cholera Vibrios	Increasingly recognized as a cause of diarrheal disease.
Norwalk virus infection	Apparently a significant cause of diarrhea.
Paratyphoid Fever	Direct or indirect contact with feces or urine of patient or carrier. Indirect spread usually through food, esp. milk and shellfish, and, occasionally through water supplies.
Poliomyelitis	Waterborne transmission has been observed but is rare.
Rotavirus infection	Newly identified agent of infantile diarrhea. Probably fecal-oral.
Salmonellosis	An acute gastroenteric, infectious disease usually spread by fecally contaminated food. Waterborne epidemics are known, e.g. 15,000 cases in Riverside, California in 1966 from contamination of a public water supply.
Schistosomiasis	Waterborne transmission occurs, but skin penetration the major portal of entry.
Travelers' Diarrhea	Often due to one of many serotypes of <u>E. coli</u> .
Trichomoniasis	"Opportunistic" flagellate protozoan intestinal parasite.
Trichuriasis (Whipworm)	Usually soil-borne but also waterborne on occasion.
Typhoid Fever	Spread through contaminated water and food. Urinary carriers frequent in <u>S. hematobium</u> areas. A very serious disease.
Yersinosis	Worldwide but rarely recognized.

* In some fecal-oral diseases, the pathogens may also be found in urine (e.g., typhoid) and vomitus (e.g., cholera).

A. MICROBIOLOGICAL (Continued)

A.2

Other Pathways

<u>Disease or Syndrome</u>	<u>Remarks</u>
Anthrax	Transmission by drinking water dubious although cited by various authors.
Brucellosis	Documented but probably very rare.
Cysticercosis (Bladder Worms)	Ingestion of eggs in food or water. Larval infection with <u>T. solium</u> . Other transmission routes. A serious disease.
Gongylolemiasis (Scutate Threadworm)	Rare. Ingestion of water containing larvae from disintegrated insect hosts.
Guinea Worm Disease (Dracontiasis)	Complex transmission route with intermediate vector (<u>Cyclops</u>). <u>Not</u> fecal-oral. Found only in LDCs and transmitted only by water.
Leeches (Hirudiniasis)	Infestation by young aquatic leeches.
Leptospirosis (Weil's Disease)	A zoonosis. Transmission more often by skin contact with contaminated water.
Liver Fluke Disease (Clonorchiasis, <u>et al.</u>)	Occasional ingestion of drinking water containing metacercariae from decomposed fish. Most infections from eating raw fish.
Melioidosis	Rare.
Sparganosis	Ingestion of water containing <u>Cyclops</u> infected with certain cestode larvae. Other transmission routes.
Thelaziasis (Oriental Eye Worm)	Water transmission rare.
Tularemia	Ingestion of untreated water from watersheds when infection prevails among wild animals, esp. rabbits, is one of several transmission mechanisms.

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B. CHEMICAL AND PHYSICAL

	<u>Disease or Syndrome</u>	<u>Remarks</u>
Metals	Toxicoses	Intake of metals in drinking water, food, and air from both natural sources and human activities. These include arsenic, cadmium, copper, chromium, lead, mercury, selenium, vanadium, zinc, <u>et al.</u> Can be important on a local basis, e.g., arsenic in parts of Argentina.
Organic Chemicals	Toxicoses Cancers Mutations Birth Defects	Intake of certain chemicals, esp. certain synthetic organic chemicals, including some pesticides. Also some trihalomethane byproducts of chlorination are suspect carcinogens. Not now a high priority problem in LDCs.
Radio-nuclides	Cancers	Natural and man-made radioactivity. Not now a high priority in LDCs.
"Hardness"	Cardiovascular Disease	Some epidemiological evidence indicates an inverse correlation of cardiovascular diseases with hardness of drinking water.
Others	Fluorosis	Damage to teeth and bones resulting from long-term ingestion of high concentrations of naturally-occurring fluorides.
	Methemoglobinemia	Serious, sometimes fatal poisoning of infants following ingestion of well waters containing nitrates (NO_2) at concentrations higher than 45 milligrams/liter.
	Endemic Goiter	Iodine-deficient water or water containing goitrogens.
	Asbestosis and Mesothelioma	Asbestos in lungs known to cause cancer. Fate in gastrointestinal tract unknown.
	Hypertension	Sodium-restricted diets necessary for parts of population.

II.

WATER HYGIENE DISEASES
(Transmission Reduced by Use of Water for Cleansing)

<u>Disease or Syndrome</u>	<u>Remarks</u>
A. <u>ENTERIC DISEASES</u> Diarrheas, Dysenteries, Gastroenteritis, etc.	All previous fecal-oral diseases except schistosomiasis, some viruses, and yersinosis.
B. <u>EYE DISEASES</u> Conjunctivitis Trachoma	Inversely correlated with personal hygiene.
C. <u>SKIN DISEASES</u> Otitis Externa Scabies, Skin Sepsis and Ulcers Tineas (Ringworm)	Personal hygiene including bathing and laundering.
D. <u>LOUSE DISEASES</u> Louse-borne Fever Pediculosis Relapsing Fever Typhus Fever Wolhynian Fever	Personal hygiene including bathing and laundering.
E. <u>SOIL DISEASES</u> Ascariasis (Round worm) Trichuriasis (Whip worm)	Fecal-oral spread. Hand washing before handling food and after defecation. Sanitary disposal of feces.
F. <u>OTHERS</u> Endemic Syphilis Leprosy (?) Yaws	General public and personal hygiene.

III.

WATER CONTACT DISEASES

(Transmission by Water Contact with Skin, Eye, or Cavities of Head)

A. DIRECT CONTACT

<u>Disease or Syndrome</u>	<u>Remarks</u>
Enteric Disease	Ingestion during bathing or swimming.
Granulomatous Skin Infections	Mycobacteria in water.
Ichthyotoxicity	Poisonous coelenterates or fish.
Leeches (Aquatic)	Blood suckers.
Leptospirosis	Zoonoses, esp. contact of abraded skin with rat urine.
Otitis media	Ear infection from immersion.
Pharyngo Conjunctival Fever	Virus infection.
Primary Amebic Meningo Encephalitis	Rare but fatal disease of swimmers and divers.
Rhinosporidiosis	Fungal disease marked by large polyps.
Schistosomiasis	Free-swimming cercarial larvae penetrate skin, over 200 million people infected.
Sinusitis	Sinus infection from immersion.
Swimmers' Itch	Avian schistosomiasis.
Tuberculosis	Infection from near-drownings.
Tularemia	Inoculation of skin with blood or urine of infected animals.

B. INDIRECT CONTACT

African Trypanosomiasis (<u>T. gambiense</u>)	Riverine tsetse flies (e.g. <u>G. palpalis</u>) live and bite near waterholes, especially in dry season.
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IV.

WATER VECTOR HABITAT
(Transmission by Vectors Living All or Part of Life in Water)

<u>Disease or Syndrome</u>	<u>Remarks</u>
A. <u>SNAIL VECTORS</u>	
Schistosomiasis	See earlier remarks.
Clonorchiasis (Asiatic liver fluke)	Human infection by eating raw or partly cooked fish.
Diphyllobothriasis (Fish tapeworm)	Human infection by eating raw or partly cooked fish.
Fasciolopsiasis (Intestinal fluke)	Human infection by eating raw aquatic plant, especially water chestnut.
Paragonimiasis (Lung fluke disease)	Human infection by eating raw or partially cooked crabs or crayfish.
Others	
B. <u>MOSQUITO VECTORS</u>	
Arboviruses	Many different viral diseases including yellow fever and dengue.
Filariasis	Increasing in populous areas due to propensity of <u>Culex fatigans</u> for breeding in polluted waters.
Malaria	Classical tropical disease.
C. <u>FLY VECTORS</u>	
Loiasis (Loa Loa)	Mangrove fly of genus <u>Chrysops</u> . West and Central Africa.
Onchocerciasis	<u>Simulium</u> spp. breed in flowing water.
African Trypanosomiasis (Sleeping Sickness)	See earlier remarks.

Table 4

HUMAN ENTERIC VIRUSES THAT MAY BE PRESENT IN WATER

Virus group	No. of types	Disease caused
Enteroviruses:		
Poliovirus	3	Paralysis, meningitis, fever
Echovirus	34	Meningitis, respiratory disease, rash, diarrhoea, fever
Coxsackievirus A	24	Herpangina, respiratory disease, meningitis, fever
Coxsackievirus B	6	Myocarditis, congenital heart anomalies, rash, fever, meningitis, respiratory disease, pleurodynia
New enteroviruses	4	Meningitis, encephalitis, respiratory disease, acute haemorrhagic conjunctivitis, fever
Hepatitis type A (probably an enterovirus)	1	Infectious hepatitis
Gastroenteritis virus (Norwalk type agents)	2	Epidemic vomiting and diarrhoea, fever
Rotavirus (Reoviridae family)	?	Epidemic vomiting and diarrhoea, chiefly of children
Reovirus	3	Not clearly established
Adenovirus	>30	Respiratory disease, eye infections
Parvovirus (adeno-associated virus)	3	Associated with respiratory disease in children, but etiology not clearly established

Note: Other viruses which, because of their stability, might contaminate water are the following:

- (1) SV40-like papovaviruses, which appear in the urine. The JC subtype is associated with progressive multifocal leukoencephalopathy.
- (2) Creutzfeld-Jakob (C-J) disease virus. Like scrapie virus, the C-J virus resists heat and formaldehyde. It causes a spongiform encephalopathy, characterized by severe progressive dementia and ataxia.

Source: World Health Organization. "Human Viruses in Water, Wastewater and Soil." WHO Technical Report Series 639. Geneva: P. 7. 1979.

(1.B) Waterborne-Chemical Diseases:

Basically, these are illnesses associated with ingestion of water containing toxic substances in harmful concentrations. These may be of natural origin or man-made. They are generally locality-specific. Interventions include their removal (generally expensive) or selection of alternate sources. On a global basis, these are not major problems in non-industrial countries and are generally of lower priority to AID than microbiological diseases.

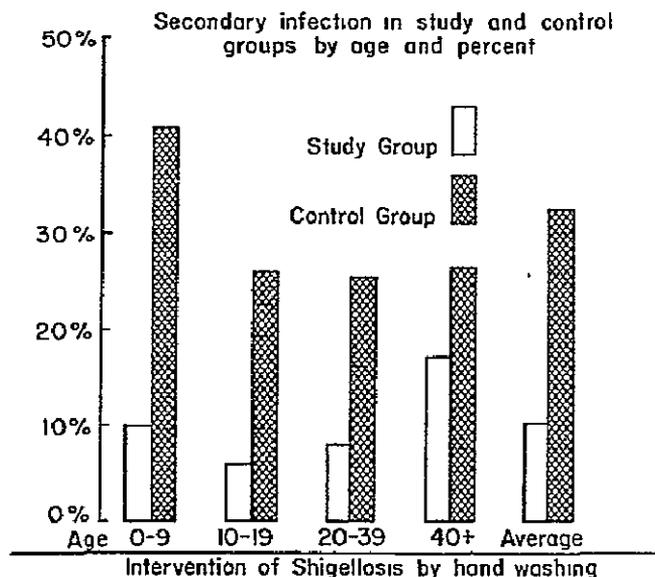
(2) Water Hygiene Diseases:

These are diseases whose incidence, prevalence, or severity can be reduced by using water to improve personal and domestic hygiene. These include many of the fecal-oral transmission diseases also listed as waterborne. Most of these diseases may also be transmitted by food, hand to mouth contact, and by numerous other means. Some of them, e.g., shigellosis, are possibly more predominantly transmitted in these ways than through drinking water.

Other hygienic diseases include those of the skin (example: tinea) and eyes (example: trachoma). Some hygienic skin diseases are associated with insect infestations; for example, scabies is caused by mites, pediculosis by lice. Lice also can transmit other diseases, for example, typhus.

Sufficient water must be available for hand washing, bathing, laundering, and cleaning of cooking and eating utensils. This quantity is needed in addition to that used for drinking. See Figure 3 for impact of hand washing in Dacca, Bangladesh (ICDDR, 1979). The principal intervention to prevent the spread of diarrhea was to provide soap, water and advice for washing hands before eating and after going to the bathroom to families of patients with proven shigellosis. This succeeded in reducing the rate of secondary transmission of shigella within families by a factor of more than four in Dacca city.

Figure 3



**EFFECT OF HAND WASHING ON THE SPREAD OF SHIGELLA
IN FAMILIES IN DACCA CITY**

Studies of Epidemics

Snow's and Koch's findings have been duplicated for hundreds of common-source outbreaks, due to cholera, typhoid fever and other enteric diseases. No doubt remains that these diseases can be transmitted by drinking contaminated water.

Waterborne diseases were widely prevalent in the U.S. and in other western countries during the late 19th and early 20th centuries and were then among the leading causes of death and illness. Many of our largest cities suffered through awesome cholera outbreaks during the 19th century pandemics.

The decline of waterborne diseases in the U.S. closely paralleled the establishment of public water supplies and sewerage and, it should be noted, economic development. Correlations were particularly strong for cities taking their water supply from unprotected watersheds with major declines following first, filtration, and then, chlorination of their water supplies. Many epidemic outbreaks were traced to breakdowns or other deficiencies in community water systems.

Studies of Endemic Diseases

Although control of epidemics is important in the developing world, the on-going, continuing, everyday levels of disease are more important - if less professionally exciting - in the aggregate.

Endemic disease is not so clear-cut in its relationship to water supply: as Figure 2 shows, there are alternative routes of transmission. However, both the experience cited earlier, a mammoth body of empirical evidence, and over 50 published studies support the water supply and health relationship. Although the relationship exists, it is not easy to quantify, either prospectively or in retrospect.

An extensive World Bank review (Saunders and Warford, 1976) found that:

Other things being equal, a safe and adequate water supply is generally associated with a healthier population. This has been unequivocally demonstrated for urban areas and in varying degrees for rural situations. The difficulty lies in measurement rather than in qualitative trends. The problem with collecting field observations on the health effects of water supply is that on a cross-section basis other things are never equal and on a through-time basis other things usually cannot be held constant or accurately controlled. Consequently, it is extremely difficult to identify and measure exactly the health effects of improved water supply, and there is a limit to the precision attainable. Furthermore, even if a case were found where governmental, physical, environmental, economic, cultural and educational factors which affect health could be reasonably controlled, the detailed findings of a health and water supply study are unlikely to be transferable from that particular setting to situations elsewhere.

Other reviews include McJunkin (in process), Miller (1962), National Academy of Sciences (1977), Wall and Keeve (1974), White, Bradley, and White (1972), and World Health Organization (1980).

A fallacious argument is sometimes advanced that quantity of water is important, quality of water is not. Economically - and inevitably - only one water supply is feasible; this must provide waters for both drinking and hygiene. Microbiologically, safe water can satisfy both purposes: even large quantities of unsafe water cannot. Even where waterborne transmission does not appear to be endemic, the epidemic risk of common source outbreaks in community water supply systems should be avoided by public agencies. In the majority of instances, the cost differential is negligible.

(3) Water Contact Diseases:

These are diseases transmitted by skin contact with pathogen-infested water. The most important of these diseases is schistosomiasis (bilharzia). Schistosome eggs in human excreta hatch on reaching water. The resulting larvae must invade suitable snail hosts or perish. Following a multiplication process within the snail, the free-swimming schistosome larvae (cercariae) escape from the snail, find, and invade man by penetrating his immersed or wetted skin.

This important tropical disease infects over 200 million people and its prevalence is probably increasing. Current control methods, primarily drugs for those infected and chemical control (mollusciciding) of snails, have had limited success. Both of these methods require periodic repetition.

Controlling schistosomiasis by limiting the need for human water contact through provision of public water supplies has shown promise in St. Lucia, Brazil, Puerto Rico, and South Africa and is being tested in Swaziland by UNEP/UNICEF/WHO. Figure 4 shows the favorable impact of water supply on schistosomiasis (Unrau, 1979).

(4) Water Vector Habitat Diseases:

These are diseases which are dependent during part of their life cycle on animal vectors which live all or part of their lives in or adjacent to a water habitat. The archtypes are schistosomiasis (associated with snails), malaria (associated with mosquitoes), and onchocerciasis (associated with aquatic flies).

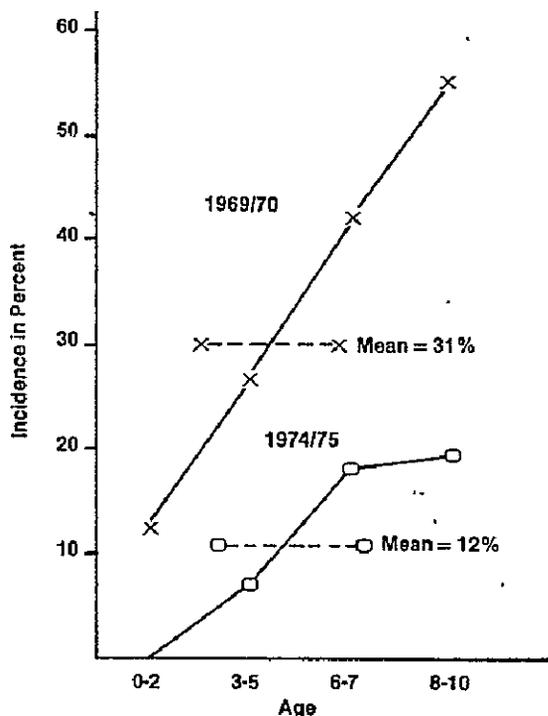
The relationship of schistosomiasis to water supply was previously described. Water supply has little role in other snail-vector diseases which are not dependent on water contact. Sanitary excreta disposal could theoretically interrupt the life cycle of this disease. However, this has not been demonstrated in practice. The issue is further complicated by the presence of the diseases in wild and domestic animals.

Mosquito-vectored diseases are not affected by water supply except, sometimes, in a negative way. Breeding may be promoted by sullage and wasted water and uncovered water storage containers. Filariasis transmission in many urbanized areas is increasing where the vector Culex fatigans breeds readily in polluted ditches and streams and even in privies flooded by high water tables.

Other than direct attacks against the vectors, i.e., spraying of insecticides, sanitary engineering has little direct impact on aquatic fly-borne diseases. An indirect effect of water supplies is to reduce human contact with tsetse flies, vectors of African trypanosomiasis (sleeping sickness), which for certain species are found primarily in riverine habitats. These same habitats are often the source of hand carried water supplies, particularly during dry seasons and droughts (Nash, 1970).

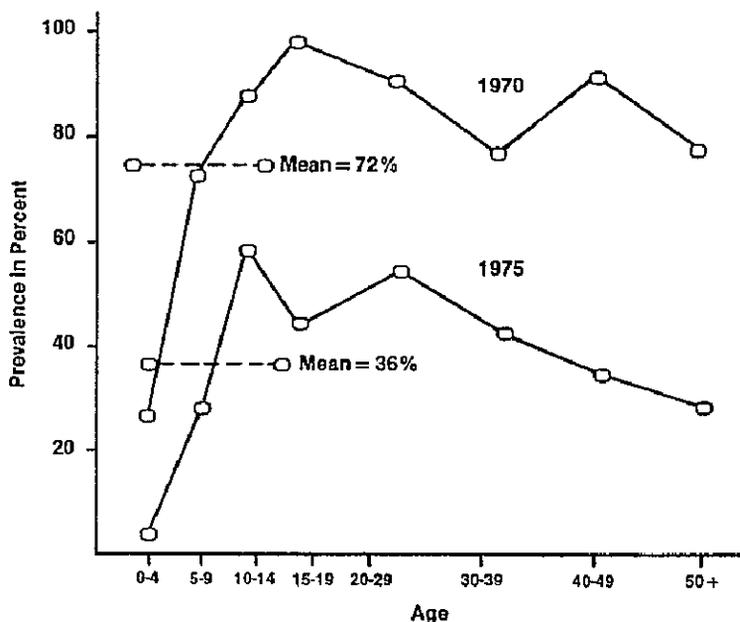
Figure 4

INCIDENCE OF NEW *S. mansoni* INFECTIONS BEFORE AND AFTER 5 YEARS OF WATER SUPPLY IN GRANDE RAVINE, ST. LUCIA



Source: UNRAU, G.O. "Water Supply and Schistosomiasis in St. Lucia." *Progress in Water Technology*, 11 (1/2): 181-190 1979.

PREVALENCE OF *S. mansoni* INFECTIONS AFTER 5 YEARS WATER SUPPLY IN GRANDE RAVINE, ST. LUCIA



Source: UNRAU, G.O. "Water Supply and Schistosomiasis in St. Lucia." *Progress in Water Technology*, 11 (1/2): 181-190 1979.

(5) Excreta Disposal Diseases:

These are diseases whose transmission may be effectively interrupted by sanitary disposal of human feces and urine. They include most of the fecal-oral diseases previously described under 1.A. Waterborne diseases; (theoretically) the snail-vectored parasitic diseases; and the following helminthic infections of the intestinal tract: ascariasis (ringworm), hookworms, strongyloides (threadworm), trichuris (whipworm), and several others of lesser importance. Ascariasis and trichuris are fecal-oral route diseases primarily by hand to mouth and by ingestion of contaminated soil.

EPILOGUE

The list of diseases related to water is long. The prevalence of these diseases is widespread and high in the LDCs. In many LDCs, they are among the leading causes of death, often first but invariably among the top ten. They weigh heavily on the poor and are especially deadly to infants and small children. They are exacerbated by increasing population densities.

Safe, convenient, reliable water supply and sanitary excreta disposal are basic human needs for healthy, productive lives. Without them, maintenance of a healthful environment is practically impossible. Nevertheless, they are not in themselves sufficient to assure good health. People must use them properly and this requires education in health and hygiene. They must be accompanied by adequate nutrition, food sanitation, security, housing, primary health care, and adequate institutions and infrastructure for their long-term finance, operation, maintenance, and replacement.

FOOTNOTES

1. Some Shigella are very virulent, i.e., they are infective at very small dosages. However, they have a low lifespan in natural waters and are rarely identified during waterborne epidemics. They may be the causative agents of much "non-differentiated diarrhea."

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ANNEX 1

ESTIMATED POPULATION HAVING REASONABLE ACCESS¹
TO SAFE WATER² IN 1975 IN 71 DEVELOPING COUNTRIES³

WHO Region (Countries)	Population					
	Urban ⁴		Rural ⁴		Total	
	Millions	Percent	Millions	Percent	Millions	Percent
Africa (16)	14,152	65	19,272	21	32,710	29
Americas (21)	145,650	81	21,753	30	104,091	57
Eastern Mediterranean (15)	46,272	80	23,955	16	67,673	34
Europe (2) ⁵	10,980	81	20,180	63	40,160	71
South-East Asia (8)	127,521	68	145,118	19	272,639	29
Western Pacific (9)	36,036	91	18,046	30	54,082	54
TOTALS⁶	450,000	77	313,000	22	763,000	38

NOTES:

- ¹ "Reasonable access", in an urban area, was defined as a public fountain or stand post located not more than 200 meters from a house. In rural areas, reasonable access implied that "the housewife or members of the household do not have to spend a disproportionate part of the day in fetching the family's water needs."
- ² "Safe water" supply includes treated surface waters or untreated but uncontaminated water such as from protected boreholes, springs, and sanitary wells.
- ³ Not including the population of China.
- ⁴ The national definition as determined by each country.
- ⁵ Algeria and Turkey
- ⁶ Extrapolated to include the 95 countries surveyed in 1970.

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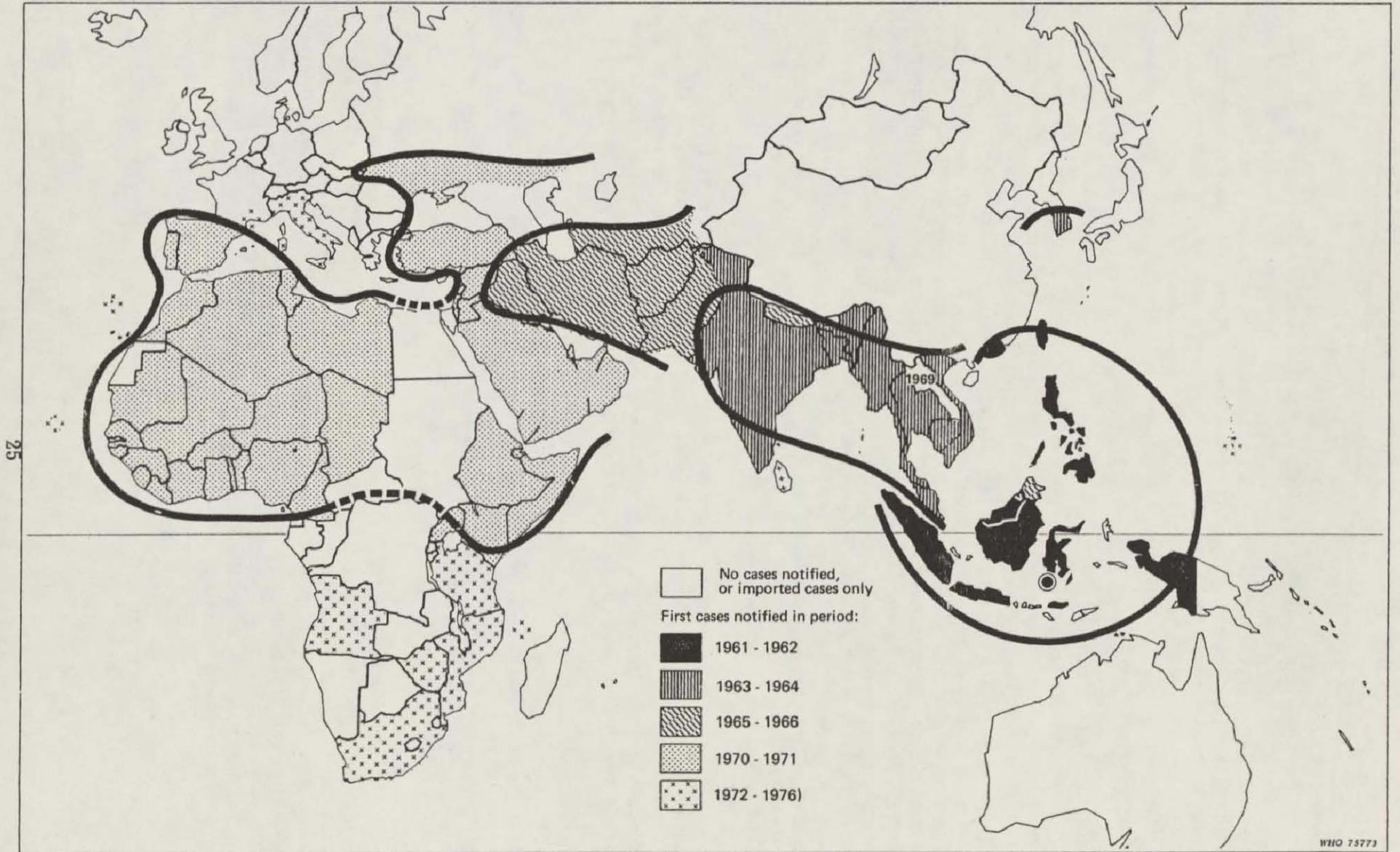
ANNEX 2

Estimated Proportion of Preventable Water- Related Disease in East Africa in 1966

<u>Diagnosis</u>	<u>Percent Reduction Expected if Water Supply Were Excellent</u>
Guinea Worm	100%
Typhoid	80
Urinary Schistosomiasis	80
Leptospirosis	80
Trypanosomiasis, gambiense	80
Scabies	80
Yaws	70
Inflammatory Eye Disease	70
Schistosomiasis, unspecified	60
Trachoma	60
Bacillary Dysentery	50
Amebiasis	50
Dysentery, unspecified	50
Tinea	50
Gastroenteritis, 4 wk to 2 yr	50
Gastroenteritis, over 2 yr	50
Skin and Subcutaneous Infections	50
Diarrhea of the Newborn	50
Paratyphoid and other <u>Salmonella</u>	40
Louseborne Typhus	40
Intestinal Schistosomiasis	40
Ascariasis	40
Louseborne relapsing fever	40
Otitis Externa	40
Classic Skin (leg) Ulcer	40
Trypanosomiasis, unspecified	10
Dental caries	10
Overall	52

Adapted from White, Gilbert F., Bradley, David J. and White, Anne U. Drawers of Water/Domestic Water Use in East Africa, Univ. Chicago Press, Chicago, pp. 189-196. 1972.

PROGRESS OF THE SEVENTH PANDEMIC OF CHOLERA (1961 - 1976)



DISCUSSION

DANIEL OKUN:

Now we come to what I trust will be the most fruitful part of our session, the opportunity to hear from you. As you direct some questions to the speakers you will allow them to get a feeling of the real issues troubling those of you who have responsibilities with an AID-type agency. I could point a finger at quite a few in the audience who have wide experience, more than all of us up here, and I am sure have something to say in connection with what has already been introduced. But before I call on them, I would rather open the floor to whomever would like to start the ball going. I have some questions of my own as well.

HOWARD KELLER:

My experience in water is quite limited, but I have come across something that some people may not have seen or they may have seen it and overlooked it, perhaps because they come from a different discipline. I am not an engineer, but about nine months ago I was taken to a market town in the Punjab in Pakistan and shown a water supply that the local authorities had built with their own money. With about one-half million dollars worth of local currency they had built a serviceable water supply. They had a deep well, a good source, an elevated reservoir, and adequate pressure to distribute it through a piping system all over the town. They built it in coordination with a sewerage operation that was being put in with World Bank money. They were a little ahead with the sewers, which often happens, and they were very proud of this thing. They even chlorinated it. Not with any scientific formula, but every once in a while, they sent a man up with a few bottles of bleach and they threw it into the water. So they were doing that. And I asked how many hookups they had. I forget the figures. I don't know how many people lived in the town, but there were less than 1000 hookups.

It wasn't being used and we asked why. The proud engineer said, "Why in this town, almost everyone has a pump in his kitchen." So while Gene was mentioning the importance of the source of the water being an unpolluted one, it is also important to work out adequate criteria for site selection so that you build a system where it can be used. The people who built it may have had another agenda than just building the system.

QUESTION:

Gene, you made the comment that treatment should be avoided if at all possible. That raised the question in my mind about the philosophical issues that have come to bear in recent years about potable water and clean water. Would you talk about the nuances of differences. What are we talking about now in the most desirable consideration in water programs?

DR. McJUNKIN:

It's all relative. I think we are talking about microbiological standards that here would be one coliform bacteria per 100 milliliters of water. Coliform bacteria are "indicator organisms" (i.e., surrogate measures) of the potential presence of pathogenic micro-organisms which may cause enteric disease, e.g., cholera. In the WHO International Drinking Water Standards you can go up to 10 in individual and small water supplies -- 10 coliforms per 100 milliliters of water. Most people probably would accept 20 per 100 ml. The problem is that the standards are really expedient. From the many sources and types that we see in rural water supplies (springs, wells, both drilled and dug wells) the standard of 10 coliforms

per 100 ml. can be achieved. Now whether that is the standard by the time the woman carries the jug back to the house or her home is another matter. It may be further contaminated. But certainly that is an achievable standard.

These standards were not derived from first principles. They were what was feasible. And these standards have been proved over a long period of years to stop the transmission of enteric diseases.

If you go to 100 coliforms some people may begin to have certain diseases. Some disease organisms are more virulent than others. I think you may have to have a very large dose or a number of organisms to become infected for certain diseases, a small dose with others. Different people also respond differently. For example, Pettenkoffer disagreed with Koch about cholera vibrios. He actually took a vial loaded with millions of cholera vibrios and drank it as a method of disproving Koch. Well, history has shown Koch to be right about the cholera vibrio. Why didn't Pettenkoffer come down ill or even die of cholera? One thought is that he may have had a very acidic stomach which would have killed the vibrios. So all people aren't affected equally. As the situation gets dirtier and dirtier, so to speak, more and more people may come down sick.

But to go back, the first standard is achievable with untreated water supplies if they are protected and sealed and if they are ground water sources, such as a spring or well. Then you get into surface water sources and you also get into piped water systems where you are taking a source of water even from a well and you are piping it to a large number of people. Then if the system is contaminated, the potential is there for a large number of people to become ill at one time, or even for an epidemic. With a very small system, if you had 100,000 people with water supply and no system serving more than 50, then you may have a few scattered outbreaks of 50 or more. If you had a piped system in which one water supply served 100,000 people, it would be possible perhaps to have a huge number of people ill with something. So that might change your mind about the approach you would take.

Certainly one policy question, that comes up is whether to chlorinate or not to chlorinate. We don't have chlorination in the United States for 12 million people that are served by public water systems but these are all very small ground water systems. In fact the state health department in North Carolina tried to get such a law and the trailer operators and the small real estate developers who owned these small systems beat them down. It wasn't politically viable.

On the other hand, a very large community with a piped water system probably should chlorinate even to maintaining residual chlorine in the system.

If you start chlorinating, you can chlorinate clear water. But when you get to highly turbid water, then the chlorine loses effectiveness so then you have to treat. And if the water is in really bad shape, you have operational problems.

The reason I said to avoid treatment is that so many of the problems in rural water supplies come from maintenance. I don't think it is just a question of cost, it is a question of operation and reliability.

DR. OKUN:

I might just add one comment and that may help put this in perspective. We have a standard in the U.S. of one coliform organism per 100 ml. This is promulgated by the World Health Organization for industrial countries. In the U.S. we could actually violate this standard without really causing us any problem. The reason we could tolerate much more lax standards here is because there really isn't very much waterborne disease in this country. Very few people have cholera. I don't believe there is any cholera in the U.S. We have very little typhoid and very few enteric diseases. So it is not so important for us to have a high standard. We could afford to let our guard down; although, don't let the public health people hear me say this.

If we did let our guard down it would not be so serious here. On the other hand, in a country like Egypt the prevalence of typhoid and cholera and enteric diseases is generally so high that even if the water met our standards, we cannot be quite sure it would be safe. Now does this mean that we have to impose a much more rigorous standard on Egypt than we might have ourselves? Then it gets into the problem of expedience. What is financially feasible? What is necessary? Can we try, in comparing the options, to provide a perfect situation and thereby perhaps restrict our water service to a small number of people, or should we recognize that there is some risk and perhaps not try to meet so high a standard? As you can see, there is not an absolute standard. A standard cannot be isolated from the cultural and economic and social setting in which it is imposed.

BRANKO CVJETANOVIĆ:

What you said about a standard could be argued in many ways. One could argue, for example, that the American population, not having been exposed to these enteric diseases, is highly sensitive and non-immune and so a small quantity of germs could cause the disease.

But I think that brings up your second point that there are no actual standards. This is of extreme importance considering that we have to supply a great number of people in the world with as much water as possible for as low a cost as possible. Therefore, we should not impose the standards unless we have justification for doing so. I think also that we should not take this long list of waterborne diseases which Gene McJunkin magnificently presented this morning as a standard. I think the list is very short; the actual problem diseases are very few. Enteric diseases, for example, are more than 80 percent of the whole problem. If you cut the list to a few of these diseases then your standards are guided a little bit. On the other hand, if you wish to suppress the rotavirus or other virus in the water, that would require tremendously higher standards.

So, one should judge everything from the actual situation. I think then one can ease the requirements to such an extent that with the available resources we can cover more population by being at one end flexible and on the other cautious enough looking at the actual situation. I think this is an extremely important issue not to be overlooked when dealing with the decayed and developing countries. Everybody is aware that we have to achieve as much as possible, but we do not want to impose anything that would make it impossible to reduce some of these standards if they prove unnecessary. To my mind, some are very stringent and it is not necessary that they be kept.

Finally, to go one step further, it is better to have polluted water to start with than to wait for years and years for good water. So I would even consider that it would be justified to go below what would be ideally required rather than to prevent some kind of intermediate solution.

STEPHEN JOSEPH:

I would like to try to be provocative, to lay something out here early that relates to what I think the real issue is, what this seminar is about and should address. I think agencies such as ours have a tendency to do at least two things. With regard to the construction, (perhaps I should say with regard to the fabrication) of policy, we tend to ignore data and objective evidence.

The second thing that we have a tendency to do is with regard to budgeting and programming. Once we have fabricated our policy or constructed our policy by ignoring the data, we then construct our programs and budgets by ignoring the complex interrelationship between the things that we have ignored the data about. And so we hang on to simplistic kinds of explanations for one phenomenon or another as a basis for programming and budgeting. Now in normal times, if there are indeed any normal times, that may not matter so much because we all ignore what each other is doing and do our own little thing within an area which is really very complexly tied to many other areas. But in the time of either great expansion or great contraction in a given area, this becomes a terribly destructive phenomenon.

I would submit to all of us that the situation in which we find ourselves in water and sanitation is at the same time expanding very rapidly and contracting very rapidly. It is sort of like a sophisticated model of the universe because we are talking about great expansion and working as if we are having great expansion, particularly around the Decade — John McDonald will speak more about that tomorrow. At the same time, we are facing the budgetary realities that were mentioned this morning by Joe (Joseph Wheeler) and Sandy (Sander Levin). In all spheres, not only in water and sanitation, we are also talking about contraction.

To get to the specific issue, about which I hope to provoke some argument over the next couple of days: despite the tendency to ignore much of the data and then to oversimplify some of the results, the statement is widely made in our agency today — and I will quote exactly as I have heard it from a policy level person in the agency, "Oh, well everybody knows that there is no relationship between water and health; and therefore it makes no sense to invest in water and sanitation projects." Well, we may all smile, because we are here at this conference talking to ourselves as we usually are. But that statement and the attitude that it represents in the agency has great importance in a time of both expansion and contraction. And if one looks at the studies coming out of Bangladesh, and at the Feachem data, that kind of partial analysis, partial digestion of data, and then oversimplification of it, leads to some very real consequences for those of us who are interested in the sector.

Anybody who knows the history of the 19th century or who has practiced medicine or public health in the third world knows that there is a relationship between water and health and that it is a positive relationship. But behind that kind of naive and, I believe, ridiculous statement, there is a much deeper statement.

The statement which has real meaning is, given the conditions of budgeting, programming, implementation and maintenance issues, all the way from some of the ones Gene started talking about to some of the ones that were mentioned over here, what is the connection between investments in water and sanitation and improvements in health and well being and development status of a population? I would hope that we would have some rather direct argument in the seminar about the points on that spectrum where

investment potential really falls. I think that one has to argue about standards and levels of standards and the importance of community participation and the role of the women and the rest. But during the two days I hope we keep our eyes and our tongues on this issue: in a time of expansion and contraction, what is the reality of investing in water supply and sanitation and how can we justify that and how can we rationalize that in terms of improvements in the health of a population, particularly in terms of the other opportunity costs which we will have to forego to the extent that we invest in this very expensive sector.

SANDER LEVIN:

May I just add to that briefly? I think Steve Joseph's comment is especially germane coming after Dr. Cvjetanović. I think it is especially befuddling to raise the question that Steve Joseph has so starkly raised right after the comment that there really are not any standards that have any relevance beyond each individual situation. That isn't quite what you said; but I am trying to sharpen it a bit.

It is confusing when one comes to try to set priorities and to carve out programs and to put together, fabricate or otherwise, policies. It is one thing, it seems to me, to say that every program has to be country-specific, which is such a truism that we should not repeat it. We ought to assume it. But it is another thing to say, it seems to me, that a little bit is better than nothing and every bit beyond a little bit is better than the previous and therefore there may not be any particular guidelines that can be adopted. I at least find the need for there to be a little more guidance to the work of development agencies and most importantly to LDC's than the notion that a little bit is better than nothing. I think you need to provide some kind of guideposts, or there have to be some kind of guideposts provided or otherwise there really is more chaos than there is programming. This serves as a layperson's reaction to your comments before Dr. Joseph's.

DR. G. WHITE:

I wonder if I could make a comment because I think perhaps you have lost his point, which was a very important one. What he said; as I understood it, was that each additional unit of resources employed to make the water pure, to reduce the bacteria count, pays an opportunity cost. There is a foregone use for those resources. If you like, you could look at it in terms of other water treatment. What he was saying was that for any given water project, we always want to ask on the margin: if we put another unit of resources into that project we will have some improved health status for the beneficiaries. But we are giving up something. What we are giving up is the alternative use of those resources in another water project or indeed in a non-water project. It seems to me that the reason there is no absolute standard is because we are really looking at it in terms of an implicit kind of cost benefit analysis. So it makes no sense to say that there is an absolute standard.

It's like malaria. How low should you get the parasite rate? When malaria eradication programs were converted into malaria control, all of a sudden people realized that the program no longer had a clearly stated objective. Eradication was clear, but control — how much control. Again, you approach it in precisely the same terms. I think that point should be clear and is a very important one.

MR. LEVIN:

Could I respond to that by saying that I think there must be something in between absolute standards which I am opposed to, and which I find unconvincing in any field, and none.

DR. OKUN:

Let me use the chairman's prerogative because there is a very important item on the agenda, the coffee break and we are already 5 minutes late for it. But I believe that the beginning of the comments of Dr. Joseph's and the last few comments, put the two day seminar in perspective because the first presentations are really devoted to providing some baseline of information for those of us who are not specialists in the field so that at least we know what we are talking about. Then, if you will notice, later on this afternoon and particularly tomorrow, we do get into the economic and social aspects.

The fact is, we are dividing a pie of fixed dimensions amongst many competing needs and this has to be directed. It's not only how we divide the water supply and sanitation pie amongst different ways of using those resources, but how these resources can compete with resources that are being cried for in other sectors of the economy of a developing country. With that, let me take the liberty of declaring the meeting adjourned.

Sanitation and Health: An Overview

David Donaldson, Regional Advisor in Rural Water Supply and Sanitation, Pan American Health Organization

I was very pleased to hear Mr. Wheeler express concern for sanitation because it is a subject which is oftentimes forgotten. Too often, we hear one say, "The International Decade for Water Supply..." and then something more is said. One is not sure but it kind of trails off as "...and sanitation." I also agree very much with his concern that we need to talk in terms of a package which one could describe as the provision of the adequate quantities of safe drinking water coupled with the appropriate methods for the disposal of human excreta.

Within this whole subject of health, water supply and sanitation, I want to discuss sanitation as I see it. I agree very much with Dr. Okun that water supply and sanitation are a continuum and represent an urgent need in a country. What we are really talking about is the time phasing for different events. Sanitation is a complex of activities that will develop and maintain an environment for the family unit where it lives, works and plays. Sanitation will not allow the environment to degrade so as to have an adverse impact on health. From a practical standpoint, that definition translates into a package which includes adequate quantities of safe drinking water, delivered as close as possible to the point of use, and socially acceptable methods for removing human excreta from the family's immediate environment. It is that package that I want to talk about.

Water supply and sanitation has to be provided at a cost that people can afford. The package also must be in a form that will enable people to use it and to maintain it over the long term. These caveats are extremely important in what we are trying to do.

Looked at in another way, I have illustrated what I call circles of defense (Figure 1). At the center you have the family and then a series of circles that relate to water supply. The first set of circles is about 1-2 liters per capita per day. You need that to stay alive over the long term. Then you begin to supply more and more water until you come to something that I'm calling a public health water supply. The figure I show here is 30 liters per capita, but in reality it varies greatly with temperature, altitude, social factors, etc., but if we had to pick a number designating how much water we could provide on a consistent basis, as close as possible to the point of use, about 30 liters per capita per day would be a good figure. From there you begin to upgrade into a whole series of other things leading to commercial use of water, lawn watering and all of that. But it is in this 30 liter area that we are concentrating our attention over these two days.

Rather than go into a list of diseases and their vectors and what have you, I would like to try to approach this problem in a slightly different way. I want to talk about how disease is transmitted and about some of the problems in transmitting the disease, hopefully to identify some strategies relating to this and to show where we can begin to take some action. Before we can go in and start to break chains, however, we have to have a fundamental understanding of how diseases are transmitted.

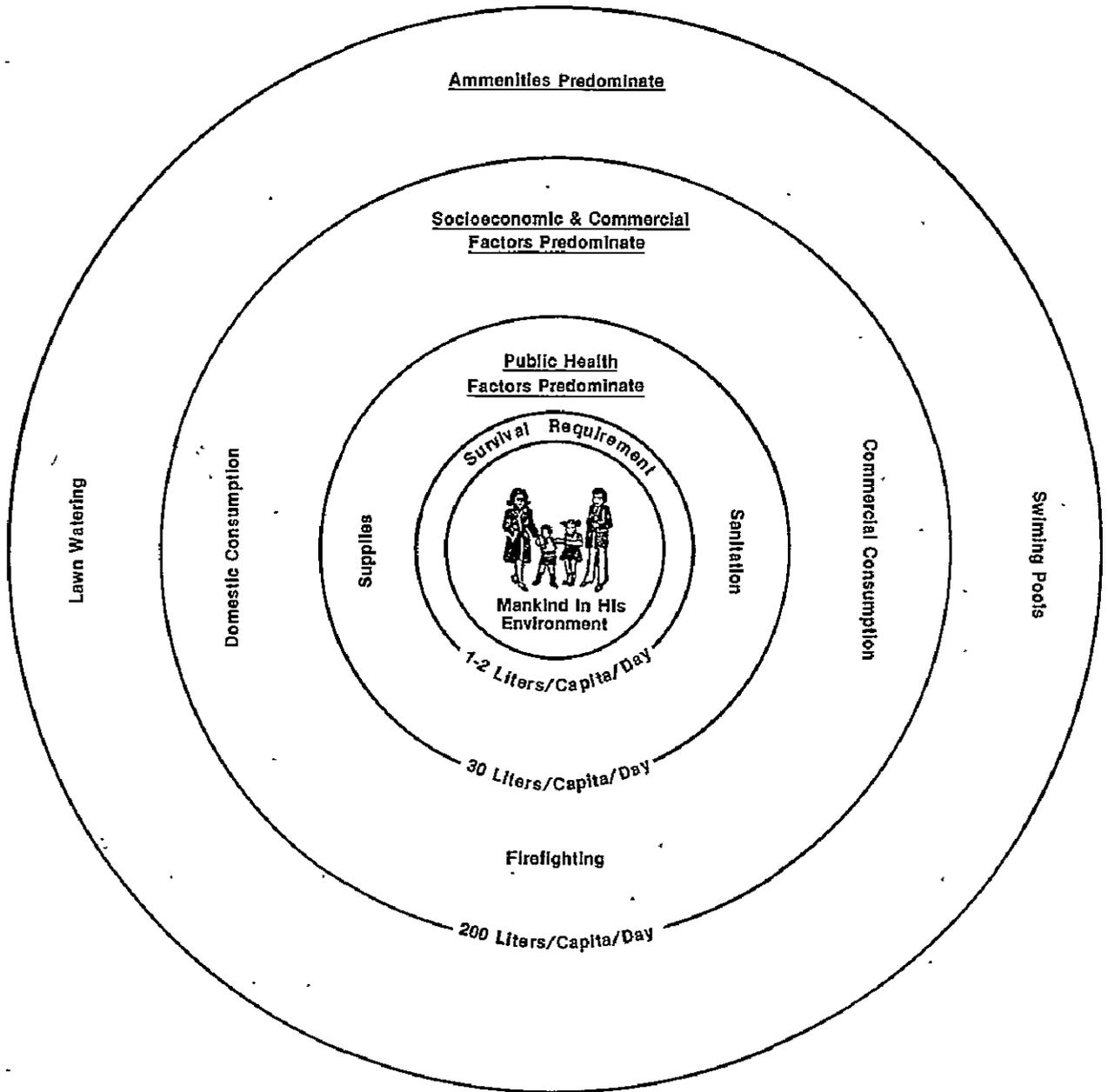


Figure 1. Water Quantity vs. Usage

As one approaches pathogens, their survival and the amounts you have to put into the environment, there are a number of factors we should look at.

The disease organisms are placed into our environment under a number of conditions. It depends on the numbers of organisms that are excreted by the people. It depends on how these pathogens, once they are placed in the environment, are affected by it. The last factor is the dose rate that we have to have in order for people to get sick. Do people get sick because they ingest one cholera vibrio? Do they get sick because they ingest a million? It makes quite a difference. I want to speak a little bit to these three factors and then try to see how we can work with them.

The fundamental factor that we are working with is the excreta load that is placed in the environment. What we want to look at in that material is the concentration of the pathogenic organisms. For example, a cholera carrier may excrete from 100 to about 100,000 vibrios per gram of feces. But in an active case that will go up to as high as 10^{13} in any particular day. As you look at particular diseases, you need to look at the load that is being deposited, the concentration of the diseases that are in that particular load. That will depend on the amount of disease that is currently epidemic or endemic in the population at risk.

Dr. Cvjetanović was pointing out that we have a long list of diseases. Gene McJunkin showed us four or five pages; but of the four or five pages, really only about five or six are extremely critical diseases that we are going to have to handle. Diarrheal diseases fall into this category of disease about which we are going to have to do the most. Once you have placed the pathogen into the environment, certain other factors begin to come into play. There are factors of latency, persistence and multiplication.

Latency is the time required in the environment to become infectious. Not all pathogens, at the moment that they enter the environment, are infectious. It so happens that the latency of diarrheal disease is about zero. It is infectious at the moment that it is placed in the environment, although the survival times on some of the pathogens vary quite a bit. For example, a cholera vibrio will survive in the environment for about a month; whereas, some viruses and other pathogens can survive up to a year. Again, this knowledge helps you know where to intervene in the cycle to break it. Unfortunately the data we have are quite general and are based on very few studies, but one of the best is Dr. David Bradley's work for the World Bank.

Once you have placed the material into the environment, looked at how much of a load it has and seen its latency, you need to look at its multiplication. How does it multiply? Here again you have another opportunity to go in and break one or another of the cycles. It is generally believed that the bacterial pathogens and protozoa do not multiply in most waters, and that the diarrheal associated viruses and protozoa cannot multiply in any environment outside their animal host. Recently, however, there have been a few studies indicating that this may not be as absolute as we would like. But in general, the diseases we find most critical are not multiplying in the environment; they are multiplying inside the human body.

The next topic is infectious dose. As I said earlier, the possibility of getting cholera from one cholera vibrio is very low. The available studies on dose rates must be taken with a grain of salt. (See Table 1). Oftentimes they state a number, but such numbers can vary quite a bit. For example, the dose rate that you have to take in order to come down with a case of cholera varies considerably with stomach acidity. Although dose rates are indicated in a number of different tables in the paper I wrote up, they vary making

Table 1

Median infectious dose of diarrheal pathogens
in adult volunteers in USA

<u>Pathogen</u>	<u>Median infectious dose (organisms)</u>
<u>Shigella*</u>	$10^1 - 10^3$
<u>Salmonella*</u>	$10^5 - 10^8$
Enterotoxigenic <u>E. coli</u>	$10^8 - 10^{10}$
<u>V. cholerae</u> (classical)	$10^8 - 10^9$

*Dose dependent in part on serotype.

Source: WHO. Environmental Health and Diarrheal Disease
Prevention, 1980 WHO/DOC/80.5.

it very difficult to come up with a fixed number. So you have a range of numbers. Once again, it is like our 20-30 liters of water. We are talking about this under normal conditions and one has to be quite aware of the limitations of these numbers. These figures reveal the median infective dosage for diarrheal diseases. As you move away from the diarrheal diseases into some others, such as viruses, the infective rates are quite different.

Within that same group of problems of latency and multiplication, you have the question of persistence. Persistence is the ability of the pathogen to survive for a period of time in the environment. This particular property is probably one of the best indicators of the organism's capability of being transmitted. The persistence of diarrheal pathogens has not been studied comprehensively and most available data come from studies of classical bacterial pathogens under controlled laboratory conditions or in long established sewage treatment processes. Again, this is another area in which a great deal more needs to be done. As I said earlier, the diarrheal pathogens, which are fundamental problems, tend to persist short times in the environment and the transmission tends to be through person to person contact and as a consequence of poor personal hygiene. By studying these characteristics of the disease vector you begin to find clues leading to the identification of appropriate measures which one can try in order to improve the health of the people of the population at risk.

I would like to say a bit more about modes of transmission, again focusing attention upon the diarrheal diseases, mainly because these constitute the principal figures concerning the use of hospital beds in developing countries for children. The principal problem, at least as it figures in Latin America, is diarrheal disease among children in the under-five age group. As you look at the modes of transmission of diarrheal and other diseases, you begin to see similar patterns. Time after time you see fecal-oral transmission as the principal disease transmission pathway. As you go through other lists, you see other modes of transmission: feces containing immature eggs, feces, and mature eggs from human or animal feces.

One of the principal problems in sanitation is to contain human excreta in such a manner as to remove it from the immediate environment, store it over a period of time which will carry it past the latency, multiplication, persistency period, and then dispose of it, ultimately in a way which will do no damage. All of these charts get tied together in the device we call in the village situation, a latrine, which is nothing more than a device which responds to this infective dose, this latency, this persistence, etc.

In the broadest sense sanitation is a dynamic process. It starts as a hole in the ground, but as John Kalbermatten and his group have shown, there are stages. Latrine technology, including what we have not known, or what we have known and seem to have forgotten, is only part of the picture. We now realize we must include such concepts as the separation of the urine and the fecal matter, as this changes the chemical reaction completely and can speed it up quite a bit. The whole question of sizing latrines introduces other aspects of technology. But as one enters the sanitation process, you have to remember it is a dynamic process. Too often in the field of water supply and sanitation, we approach the building of a water supply or the building of a latrine as if that were the end product. But in a developing country you then have to understand the whole process. What are the next steps in the sanitation process? Several recent papers by John Kalbermatten at the World Bank have described these steps very nicely. If you are interested, I can make them available to you.

Next, I would like to look at some of the public health strategies that respond to diarrheal diseases associated with water supply and sanitation. (See Table 2). Basically, in

Table 2

METHODS OF CONTROLLING WATERBORNE DISEASE

VS

DESIRED LEVELS OF HEALTH

Methods Used to Control Public Health Problems	Level #1 Maintenance of Public Health Problem at an Acceptable Level	Level #2 Reduction of Public Health Problem to an Acceptable Level	Level #3 Prevention of Problem
1. Separation from Infective Agent			
- Increase quantity of Water	+++	++*	++*
- Provision of basic sanitation	+++	+++	+++
2. Dilution of Invective Agent			
- Improve Water Quality			
- Bacteriological	++	++	++
- Chemical	+	+	-
- Increase Quantity of Water	+*	++ (Depends on problem)	+*
3. Removal of Infective Agent			
- Chlorination	+++	+++	+++
- Filtration	+++	++	+

* Limited value over \pm 30 liter /caput

public health, we can isolate the person from the infectious agent. We can do that by increasing the water supply and providing basic sanitation. Thus, we have an isolation strategy. We also have a removal strategy, that is, remove the infective agent from the immediate environment.

Usually when you go into the developing country initially, you are trying to reduce the sanitation problem to some acceptable level through separation, dilution and removal. Once you have reduced it, you are then talking about a maintenance situation. In most cases, this is what we have here in the United States, a maintenance situation. And then there is the prevention of the problem. As you begin to think in terms of separation, dilution or removal, you have also to think in terms of maintenance, reduction and prevention. I have played with the elements of water supply and basic sanitation and tried to assign some value. We can argue all day as to some of the assignments of values, but this type of thinking is what you, as public health people, as administrators, etc. are going to have to have somewhere in your minds as you design the programs for water supply and sanitation.

Another way is by thinking in terms of a classification which Dr. White and Mrs. White have developed. (See Table 3). Here you have bacteria, here you have particular diseases, and over here you have various interventions such as a latrine, chemicals, or medicine. This type of approach, again, is in relationship to maintenance, reduction and/or prevention. In other words, if the problem that you choose to try to solve is cholera and if you are trying to pull it down very quickly, some combination of immunization, water supply and basic sanitation would be a likely measure.

Before I open the subject for discussion, I want to make one additional set of comments. The strategy put forth here for approaching the whole question of village water supply and sanitation programs is that health education be part of these programs. Even though you provide water supply or you provide latrines, it does not necessarily follow that people are going to use them. Like so many other situations where you are trying to change people's habits, you are going to have to teach them what it is, how to use it, and why.

We oftentimes make the fundamental assumption that there is a water supply and people are going to use it. The world is littered with water supplies and latrines that are not being used. Often this is our fault because we assume that people will use the system and therefore do not put into the programs a strong element of health education. But remember, health education costs money! We too often assume that the country will pick that up, that it is the country's responsibility. Too often the international agencies have been saying "We will supply you with pipes and pumps and the rest of the problem is yours." That has not worked. If you want proof, you need only look at all of the systems and hand pumps and latrines that are not being used. So if I can stress one thing, it is that health education is an element that must be woven into the strategies that I've already mentioned.

In the final illustration, I am trying to show that there are many health benefits to be gained by providing, in this case, water supply, and thereby increasing the consumption of water (See Figure 2). You start at somewhere around two or three liters per capita per day which you need for survival. As you begin to supply more water, you reach a point at which you carry it. It has been shown that people carrying water from a standpost tend to carry anywhere from 15-20 liters per capita per day. If you want to have more water than that, you are going to have to start providing patio connections. And if you want even more, you have to start providing house connections. As you begin to provide even more, you must turn your thinking to that of providing amenities, and then you reach

Table 3
Water Related Diseases
VS
Control Measures

Classification of Disease Route	Disease or Environmental Condition to Be Protected Against	Control Measure That Must Be Provided to Obtain Desired Result		
		Maintenance acceptable	Reduction of incidence	Protection From disease
I. Waterborne				
A. Bacteria				
	Cholera	WS, BS	IZ, WS, BS	WS, BS
	Typhoid Fever	WS, BS	IZ, WS, BS	WS, BS
B. Helminth				
	Schistosomiasis	BS	WS, BS, CH	WS, BS
C. Protozoa				
	Amebic dysentery	BS	BS	BS
D. Virus				
	Infectious hepatitis	WS, BS	BS	WS, BS
I. <u>Water Related</u>	River blindness	WS	WS	WS
II. <u>Diseases of Filth</u>	Scabies	BS	BS	BS

WS - Adequate water supply
 BS - Basic sanitation (i.e. latrine)
 IZ - Immunization
 CH - Chemoprophylaxis

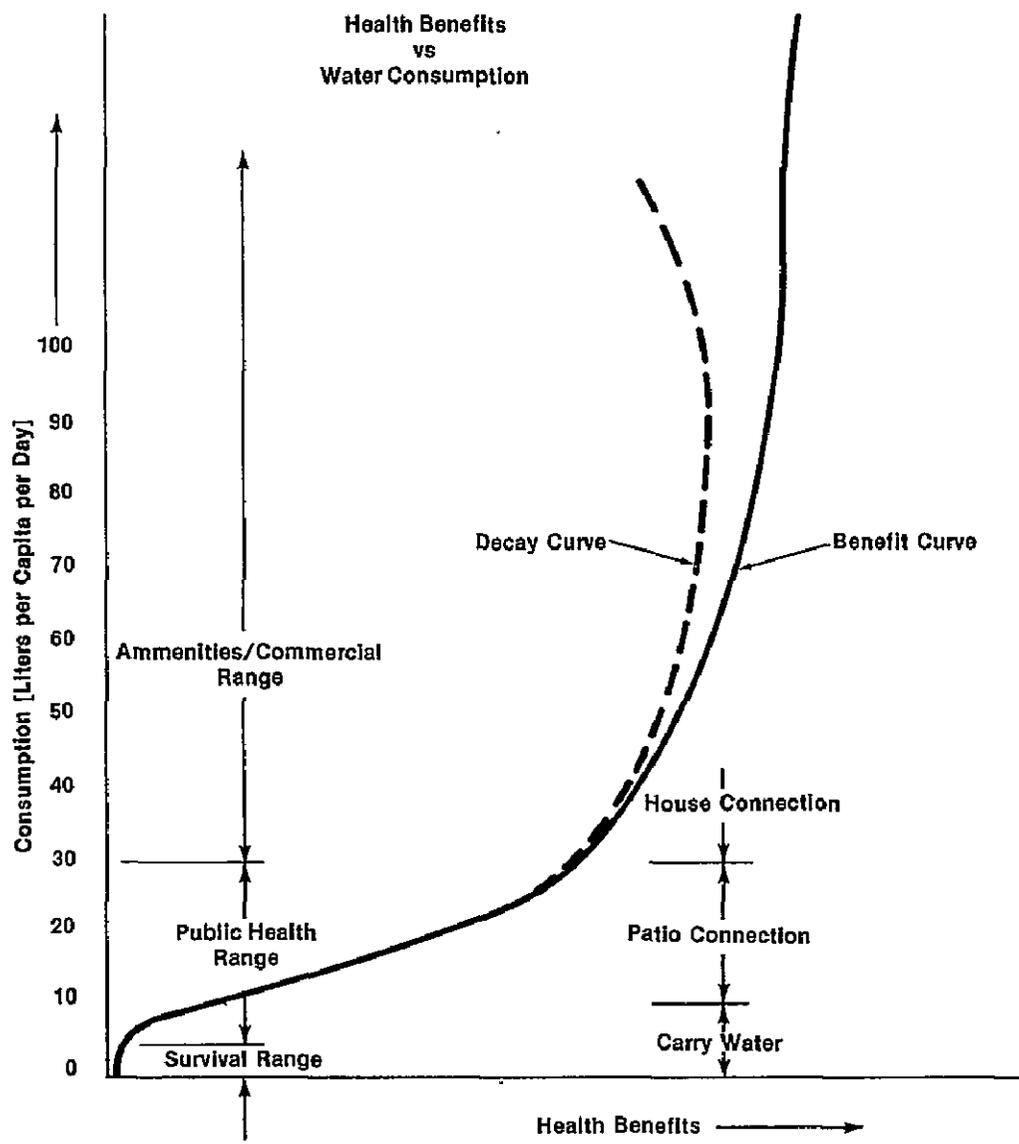


Figure 2. Health Benefits vs. Water Consumption

the commercial level. But at some point in this process, if you don't begin to remove the water in some manner, sewerage or whatever, your situation begins to decay because you are going to start having water standing around and the list of diseases that Gene McJunkin spoke of earlier begins to come into play. Thus, we close the continuum of water supply and basic sanitation.

DISCUSSION

DR. OKUN:

Now, instead of going into the technology of latrines I would like to open up the discussion.

DR. McJUNKIN:

One quick point or two quick points but one which is really relevant: you spoke about your secretary questioning your strange reading habits. A few years ago, the public health service published a book called The Sanitary Significance of Fecal Coliforms, these indicator organisms we are talking about, the fecal coliforms in the environment. I ordered the book, and only after it had been mailed did I discover that my secretary had actually ordered a book for me entitled The Sanitary Significance of Fecal Californians. I got the right book, however.

There are two things I wish you might touch on a little more although I know the Bank studies have gone into this in great detail. One is this question of sanitation and piped sewers. From a health point of view, we want simply to contain these materials. This the privy can do, assuming as you say, that it is used. There is a tremendous difference in the cost and this is, of course, what we might call level of service. And as you have pointed out, a large amount of water can overwhelm the latrine.

The second thing relates to questions you are often asked in the field because of the current emphasis on environmental recycling, reuse, biogas, and so forth. Often people ask in the field about the health aspects of promoting these policies, particularly of recycling excreta.

MR. DONALDSON:

The health aspects of recycling the material and what have you? Yes, there are quite a number of health effects that can be noted. But again, if you have an understanding of the excreta load, the persistency, the multiplication and so on, then you can design your system to respond to that. It is possible to use the fecal material and many societies do so. I believe Dr. Okun mentioned that in China they have for centuries used the excreta. They probably arrived at the length of time they stored it and how they stored it through hit and miss, but I think it is time that we have far more studies. We need to have a much deeper understanding of this subject in order that we can design better systems.

DR. BEYER:

We have been listening with great interest to the presentations on water and sanitation and health but I think we have been dealing mainly with the question of pathogens and the question of standards. I was quite interested in Steve Joseph's trying to get the discussion a bit more on terms that would embrace larger facets of the problem. For one thing, there are quite a lot of hidden health benefits. Some are not so hidden even, but difficult to measure in terms not only of the disease pattern or the improvements, but also in terms of such things as the easier access to both water and sanitation and the convenience element. Naturally we are all in agreement about the health benefits to be gained by lessening the impact of disease, but the other points should not be overlooked either.

That leads to my second point and that is the difficulty in many cases of finding valid indicators for monitoring and evaluation of projects and programs. Evaluation is the only way we can really gauge whatever usefulness there is with the various government and community enterprises that are assisted by AID and a number of other organizations.

I don't want to carry it much more at this stage; I just wanted to mention these two issues. The average villagers, say of Fada N'Gourma in Upper Volta or Santa Gorsa in Mexico, probably would not know much about the pathogens or the standards. At the outset they are quite happy to have any water at all. But the effects definitely are there. If we go further into wherever the water resources so allow, the indirect health effects can be even more difficult to measure, such as a better village economy where the women have been liberated. We had a survey made in southern Sudan by a small UNICEF team several months ago of the impacts on women of the installation of handpumps in their villages. Before the handpumps came to the village, women used to spend an average of six hours per day drawing water. Now they are using this time both for participating more in their food production, (brewing beer which they sell to the benefit of the family's economy) and for sleeping, resting and socializing. How do we measure such health effects? I am raising the question now. I don't want to go into it, as I think I may take up some of these points this afternoon.

HELI PERRETT:

I want to commend you on your recognition of the role of health educational software in packaging the hardware, but I also want to add a little caution to that. In practice we have found that it is not a theoretical argument that is required in most cases. And it is not even the scientific one that will work. It is often just an argument of status, convenience or privacy, particularly in the case of sanitation. And to illustrate, let me cite one project I was just looking at in Bangladesh. There they found that the scientific argument had not worked at all, so they tried several others. It turned out that the best way to get people to accept and use latrines was simply to say, "It will help your daughters to get married." Because of the privacy and the convenience, that actually was working.

I also want to commend you on your emphasis upon explaining exactly what health education is, because that is often something that health education tends to forget about when it is associated with water and waste programs. This can be illustrated in many countries, among them Bangladesh and Indonesia where a couple of programs have been having trouble with water seal latrines. Part of the problem has been that their gooseneck has often been broken. People have simply been taking sticks and smashing it. As it turns out, people simply did not understand why the water kept staying there. Not realizing that it helped in controlling odors, they felt that it was just wasting water and so they broke the gooseneck. In some programs the percentage of broken goosenecks over a period of two years has been as high as about 40 percent. So I think that this software packaging, as many agencies are now recognizing, is very important however you look at it, including from the engineering perspective as well as from a financial one.

DR. CVJETANOVIĆ:

Mr. Chairman, I would like to congratulate Mr. Donaldson. For a sanitary engineer he has spoken wonderfully of epidemiological factors and the transmission of the waterborne diseases. Since he has been able to understand and present this process so well, the other sanitary engineers should do the same. I believe that with their background they can easily learn as much as necessary of practical epidemiology to interpret various problems such as the one we discussed about standards of purity. If you understand and recognize the dynamic process of diseases, you can then interpret properly. If you do not understand that, no book can really serve you as a guide.

Now, having congratulated Mr. Donaldson for being an excellent epidemiologist, I can go on to say that he has made one mistake that epidemiologists usually make. This is to

be overzealous in controlling disease. He mentioned for example that against cholera you use a combination of immunization, sanitation, chlorination and everything. If you do all of this the cost will be very high. Moreover, once you have prevented the disease once, if you prevent it a second time, that just raises the cost, but the prevention remains exactly the same.

This brings us to the matter of cost-effectiveness. If you are a really good epidemiologist you will select the action that is especially effective in controlling the disease as well as being the most cost-effective action to be taken because there is a limit to what can be done. You cannot ask the people to do everything. If you do, they will do very little in all these fields. I think this is an important practical point in dealing with any disease.

Nevertheless, I really want to congratulate Mr. Donaldson once more. I propose that USAID try to broaden the training of the sanitary engineers who have been dealing with the problems in the field. The training should include epidemiology, and enough sociology and health education to deal completely with water. I trust that they can do it because they cannot send a team of 10-15 specialists to every country. Either they will have no common language among them, or they will acquire it too late.

Epidemiological Studies of Water Supply and Sanitation and Health

James M. Hughes, M.D., Chief, Water-Related Diseases Activity, Bureau of Epidemiology, Center for Disease Control

I would like to start by reading you this quotation from a paper by John Briscoe that appeared in the American Journal of Clinical Nutrition a little over a year ago. "The literature on water supply and health is strikingly heterogeneous in design, in method, and in conclusions, and offers little in explaining water's health impact beyond confirming the existence of a general association between improved quality and increased quantity of domestic water and a reduced incidence of enteric disease."

I would like to follow this with a second quotation from a more recent paper that was co-authored by Drs. Julia Walsh and Kenneth Warren of the Rockefeller Foundation and that appeared in the New England Journal of Medicine: "Proper sanitation and clean water make a substantial difference in the amount of disease in an area."

Both of these quotations imply that water and sanitation projects have positive health benefits. Briscoe's quotation suggests that such effects frequently may be quite difficult to measure; the quotation from Warren is much more optimistic, suggesting that these substantial differences in health may, in fact, be measurable. I think the reality is somewhere between these two statements and I hope that some of what I am going to say will illustrate why I think so.

During the course of this talk, I plan to review briefly some modes of transmission of the infectious agents causing diarrhea. Since this was quite well covered this morning, however, I will just discuss a couple of points. Then I will review very briefly the classification of water-related diarrheal disease and some considerations in selection and interpretation of diarrheal disease indicators. At that point in the presentation you will all be well trained in the epidemiology of water-related diarrheal disease; we will turn then to consideration of the results of selected studies that have looked at the relationship of water supply and sanitation to diarrheal disease.

There are several modes of transmission of infectious agents which cause diarrheal disease. It is important to be clear on this. Infectious agents causing diarrhea can be transmitted through food, through water, or by person to person spread. These three mechanisms all have in common the fecal-oral route of transmission, but the actual vehicle and mode of transmission differ. It may be food, it may be water, or it may be person to person spread either directly or through intermediate mechanisms such as fomites, which Mr. McJunkin alluded to this morning. Some consider airborne transmission as an additional mode; there we have a very big question mark. There is some debate now over whether or not rotaviruses, a common cause of childhood diarrhea, may, under certain circumstances, be transmitted through the air.

Table 1 very briefly summarizes the epidemiology of water-related diarrheal disease. I apologize to you if it appears that Mr. Donaldson, Mr. McJunkin, and I are each using very slightly different terminology. The classification comes originally from Professor Bradley in London. We mean disease that is transmitted by the ingestion of contaminated drinking water. For agents transmitted primarily by this route, the infectious dose, which is a concept subject to all the limitations that Mr. Donaldson mentioned this morning, tends to be moderate to very high, relatively speaking. The important part of this kind of classification is that it allows you to focus on the appropriate prevention strategy. For waterborne diseases it is obviously to improve water quality.

Water-washed diseases, which Mr. McJunkin referred to as water hygiene diseases, are those in which infection occurs by the person to person route. Infectious doses of agents transmitted by this route tend to be low and Shigella is a good example of a disease that is frequently included in the water-washed category. It has a very low infectious dose and is very easily transmitted. The prevention strategy here is to increase water availability and, very importantly, as alluded to this morning, water utilization.

I want to point out also that all the agents that are traditionally put in the water-washed category can be waterborne as well. This is one thing that complicates studies of the impact of various types of water supply interventions. Water-washed diseases such as Shigella, can be transmitted by drinking water although, more frequently, they are transmitted from person to person. In contrast, diseases that tend to be waterborne are the ones that generally require more organisms to cause disease, and they are less likely to spread by the water-washed mechanism.

Table 2 is a less useful classification of water-related diarrheal disease. I include it here only to show you that there are many organisms that may be water-related and can cause diarrheal disease. But some of these organisms may also be food-borne. In addition to the bacteria, there are two groups of viruses that are common causes of diarrheal disease in developing countries. There are also two protozoa that are responsible for some water-related diarrheal disease.

The incidence and epidemiology of disease due to these various agents may vary dramatically from one area to another. An agent that is primarily water-washed in one area may be primarily waterborne in another. It is misleading to think of any of these agents as exclusively waterborne or exclusively water-washed.

In preparation for a review of several studies concerning the relationship of water supply and sanitation to diarrheal disease, I want to mention indicators of diarrheal disease which were referred to on several occasions this morning. I do not mean indicators in the sense that Mr. McJunkin used them--indicators that apply to water quality. I mean indicators of diarrheal disease per se.

Regardless of the mode of transmission or the etiology of a single episode of diarrhea, several events may occur that can be measured. A single episode may be fatal, in which case the death can be recorded. But more typically, a single episode will result in some morbidity or some illness to an individual and can be manifested in a number of different ways--some of which can be relatively easily measured. An individual with diarrhea may seek medical care at a hospital or a clinic or from some traditional medical source. When that person does so, he may be given medications or intravenous fluids. Thus, there are visits, medications, and fluid use that could be measured. The individual may not seek medical care, but he may be unable to perform his normal daily activities. This inability could be measured by a review of absenteeism records, if such are available, or it could

Table 1

EPIDEMIOLOGY OF WATER-RELATED DIARRHEAL DISEASE

	<u>Waterborne</u>	<u>Water-Washed</u>
Transmission	Ingestion of contaminated water	Person-to-person (fecal-oral)
Infectious Dose	Moderate-high	Low
Prevention Strategy	Improve water quality	Increase water availability and utilization

Table 2

CAUSES OF WATER-RELATED DIARRHEAL DISEASE

<u>Bacteria</u>	<u>Viruses</u>	<u>Protozoa</u>
<u>Escherichia coli</u> (ETEC, invasive, EPEC)	rotaviruses parvovirus-like agents	<u>Giardia lamblia</u> <u>Entamoeba histolytica</u>
<u>Vibrio cholerae</u>		
<u>Shigella</u>		
<u>Salmonella</u>		
<u>Campylobacter</u>		
<u>Yersinia</u>		

be measured by interviewing an individual to establish whether or not he has been able to perform normal activities. In children, even a single episode and certainly recurrent episodes of diarrheal disease can result in a deterioration of nutritional status which can be measured.

To follow up on indicators a bit further, Professor Bradley has specified a number of criteria for an ideal indicator condition. According to him, an indicator should indicate the occurrence of infection or disease or should measure some manifestation of disease disability. It should be objectively definable and easy to measure and quantify, as well as sensitive to and specific for changes in water supply and/or sanitation. I do not think I need to point out to you that, unfortunately, we don't have the ideal indicator condition. This is one of the problems in interpreting the results of some of the studies that have looked for associations between water and/or sanitation projects and positive health effects.

Potential indicators of diarrheal disease include the following:

- o Diarrhea (gastroenteritis) rates
- o Positive stool culture rates
- o Intestinal parasite rates
- o Skin infection rates
- o Eye infection rates
- o Nutritional status
- o Typhoid fever rates
- o Hepatitis rates

These are actual indicators of diarrheal disease; I have not included other indicators of positive health benefits from water projects including increased availability of time to mothers, for example. One might try to measure diarrhea or gastroenteritis rates, which are frequently expressed either as incidence (the number of new incidence cases of diarrhea in a population per unit time) or prevalence of diarrhea (the number of all cases of diarrhea, both old and new, in a defined population during a specific period of time.)

Other indicators that have been used are rates of stool culture and intestinal parasite positivity. Skin and eye infection rates are frequently used as indicators of water-related diarrheal disease. Their occurrence might be expected to be frequent in areas where water availability is limited. Nutritional status, as I have suggested, is a potential indicator. Under some circumstances, typhoid fever or hepatitis rates may also constitute indicators of diarrheal disease. Data on these indicators may be obtained by reviewing hospital or clinic records, by interview, by collection of stool samples for culture, or by weighing and measuring children.

There are several types of study designs that have been used to look for an association between water and/or sanitation projects and positive health effects. Basically, they are of two types: cross-sectional or longitudinal.

In cross-sectional design, the frequency of an indicator condition is evaluated at one point in time, usually in a study group that has received a project or has a certain level

of water supply or sanitation. The frequency of these indicators is then compared with the frequency of the same indicators in a control population at the same point in time.

A longitudinal study is simply one that is done over a period of time. It frequently attempts to identify changes in frequency of indicators that follow the provision of a water or sanitation project in the same population. These studies often include a control population, are more complicated, and take a longer period of time to conduct.

A third category, which does not preclude the others, is a review of existing medical records. This is a frequently used approach that is subject to a whole variety of limitations. Studies of this type can be done either in a cross-sectional or longitudinal fashion.

Before turning to a few of these studies, I want to mention some considerations in interpreting the results of studies of the relationship of water and sanitation to diarrheal disease. These considerations include the following:

- o Comparability of project and control areas
- o Indicators: definitions and methodology
- o Utilization of system
- o Maintenance of system
- o Seasonality of diarrheal diseases
- o Epidemics of diarrheal diseases
- o Transferability of results

In studies that have a control area, which we hope most will, one has to make some judgement about the comparability of the project and control areas with respect to crowding, age distribution, and socioeconomic status. A whole variety of variables must be considered and that poses one of the major problems of studies that compare project and control areas. No matter how careful you are, you can never be absolutely sure that you have well matched areas.

When considering these studies, you have to determine how well defined the indicators are, how objective they are, and what the methodology used to collect the data is. For example, we can look at a case where data were collected in field studies consisting of interviews of the female heads of households. You probably would be a little skeptical of data obtained from an interviewer asking a mother: "During the past six months, how many episodes of diarrheal disease occurred in the family?" It would be better to ask the mother: "During the past week, or during the past 24 hours, how many episodes occurred?" I think most people would feel a little more confident in the use of that sort of information.

Utilization and maintenance of the system are important considerations as we have discussed this morning. One must consider the extent to which a new system is utilized, particularly if you do not see a benefit from a new system. You also have to know to what extent the new system has been maintained.

Finally, in longitudinal studies, you need to consider such things as seasonality and epidemic occurrences of diarrheal diseases. Almost all of the diarrheal diseases will vary

in frequency during certain times of the year. So, you would not want to get baseline data for a water project in March and look at diarrheal disease rates in the same area in September. If you knew the seasonality, you might know that the incidence would be expected to be either lower or higher in September than earlier in the year. You must also consider whether it is possible that epidemics of diarrheal disease occurred either in the study area or in the control area during the conducting of the study. Such epidemics might be totally non-water-related and might dramatically bias the results of the study. It is also important, I think, to ask to what extent the results of the studies may be transferable from one area to the other.

DISCUSSION

DR. HUGHES

Now that we have had the crash course in water related diarrheal disease epidemiology, are there any questions before we turn to the handout?

DR. McJUNKIN:

Could I add one point? Although it is often taken for granted I think you would have to be assured that there actually is a difference in the quality of the drinking water being delivered to the two communities.

DR. HUGHES

Absolutely. I think that will come out when we talk about some of these studies. Let's turn to Study One.

In the handout I have summarized the methods and results of six studies most of which will be familiar at least in a general way to many of the people in the audience. Four of these studies took place in developing countries and two took place in developing areas of the United States that I would consider to be developing areas at the time the studies were actually conducted. There were specific interventions evaluated in three of these six studies.

As I run through the design of the studies and very briefly some of the results of the studies I want you all to be thinking about what some of the defects in some of these studies might be and what questions you should have in your own mind when you interpret the results of the studies.

The first is a study that was conducted in the Central Valley of California. This study looked at the association between water availability and prevalence of Shigella infection. The study design here was longitudinal and it took place in 70 different migrant labor camps over a 7 month period in 1952 and 1953. For indicators they used the prevalence of Shigella infection and the prevalence of Salmonella infection. Since they didn't really find any Salmonella infection we will focus on Shigella infection. They focused on children 10 years of age or less. There was no intervention in this study. Rather the individuals performing the study classified households in these 70 camps into 3 groups according to the availability of water. Data collection included performance of rectal swabs for culture from ill and well children during home visits at one month or greater intervals. They were not concerned about whether these patients were symptomatic with diarrheal diseases or not; they were simply concerned with the prevalence of Shigella infection.

I have summarized some of the results here in terms of prevalence of Shigella infection expressed in percent. On the left you see the three groups into which the residents of these camps were divided. There was a group that had no indoor plumbing facilities whatsoever. There was another group that had only faucets inside the house. And there was a third group that had both a faucet and either a shower and/or a toilet inside.

For individuals living in all 70 of these camps they looked at the prevalence of infection first in families shown there in the first column and then in all individuals. When they looked at families, it is clear that the prevalence of Shigella infection in the group

Study 1

Country: USA (California)

Variables Assessed: Water availability

Study Design: Longitudinal (70 labor camps)

Time Frame: Seven months (1952-1953)

Indicator(s): Prevalence of Shigella and Salmonella infection.

Age Group: Children ≤ 10 yr.

Intervention: None; households classified into three groups by availability of water.

Data Collection: Rectal swabs for culture from ill and well children during home visits at one month or greater intervals.

Results:

Group	Prevalence of <u>Shigella</u> Infection		
	<u>All Camps (n=70)</u>		<u>Matched Camps (n=26)</u>
	<u>Families</u>	<u>Individuals</u>	<u>Individuals</u>
No plumbing	11	6	6
Faucet only	7	3	1
Faucet and shower (bath) and/or toilet	3	2	--

Reference: Hollister et al. Am J Pub Health 45:354-362, 1955

with no plumbing was 11 percent throughout the course of the study. The prevalence in the faucet only group was 7 percent and the prevalence in the group with more extensive indoor plumbing was 3 percent. You see similar changes if you look there at percentage of individuals positive for Shigella.

They did one other thing which was reflected in the right hand column. They took the 26 camps that did not have anybody in the well off group, or what we are considering the well off group, that is with both an indoor faucet and additional plumbing indoors. They took only those camps that had either no plumbing or faucets only in the house and they saw essentially the same results. Individuals in families with no plumbing had a six percent prevalence of Shigella infection while individuals in families with faucets only had a one percent prevalence. They concluded that there was a decreased prevalence of Shigella infection with increased water availability. To me this seems like a reasonably conclusive study. Does anybody have major problems with this?

QUESTION-

Was seasonality a factor?

DR. HUGHES

It should have been the same in all of the camps. That is a good question though.

ANNE TINKER

What socioeconomic differences were there among the groups living in the three housing arrangements?

DR. HUGHES

Good question. In the paper they say that there were none. Housing arrangements depended simply on where you were and what camp you got assigned to. But I think that is a very important consideration in interpreting these results.

QUESTION

Did the quality of water represent a significant variable?

DR. HUGHES

Excellent point. They don't get at that very well in the paper. I presume that each camp had only one water supply which was either distributed through standpipes outdoors or through faucets inside although they do not say that and so it may not in fact have been true. That is an implication. The only comment that they do make in the paper about water quality is that water in all the camps met minimal standards.

VICTOR WEHMAN

What about the survey frequency? Do you feel once a month was enough?

DR. HUGHES:

Since they were only looking for prevalence of Shigella infection that was probably enough. In fact, they apparently must have done the surveys more frequently on occasion because they specifically said that they did not count a single individual twice if he or she had two positive cultures within a month. You could bias yourself in one way if you did these every two weeks and counted each infection as a separate episode; that would be misleading. Instead I think they made a reasonable compromise.

DR. OKUN:

These people in the no plumbing categories had to get water somewhere. Do they indicate where they got the water and how they got it?

DR. HUGHES:

I'm glad you asked that. These are outdoor taps. Another problem that I see with this study is that they don't tell you anything about these outdoor taps. You don't know if they are right in front of the house or a mile down the road which is something you would like to know.

QUESTION:

Were these indigenous populations?

DR. HUGHES:

No they weren't. In fact, I got the impression from the paper that one year a family would be in camp A and the next year they would be in a different camp. But during the course of the season during which the study was conducted I think the residents of the camp were a fairly stable group though you can't be sure of that.

One final point that I would make is that in this study they did not in any way evaluate the use of the facilities, a frequent problem.

Now let's turn to Study Two. This is a fun one which everyone probably knows about. This is a study by Richard Levine and his colleagues from Matlab Bazar, the area in Bangladesh that many of you know as the location of the Cholera Research Lab which has recently changed its name and where vaccine trials have been conducted since the early 1960's. This is not necessarily a typical area with respect to the rest of Bangladesh, needless to say.

This study was designed to look at the relationship primarily between water quality and the incidence of cholera, clinical cholera, cholera disease and diarrhea of unknown cause. This was a longitudinal study that involved 88 families and the time-frame for the study was quite long, 11 years extending from 1963 to 1974. The incidence of both classical and El Tor cholera disease. I think you all are aware that there are two types of vibrial cholera and I don't think we need to go into that any more, but one type is called El Tor. Anyway, they looked at both. They included all age groups in their study and there was no specific intervention in this study. They simply classified these 88 families as tube well users or non-users.

Their data collection was as follows: they reviewed records of results of stool and rectal swab cultures from members of study families who were seen at the clinic or admitted to the hospital at Matlab with diarrhea during the study period. They all had diarrhea, and they knew how many of them had positive cultures for Vibrio cholera and therefore were assumed to have cholera. They did try to evaluate water use and they did that by observing and interviewing water related activities of these 88 families during a 6 day period.

Their results are somewhat disconcerting to some of us and they are shown here in terms of incidence of cholera and incidence of other diarrheal diseases. You will see that among the two groups, tubewell non-users and tubewell users, the rates of both cholera and other diarrheas were higher in tubewell users than in tubewell non-users. Well, that is disturbing. What are some of the problems of this?

Study 2

Country: Bangladesh (Matlab Bazar)

Variables Assessed: Water quality

Study Design: Longitudinal (88 families)

Time Frame: 11 years (1963-1974)

Indicator(s): Diarrhea incidence; incidence of classical and El Tor cholera

Age Group: All

Intervention: None; families classified as tube-well users or non-users.

Data Collection: Review of records of results of stool and rectal swab culture from members of study families seen at the clinic or admitted to the hospital with diarrhea. Water use assessed by observation and interview.

Results:

	<u>Incidence *</u>	
	<u>Cholera</u>	<u>Other Diarrhea</u>
Tubewell non-users	8.4	3.2
Tubewell users	14.2	7.5

* Cases/1000 person-years

Reference: Levine et al. Lancet 2:86-89, 1976

HOLLY WISE:

The sociocultural variables would indicate that tubewell users would probably have more access to the clinic, I would think, and the non-users may not have been recorded in the clinic.

DR. HUGHES:

She felt that tubewell users might be more apt to use the clinic and therefore more apt to be included as cases in the study. That may be. They don't really address that and I can only say that from having worked in that area, it is so well blanketed with speed boat ambulances that it is easy for people to get to the clinic. These families were all located in villages near the clinic although that is not to say that they were equally likely to use the clinic, however. I agree with you.

MARTIN BEYER:

These results (as presented in Lancet some years ago) were very disconcerting, especially to us in UNICEF who had been promoting quite a major tubewell program of the Division of Public Health Engineering in Bangladesh. Right now this is supplying more or less half of the rural population of Bangladesh with what we hope is potable water. I just wanted to underline that some of us dealing with that very program thought that this study, despite its longitudinal frame of 11 years, was indeed very limited in many respects. Since then other studies have been made, including one that unfortunately never was published. That was completed about 3 years ago jointly between government, UNICEF and WHO and hooked on to, if I remember right, a smallpox investigation which covered some 234 villages all over Bangladesh. There we got a little bit more of a representative picture. At least it did not say that the tubewells were no good which you would easily be lead to believe after this very study.

This study does bring out that the incidence of diarrhea is not very conclusive and it did lead to some conclusions which you might read out of it. There was significantly a lack of the social factors included in it and also a lack of health education and sanitation at that very stage of children up to 10 years of age. There was a subdivision of that study into different age groups and it showed that in fact the diarrhea frequency was changed the least in the age group up to 10 years of age. This leads us to the suspicion children very frequently go swimming in the canals and river branches and drink the polluted water down there. Another thing that was reflected is that nearness to the tubewells is also a factor. It is preferable to have the tubewells at a maximum of 100 meters from the user's homes.

MR. WEHMAN:

I think two other aspects that should have been documented here would have been the water quality that was coming out of those tubewells in terms of possible taste or some palatability problem whereby maybe the people used the water to wash their clothes but they didn't use it to drink because it did not taste right. It is also important to look at some of the other sources that these people used during the time the investigation was going on besides just their tubewell which supposedly provided potable water.

DR. HUGHES:

I agree with you. Regarding quality, one point that I did want to make is that I think many of us are aware of the fact that the water derived from tubewells in the Matlab area has a very high iron content and is undesirable for a number of reasons for use. So it is frequently not used. They attempted through interview and observation to

get at specific usage patterns and I think you can debate about how successful they might have been in that regard. Regarding bacteriological quality, all they did was sample each day the four tubewells that these study families used. They sampled each one time, apparently, because they had four cultures, and they were all negative for coliforms. I think that you have hit on a couple of major problems with the study.

CHARLES S. PINEO:

There is one thing that was always disturbing about this study and that is the fact that I don't believe any mention is made of excreta disposal. I think that it just zeros in on the water supply with no mention of whether or how the people dispose of their excreta.

DR. HUGHES:

Yes, that is correct. They do provide some anecdotal information that is consistent with what one observes there which is that the people defecate in streams, in canals and along banks thereof, and also near the other bodies of water.

DR. McJUNKIN:

Is this the paper that was entitled, "Failure of Tubewells"?

DR. HUGHES:

Yes.

DR. McJUNKIN:

Well, the title, I thought, was provocative and one of the problems is that I have read about six studies from this same area and you can pick and choose depending on what you want. I have never been able to straighten that out in my own mind. Going back to Dr. Beyer's study, I have results from that for 68,000 villagers. Those having one case per week of diarrhea the week preceding the interview was for tubewells 17.3 percent but for non-tubewell sources they were 29.1 percent, and with two cases per week it was 4.2 percent versus 9.8 percent. But that was for the entire country, not just for that one area.

DR. HUGHES:

I think that there are many things that you need to question about this study. The transferability of these results to other parts of Bangladesh, even if they are valid, which I question, is probably totally inappropriate.

DR. McJUNKIN:

Could I add one more comment about their transferability? You know the situation with the tanks in Bangladesh; the transfer of this to the whole Asia region doesn't seem to make much sense to me.

DR. HUGHES:

I just want to make a couple of other comments. As Gene mentioned, this is a good example of how not to title a paper. They concluded that the tubewells were not beneficial but they hypothesized that that was because they were frequently out of service and so weren't used as often as they should have been. Instead, the people used alternative more contaminated sources of water. But they called their paper, "Failure of Sanitary Wells to Protect Against Cholera and Other Diarrheas in Bangladesh."

Study 3

Country: Lesotho

Variables Assessed: Water quality, water availability

Study Design: Longitudinal (multiple villages with a total population of 2000 in each of two study areas.)

Time Frame: Three years (1973-1976)

Indicator(s): Diarrhea incidence; skin disease; eye disease

Age Group: All

Intervention: None, villages classified in two study areas into subgroups by nature and reliability of water supply.

Data Collection: Review of hospital and clinic records for visits for diarrhea, skin disease, and eye disease.

Results:

	Ratio of Disease to Others *					
	Diarrhea		Skin Infections		Eye Infections	
	Area #1	Area #2	Area #1	Area #2	Area #1	Area #2
No improved supply	.23	.08	.24	.13	.02	--
Improved reliable supply	.24	.14	.28	.20	.03	--

* Excluding other water-related disease, V.D., trauma, pregnancy and family planning visits.

Reference: Feachem et al. Water, Health, and Development, 1978

MR. DONALDSON:

One problem is, if I understood you correctly, that they took only one water quality sample in eleven years. Another that needs to be looked at, I think, is that you are talking about tubewells which seems to imply that cholera occurs completely in relation to the tubewell situation. In fact, cholera can be spread in a number of other ways. Did they look at the fact that cholera is also a food-borne type disease? The implication of this study is that this is all spread by water which is a very false premise.

DR. HUGHES:

Excellent point. They did not really look at the role of food-borne transmission here. If these results were valid, they would be perfectly consistent with the primary food-borne mode of transmission for cholera. In fact, however, there are other studies that would suggest to me, at least, that the cholera in this area is primarily water-borne, but your point is still well taken.

I do want to make one last point which you alluded to. They make these conclusions based on 11 years worth of data, but in fact they observed the water use habits of these people over a six day period, during the dry season of the year in 1975. They talked about the relationship of cholera, and diarrhea to water use from 1963 to 1974. So this study is not helpful in any way as far as I am concerned.

DR. OKUN:

One important characteristic of Bangladesh as contrasted with many other countries is that it is a very humid area and during much of the year, other sources of water are readily available which may taste better and may traditionally have been used even in the presence of a tubewell. So it is a clouded study.

DR. HUGHES:

Let's try to do one or two more of these. The next Study (Study Three) many of you will know also. This is the Lesotho study which Richard Feachem and his colleagues did and recently published as a book. They looked primarily at water quality and to some extent water availability as they related to diarrhea, skin infections, and eye infections. It was a longitudinal study that was done in multiple villages in two areas, each of which had a population of about 2000 people.

The time frame for the study was three years although in one area it was only five months. The indicators that they used were diarrhea, incidence of diarrheal disease, skin disease and eye disease. They included all age groups in the study. They also did not have a specific intervention in this study, but they classified their villages in the two study areas into subgroups according to the nature and the reliability of water supply to these specific villages. They then proceeded to review the hospital and clinic records for medical facilities serving these areas for the number of visits for diarrheal disease, for skin disease and for eye disease.

I've shown you some of their results. They acknowledge the problem of using medical records in these sorts of environments for generating data of this type because as we have talked about in reference to one of the other studies, clinic utilization may vary dramatically from one population group to another. In order to get around this, they generated something that they are referring to as proportional morbidity which is I think a little bit hard to explain, but the way the data in this table are presented, say under diarrhea, they'll show you a ratio of the number of visits for diarrhea to the number of visits for everything

else excluding water-related diseases, venereal diseases, trauma, pregnancy, and family planning visits. They are left, I presume, with a lot of respiratory diseases. Now they had four different subgroups but I have showed you data from the two most extreme and those are on the top, villages with no improved water supply whatsoever, and on the bottom, from villages with improved reliable supplies.

To summarize, they found only one significant difference in looking at these three diseases in the two study areas and that difference was the reverse of what one might hope for. They found more diarrheal disease in the area with the improved reliable supply than they did in the area with no improved supply. So they concluded that the incidence of diarrhea, skin infections and eye infections was the same in areas having relatively good quality water as it was in the areas having poor quality water and therefore that diarrheal disease in this environment was not waterborne but water-washed. How does that strike everybody?

MR. WEHMAN:

How did they come from that hypothesis to that conclusion?

DR. HUGHES:

Well, they have areas with reasonably good quality water and areas without good quality water and they show that according to these proportional morbidity ratios (if you believe that) people in the areas with good quality water were just as likely to go to the clinic with diarrhea as people in the areas with bad quality water. There was no difference in the ratios for skin infections and eye infections in the two areas that differed only in water quality and since these are water-washed or water quantity diseases, they said that things just are not related to water quality but rather to water availability. They felt that if instead they had increased the amount of water that was used, there would have been a decrease not only in diarrhea, but also in skin and eye infections.

Let me mention a couple of problems I see with this. Their relatively good quality water group was not so great according to some standards anyway. The data they present suggest that the good quality villages really had average fecal/coliform counts of 10/100 ml. in the water, and that was good relatively speaking, because the bad quality areas had 10,000/100 ml. Potential problems to consider again in interpreting these results stem from the fact that medical records were used and, as I have mentioned, clinic utilization may vary from area to area. There is no way they were able to get at whether or not that occurred. They also had very limited data on water use by the children, which is the group in which the diarrheal diseases primarily occur. They had no data on contamination of water that was stored in the home, although it was the practice in essentially all of these homes. And finally, they did the best they could in classifying the reliability of these systems but you would have to wonder, since they were considering a three year period of time, how accurate their actual classifications were. So I'm not convinced that this is a definitive study though it may in fact be representative of the situation in Lesotho.

Let's turn to Study Four which was conducted in the Philippines. It looked at the impact on cholera of interventions in the design to improve water quality and in the design to improve excreta disposal. This was a longitudinal study design that was conducted in four different communities of about 750 people each. These were all poor areas said to be socioeconomically equivalent. The populations were well matched with respect to size and with respect to age distribution. The study was conducted over a 4 1/2 year period from 1968-1972 and their indicator was the incidence of cholera caused by Vibrio cholera

Study 4

Country: Philippines

Variables Assessed: Water quality, excreta disposal

Study Design: Longitudinal (four communities of ~750 people)

Time Frame: Four and a half years (1968-1972)

Indicator(s): El Tor cholera incidence.

Age Group: All

Intervention: Water supply improvement only; excreta disposal improvement only; water supply and excreta disposal improvements; no improvement (control).

Data Collection: Rectal swabs for culture from persons with diarrhea during daily home visits; rectal swabs from family contacts of persons with positive cultures.

Results:

<u>Intervention</u>	<u>Cholera Incidence *</u>		<u>Cholera Introductions</u>		
	<u>(Cases/1000/yr.)</u>	<u>% Reduction</u>	<u>No.</u>	<u>% w. spread</u>	<u>Av. No. Cases</u>
None (control)	52	--	31	71	7.4
Water	14	73	24	50	3.2
Latrines	17	67	26	50	3.5
Both (outdoor taps)	14	73	17	53	3.7

* Adjusted to five full years

Utilization factor ignored

Reference: Azurin and Alvero. Bull WHO 51:19-26,1974

biotype El Tor. They included all age groups in this study and as I mentioned this was an intervention evaluation.

They had one area, one community where water supply was improved. They had another where excreta disposal was improved. They had a third where water supply and excreta disposal improvements were made. And they had a fourth control area in which nothing was done. They make the point that there was a lot of community participation in all three of the groups where there was an intervention. People in the community were involved both in the construction and in the maintenance of the systems. Data consisted of rectal swabs for culture collected from persons with diarrhea during daily home visits. They also collected rectal swabs from family contacts of persons with positive cultures. They also monitored water quality in these different communities during the course of the study.

Now let's look at their results very quickly. Looking first at cholera incidence, you can see the four communities ranging from the no intervention or control community down to the community which had an intervention both in water supply and in sanitation. I should mention that in the communities, the water supply improvements consisted of outdoor taps which delivered water from a gravity fed chlorinated system. The taps were all located within 10 meters of the house, but were not indoor connections. I can't tell from the paper whether these were indoor or outdoor, but I suspect they were outdoor. You can see a reduction in cholera incidence in the three communities where an intervention was performed compared with the control where there was no intervention. The percentage of reduction is shown. It differs a bit from the figures that are actually in the paper because I adjusted them to a yearly incidence and the study was really done over only 4 1/2 years.

Another interesting thing which they presented was data on cholera introductions, what happened once cholera was introduced into these three communities. You can see that in the communities with intervention, cholera introductions were less likely to spread to other individuals and when they did spread, less individuals were affected. To me, this is a reasonably persuasive study which shows that both water and sanitation decrease cholera incidence, at least in this setting, and some data which I haven't shown you suggested that water alone was more effective than sanitation alone. Is anybody convinced on this?

STEVEN SINDING:

Do you have any information on health education efforts?

DR. HUGHES:

Dr. Cvjetanovic may recall this study better than I. In the three communities with interventions, there was an effort to conduct some health education. It was not clear from the paper whether that effort was comparable in the control community, which is a potential problem with the study.

ANNE WHITE:

One problem in most of these studies seems to be that they assume that people do use the facilities, and there is very little attempt to see whether they make use of other sources or other disposal.

DR. HUGHES:

I think that is another defect in this study.

QUESTION:

There are a number of studies which show that sanitation is not effective in decreasing cholera incidence or diarrheal incidence, but they do not address the issue that you just raised, Dr. White, of utilization rates, particularly among children. Children simply do not use sanitary facilities.

DR. HUGHES:

I completely agree. I think that is a problem with almost all of these studies and certainly a problem with the ones I have talked about here.

MR. DONALDSON:

I noticed that you used the word "toilet". I question the word "toilet" because that implies that you have a water carry system. I think you mean some type of a special latrine or something.

DR. HUGHES:

I do. That is a cross-cultural problem.

QUESTION:

Are these studies which you have given us selected for special didactic purposes or is this the state-of-the-art. Is this the best epidemiology that can be brought to bear?

DR. HUGHES:

Both. The ideal study has not been done and probably can't be done, and these are very difficult studies to do, as you know.

QUESTION:

What seems to be incredible is that studies of this kind can be undertaken knowing in advance that whatever the results are, they can be discredited. Nobody has ever argued that pure water which is not ingested is going to do something for your health. So I don't see how you can mount a study which leaves every tag end open. At the time these studies were fielded, if the people who fielded them sat down and thought about the study design there is only one thing they could conclude: they could test nothing. There exists no hypothesis about water that could possibly be rejected on the basis of these studies and if this is the state of the art epidemiology then it seems to me that we have got ourselves some serious problems in this domain.

DR. HUGHES:

I couldn't agree with you more. To follow up on that, these are the studies that are quoted by people both to show that there is a positive health effect but more commonly by people suggesting that there is no positive health effect. And I agree with you that the utilization issue is extremely important and one that has rarely been adequately addressed in these studies. That is the major missing link in these studies, I think.

HOWARD KELLER:

We had a housing project in Thailand some years ago which had sewers and water and even toilets. After some time the sewage system broke down because the plant wasn't working. It was then discovered that it wasn't working because no water was going through the pipes; there was absolutely no utilization of the system.

ABBY BLOOM:

I'd just like to make one last comment on this discussion. Perhaps our visitors from other agencies can help us at AID by giving us some suggestions about what to do at this point. It's not only that there is a lot of disagreement about what conclusions one should draw, if any, from these studies. It is a comparative problem. As Mr. Levin said, we are in an age of restricted resources. While we talk imprecisely about decreasing morbidity and mortality through interventions in water supply and sanitation, our colleagues in other fields, particularly in health, are saying to us that they have evidence through scientific studies which proves that particular types of intervention at known costs can have a specific impact on morbidity and mortality. How are we possibly going to compete and maintain that limited funds should be utilized for interventions in water supply and sanitation? Perhaps we can take this up again later.

DR. HUGHES:

Just by way of closing, let me say that I think the last study which I presented, is fairly sound and some fairly specific conclusions can be drawn from it. That is the best one of the bunch as far as I am concerned.

HELI PERRETT:

This study recalls an earlier study which has been repeated, more or less, by what used to be the Cholera Research Laboratory and is now the International Center for Research in Diarrheal Diseases. There is a fourth variable, health education. And of course everyone is finding out that it is very difficult to incorporate health education into this kind of field test. But without health education it is difficult to get a high acceptance rate for latrines, especially among boys up to age 15, girls between 11 and 12, and older people. And you have the same sorts of problems in water supply. Still, however, I think it is a very carefully and well done study and we should watch for future results.

DR. HUGHES:

I think this would be a good time to stop; you probably have all had time to read the conclusions of this last study.

DR. OKUN:

I believe that we do have to go on, but I would like to take the chairman's prerogative to make one comment. One conclusion that can be reached is that these experiments reveal that interventions made without local participation and local impetus are not likely to be very successful. We have seen time and time again that when something is imposed from a capital city or some grant funds are provided to a community that did not want anything in the first place, it is not likely to be very successful. Northeast Thailand is a very good example of that and we have many others. On the other hand, if a program is in response to what local people want, then the problem of utilization is not likely to be nearly so serious, although the problem of children and others still comes up. But now I think we ought to move on to the next part of the program.

Study 5

Country: Kenya (Zaina)

Variables Assessed: Water quality, water availability

Study Design: Longitudinal

Time Frame: Four years (1961-1965)

Indicator(s): Diarrhea incidence, gastrointestinal illness incidence, intestinal parasite prevalence

Age Group: All

Intervention: Provision of gravity fed chlorinated water supply; no improvement (control).

Data Collection: Histories of diarrhea during home visits every two weeks; collection of stool specimens for examination for intestinal parasites.

Results:

	<u>Children Aged 1-2 Years</u>				<u>Children Aged 3-6 Years</u>			
	<u>Gastro-intestinal Illness*</u>		<u>Diarrhea*</u>		<u>Gastro-intestinal Illness*</u>		<u>Diarrhea*</u>	
	<u>Control</u>	<u>Water</u>	<u>Control</u>	<u>Water</u>	<u>Control</u>	<u>Water</u>	<u>Control</u>	<u>Water</u>
Before	27	31	--	--	11	23	--	--
After	30	18	17	6	27	33	7	7

* Expressed as percent of all illness

	<u>Ascaris Prevalence</u>	
	<u>Control</u>	<u>Water</u>
Before	37	15
After	50	9

References: Strudwick, E Afr Med J 39: 311-331, 1962
Fenwick. Mimeographed report, undated

Study 6

Country: USA (Georgia)

Variables Assessed: Excreta disposal

Study Design: Longitudinal (four communities of ~ 1000 people)

Time Frame: Two and a half years (1951-1953)

Indicator(s): Diarrhea incidence, prevalence of Shigella infection

Age Group: Children ≤ 10 yr.

Intervention: Privies improved in one community; no improvement in three (controls).

Data Collection: Histories of diarrhea and rectal swabs for culture from ill and well children during monthly household visits to families in blocks with a high proportion of children.

Results:

	<u>Diarrhea Incidence *</u>		<u>Prevalence of Shigella Infection</u>	
	<u>Control</u>	<u>Privy Area</u>	<u>Control</u>	<u>Privy Area</u>
Before (12 mos)	18	16	3.3%	4.7%
After (18 mos)	17	9	5.7%+	2.8%+
* cases/1000 person-months			+p<.05	

Reference: McCabe and Haines. Public Health Rep. 72:921-928, 1957

Water Supply, Sanitation and Primary Health Care

Martin G. Beyer, Ph.D., Senior Adviser, Drinking Water Programmes, United Nations International Children's Emergency Fund (UNICEF)

Tremendous needs lie ahead of us; increases of three to four times over present investments will be required if we expect to be able to meet the goals and targets of the International Drinking Water Supply and Sanitation Decade. This is of vast interest to all governments we are serving and with whom we cooperate and to the different agencies including USAID, SIDA, other bilateral agencies, the development banks, the non-governmental organizations, and the UN system.

This theme of improving services pertains not only to water, sanitation, and primary health care, but to our day to day work out in the villages; in the various urban areas, especially the slum and shanty town areas; our work with the governments; our work within our own headquarters in the different places; and to our attitudes toward this work.

We are trying to get away from the strictly sectoral public works type of approach. We are trying to achieve a maximum or an optimum of services to the water users, especially in the developing countries. In that context, we are trying to help bring about the desired impacts, not only on health, but on the general well-being of the villagers and the slum inhabitants.

This is not only a matter of pathogens or standards. It involves a multi-pronged approach in which the engineering aspects or the health parts should be seen as only a portion of an integrated whole. This approach pervades the policies of UNICEF, among other organizations, and increasingly affects the way in which we are cooperating with governments in their programs.

There is considerable experience in this area. Some of it is summarized in two official UNICEF documents summarizing a study that was made jointly by UNICEF and WHO in 1971. These resulted in recommendations presented to UNICEF and WHO executive boards in 1979. My presentation is, to a large extent, based on these.

First of all, I believe the objective of the exercise we are involved in is clear to us. It is to increase the well-being of people around the world. It has, in more strictly health terms, been summarized by WHO in the goal: "Health for All By the Year 2000." Along these lines, we have the recommendations from the Habitat Conference on Human Settlements in Vancouver, 1976; we have the recommendations from the UN Water Conference, Mar del Plata, 1977; and we have the endorsements from the International Conference on Primary Health Care in Alma Ata in the Soviet Union in 1978.

Primary health care is a strategy for arriving at the objective of "Health for All by the Year 2000" or, at least, as quickly as possible. This implies that we should see water and sanitation as just one of several components of primary health care, which in itself is one of the factors leading to overall community development.

Primary health care aims at focusing on the main health problems in the communities with priority given to the special needs of underserved and vulnerable groups. Among these vulnerable groups, children are naturally in the first line, especially children up to the age of five years.

There are a number of other aspects bearing on health that should be taken into account such as the access to various services — including water and sanitation, the economy of the community, and so forth. The necessity of interaction of different sectors is quite evident from the list of activities included in primary health care. Education extends to health and related activities such as the promotion of higher food production and improved nutrition. Water supply and sanitation is just one part of it. Maternal and child health care comprise another part. Then there is immunization, the prevention and control of locally endemic diseases, and the question of appropriate treatment of common diseases and injuries. There is, in addition, the promotion of mental health, and last but not least, the provision of essential drugs.

All of this implies the recognition of the role of communities in participating in and accepting responsibility for the maintenance of their health and well-being. The self-reliance of the communities should not, however, bar support from government and other agencies.

How do we arrive at programs that really would lead to all of this and that would help promote health for all? One of the problems is that water and sanitation are still being treated very sectorally and often completely apart from each other. Water often is the province of the public works departments, of ministries of agriculture, or of local government. On the other hand, sanitation very frequently falls under the health ministries and very little dialogue occurs between these authorities. The other constraints we normally encounter are sufficiently familiar to most of us. The question is, how do we go about all of this? What particular parts of the planning and programming exercise should we go into when it comes to developing water and sanitation as components of primary health care? I would like to suggest the following nine points.

To start with, the policy and planning aspects should definitely include integration of the sectoral approaches and mechanisms as practiced in the UN system and particularly in UNICEF's work in water and sanitation. In integrated programs we try to work with all the related sectors, dealing, of course, with ministries of the various sectors. We especially try to work with the ministries or offices of planning that serve, in many countries, to coordinate all of the development work of the governments.

In UNICEF we strive for a balance between the top-down and bottom-up approaches, trying from the beginning to sensitize governments not yet oriented to approaches from the village level, and to work with village level staff. There are some good examples in Mexico of programs in which we cooperate on a state level, one in Chiapas, which goes back eight to ten years, and another one that started recently in Quintana Roo. There is another very recently started program in Benin where water and sanitation are integrated parts of the overall development effort.

Secondly, there is community participation and support to the communities. Community participation is often confused with a concept of self-help in which the only notion of

community participation is a kind of almost forced labor input from the villages. Community participation goes beyond that—it should include all the stages from the planning and the designs to the implementation, evaluation, monitoring, as well as the operation and maintenance. Of course, foremost attention should be given to ensure the proper use of the facilities by the villagers.

The third point covers institutions and management, an area in which the UN agencies seek extensive cooperation particularly with WHO's support. Accordingly, we phase in the material aspects as well as certain institutional aspects for very specialized technologies, particularly when it comes to ground water utilization. We consider ground water as the safest source of water with some exceptions in terms of chemical water quality. In fact, ground water accounts for about 70-75 percent of the water sources which we are dealing with in the UNICEF-assisted programs and projects.

The fourth point ties in closely with this—the motivation and education of, as well as communication with, the users should be a two-way process. There has to be a dialogue with the villagers through a number of channels. The most likely ones are the school system, the health system, and even some of the implementing agencies, although they are not very geared for it — for example, the water well drillers or the people installing pumps in the wells. However, even before the actual implementation takes place, there should be full participation, starting with the initial motivation of the community. The question of whether or not the inhabitants want the improvements in water supply or sanitation should be at the base of all activities. Their subsequent motivation should be sought by various means including the use of available media.

There are many good examples of the use of media. One is that of the radio programs beamed at villages from a radio station in Chiapas, Mexico, which has broadcast to about 600,000 Tzotzils and Tzeltals and a number of other ethnic groups of American Indians since 1975. This was the first time that anybody had actually broadcast to them over the radio in their own language. One result is fan mail that amounts to about 250 letters per day from a total of 600,000 inhabitants. This says something about both the increase in literacy and the interest of the people.

There are many films including one made by Mr. M.A. Hussain, Chief Engineer of the Division of Public Health Engineering in Dacca, Bangladesh, who is the chief government official responsible in that country for the rural water supply program. He is a poet and an author who made a beautiful movie some years ago—a full feature of one and a half hours—depicting the love of two young men for a beautiful young woman who must choose between her two suitors. The one is really a beautiful, dashing fellow but he has no sense for sanitary latrines. The other one, needless to say, knows how to install sanitary latrines, demonstrates it, and, of course, gets the bride in the end.

The fifth point includes recruitment, training, and orientation. We are trying to serve people, but people are also the most important resource for carrying out the work and for maintaining it. Of particular importance is training at all levels of the government—managerial, organizational, and technical staffs. Training also has to reach all the way out to the community level workers including the village people who ultimately will be responsible—the operators, such as the handpump caretakers in India or the engine pump operators in Burma.

There is much work done already in this respect. An example of this is the village-level work with sanitarians in Indonesia being done with the assistance of USAID with WHO consultation. There are also quite important projects at the operational level for water-well drillers in Sudan involving the UNDP and UNICEF.

The consequent reorientation and retraining of higher level professionals is also necessary. As I understand it, this seminar is part of that process. As to the United Nations agencies, I can mention that we have similar exercises right now going on all over the world: WHO and UNICEF arranged for a number of regional seminars during 1979-1981. The United Nations and SIDA have an international seminar for rural water supply scheduled for October 1980 in Sweden. Such events should not be restricted to the initial phases of the Water Decade but should be recurring at regular intervals.

The sixth point concerns the technology and its appropriateness. It must be hygienically safe, technically and scientifically sound, socially and culturally acceptable, environmentally sound, and economically viable. I am using the phrase "appropriate technology" not just in the sense of village technology or inexpensive, low cost, very simple technology. Technology is appropriate if it can serve the countries—if the people can master it—whether it is a simple shaduf in Egypt or whether it is down-the-hole-hammers with hydraulic rotary drive that cost half a million dollars. It is important that the benefits are spread as quickly as possible and that the technologies can be used and understood by the people.

The seventh point is operation and maintenance. To this should be added the proper utilization of the facilities which we are increasingly trying to build into the programs. There are now quite a number of good examples for the maintenance of low cost, widespread rural systems such as the three-tiered system of handpump maintenance in India. This operates both from the village level up and the other way around with strong support from the various state administrations. I can also mention Bolivia where there are a large number of women in the villages who deal with the day-to-day handpump maintenance while the men are out working in far off fields or tending to their llamas.

The eighth point is the timing of the process which is very important. You must have all the factors mentioned before: education, community participation, and the actual implementation of the projects occurring at the same time. It is very bad to motivate the community and arouse a tremendous amount of interest for this service only to have it fall flat on its nose because it takes another year or two or three before you really get the materials into the villages. The villages are terribly disappointed.

We have rare cases, too, in water well drilling in which implementation and other aspects are nicely done, but the water happens not to be there. That is something for which there is no remedy. It is a bad situation, but it can be improved with a somewhat sophisticated approach which I warmly recommend. That is, prior surveys—notwithstanding the costs—by hydrogeologists and hydrologists who should work hand in hand with all the other government agencies and villages concerned. Such surveys, in fact, greatly improve the project performance and cost-benefit ratio of any program.

The ninth and last point is that of external support and concerns a few topics which coincide with some of the recommendations I will put to you. External support should generally increase considerably in order to match the overall goals, targets and capabilities of the countries. We should not let ourselves be deterred by the current lack of capability. That is precisely what we are here for: to help increase the capabilities and capacities for self-help of the developing countries.

The setting of priorities is also an element involving external support. I have listed some of the priorities which concern UNICEF. We try to reach the neediest, the poorest, and the most marginal areas. The distribution of priorities between rural and urban areas depends on which technical and funding level you can work on. UNICEF and other agencies, dealing with grants through equipment, other commodities, and technical assistance, provide these to the areas with the weakest resources rather than to the more bankable areas where the more regular resources, in terms of consultants and contractors, can be mobilized.

External support must take into consideration the interrelationship between water supply, primary health care, and other sectors. Criteria should be used with flexibility. Different types of projects need to have different criteria adhered to in many different ways. In terms of low cost technology you can gamble a bit more in your ventures and take more risks than you would do with municipal schemes in which you need to have very strict criteria and proper designs from the outset.

In terms of simple technology, it is much easier to be generous. In terms of the rapid population increase and the corresponding increase in needs, we have to act rapidly and take certain risks. In our experience of the last eight to ten years, during which UNICEF has expanded rapidly in this field, the return on investment has been fairly good in spite of many uncertainties in the initial phases of the programs and projects.

UNICEF currently works in 110 countries. We cooperate with 90 of these in their water supply and sanitation programs. Most of this work is in rural areas although it is gradually spreading to some marginal urban projects. Of the total program expenditures for 1979 of about 220 million dollars, 53.4 million dollars went to water supply and sanitation. Thus, nearly 25 percent of UNICEF's total expenditure goes into this very field as part of the inputs for overall development and primary health care.

We pay particular attention to the overall need for reinforcement of national policies and action, and to increase the level of environmental sanitation. In the last few years, the UNICEF inputs in sanitation constituted only a small percent of the total inputs in water supply and sanitation together. We are trying to promote much larger activities in sanitation now. It is easier to do so, for instance, in southeast Asia where there is a tradition and a corresponding interest that includes such aspects as the recycling of wastes which has seen considerable activity of late.

Greater attention is now being paid to the integration of water supply with other sectors, particularly the health sector, through primary health care, nutrition, and food production. This is a very important point and we are trying to promote it even more in UNICEF terms. We have good possibilities where the water resources are sufficient. Bangladesh is one example with its manually operated, shallow tube well irrigation program. The first pilot project encompassed some 30,000 shallow wells, with very simple suction pumps for the irrigation of small fields in an attempt to increase food production and improve nutrition. The program, which was launched in cooperation with UNICEF some years ago, was taken up recently by USAID which allocated a loan of some additional 14.5 million dollars.

There was not much of a debate on the subject of allocations for water and sanitation programs in UNICEF until about a year or two ago when we started working on new policy guidelines. Concurrently, we started to have talks at different levels: at our own headquarters, in our field offices, and with governments. There was a bit of a competitive situation between some of our generalist colleagues and the water and sanitation specialists. Some of the former charged that water and sanitation were taking funds away from other sectors. This kind of discussion has been going on in all the agencies.

In reality, we have to look at it in terms of the overall needs of the communities. It is not important whether we are water engineers or geologists or physicians on the one hand, or, say, social scientists or social community developers on the other hand. We must all sit down together and discuss these things, not in sectoral terms, not with professional blinders, but with open minds in an intersectoral spirit.

Policies have to follow the real needs during any given period. For instance, the inputs from UNICEF to children in the world since 1947, when UNICEF was formed, have undergone a series of transformations. Establishing milk plants and, through these, providing milk to children, was an important activity in the late 1940s and 1950s. Then that was replaced by supporting the production of supplementary food in the 1960s. For the moment, it is water supply and sanitation which commands prime attention. You cannot do many other things for community development or primary health care efficiently unless you have provided for this basic service. This need may well abate once everybody gets his or her hand pump in the backyard or, even better, a water tap in each household as well as a sanitary latrine for each family.

Finally, I would welcome any of you to come to UNICEF Headquarters in New York to continue this discussion. Also, I would suggest to anyone of you travelling out into the world to visit the UNICEF field offices wherever you are. Our field staffs are in frequent touch with USAID and have a lot of experience in the integrated approach to water and sanitation in the context of primary health care and community development. In this, we all are trying to follow the Swedish theologian's exhortation: "You should not only just say 'Hallelujah,' you should really do it!"

DISCUSSION

QUESTION:

Is UNICEF now considering the financing of simple technologies for water and sanitation along with these guidelines that you have delineated?

DR. BEYER:

In principle, yes, but it depends on what you mean. We have always financed the application of low-cost simple technology in the various project areas. On the other hand, we do not normally finance pure research, especially if it is done in the industrialized countries. There are other financing sources that support pure research in the developing countries, one example being the International Development Research Center of Canada. We have been participating actively in the development of certain kinds of handpumps where inadequate technology has contributed to failures in the handpump programs.

FOLLOW-UP:

I wasn't thinking so much of research as of the simple operation of facilities in rural areas.

DR. BEYER:

That is very much a part of our work.

FOLLOW-UP:

In terms of recurring costs?

DR. BEYER:

You mean operating costs? Only in one or two cases have we financed operational costs and those only in the first year. It is not adverse to our policies in utterly poor areas having no resources whatsoever, but we would expect that after that initial period either government or the communities would take over.

STEVEN SINDING:

I would like to elaborate on the question of resource allocation and relate it to some issues that were raised earlier. Throughout the day we have heard presentations which, in the most optimistic interpretation, would lead us to conclude that water and sanitation investments make sense for health reasons. However, as several people have said, the evidence can be used on either side of the argument. It doesn't seem to me that today's discussion has really clarified that argument. Nevertheless, where a development agency is trying to make decisions regarding allocations, it seems to me that in the absence of perfect information we probably ought to put ourselves in the position of erring on the side of chance where we are not sure what to do. This would have us take on faith what we all know in our guts to be true; everything else being equal, clean water is better than dirty water.

That being the case, the next step is to address a set of questions that have been alluded to but have not really been dealt with yet. If water is a necessary condition for improved health, what are the additional conditions of sufficiency that a development agency like ours, or UNICEF, or others ought to be looking for in order to predict the greatest likelihood of positive health outcomes?

As we try to make allocation decisions we have to deal with the question of water and sanitation as representing one of many possible investment areas. But within that,

there must be some evidence which the experts assembled here can, to some extent, pass on to us pointing to the conditions under which water and sanitation projects have the greatest impact on health. What kinds of places are those where water and sanitation projects have in fact improved health the most? We have heard references to the importance of community participation, the predisposition of the community to use the resource once it is made available, commitment to maintenance, a whole series of sociocultural variables and there are probably many others I haven't mentioned. In the remainder of the time that is devoted to the impact on health of water and sanitation, I would like to hear some discussion that might help a knowledgeable decision maker, faced with the question of where to put scarce health resources, identify the conditions under which he/she can best predict a health outcome from a water and sanitation investment.

DR. OKUN:

That is a very good question and that is really what this is all about.

DR. BEYER:

There are quite a few of us who can respond to this question. We face this problem all the time, particularly in terms of allocations. That is the least problem.

Whatever UNICEF is doing, both in terms of allocation between different sectors and among different countries, is ultimately decided upon by our executive board with representatives of 30 governments equally spread over the world. These are the ones ultimately who not only approve of what UNICEF is doing, but who often give us very active guidance in this very field. They, in turn, reflect their various experiences, both the industrialized and the developing countries. I wouldn't say it as an answer to your question, but there is apparently quite a consensus among those who govern these countries about the overall needs and about the intrinsic value to health of water and sanitation investments.

We have been discussing here certain health indicators such as frequency of diarrhea. There are a number of other health benefits which can be observed, especially if you live out in the bush for a while anywhere in the world, as many of us have probably done.

One of the principal health factors is the access or lack of access to water. Take those women in the south Sudan who walk an average of six hours a day to get their water; how do you measure the health impact? If you were a woman living in a south Sudanese village, I think you would definitely feel much better if you had the handpump in your own back yard, so to speak.

That is just one aspect. There are many other indirect aspects, some stemming from increases in water supply that go beyond household or drinking purposes and allow, say, for the irrigation of fruit orchards or school gardens. Such is the case, for example, in Nepal and along the Himalayas from Pakistan to the Nepal-Bhutan in north India. Here piped water schemes, perhaps from protected springs, and horizontal water wells that tap the water much closer to the villages have provided additional quantities of water. How do you measure the health impact of this? It is certainly there in terms of improved nutrition.

Beyond this it is hard to answer your question. There are no direct methods of measurement but you may definitely appreciate the benefits after living for a while out in the villages in Africa or South America.

DR. OKUN:

Would anyone else like to try to address the question?

COMMENT:

I would like to address this from a different viewpoint; suppose you are living in a city with a good water supply and that water supply is interrupted for several days. The result can be effectively measured in terms of costs and benefits and it has been done here in the Washington area. In some neighboring communities where there was an oil spill, water had to be trucked in. These studies have approached the issue from the point of improving and providing a system. I would suggest that in some cases where the water supply has been interrupted and epidemics have occurred, perhaps these impacts could actually be quantified and used as a proxy for establishing the positive impact on health of improvements in water and sanitation.

RIFAT BAROKAS:

The original question was, if I remember right, how can a decision maker confronted with a budget of 10, 20 or 30 million dollars for so many development projects choose between an agricultural production project, a health project or a water supply and sanitation project.

We have come across this when working in various countries and as we all know, it is not so easy to compare internal rate of return or cost-benefit ratios when measuring the life of a human being. There really is an absence of objective criteria or of measurement instruments.

About six months ago we were confronted with a choice of putting some food in people's stomachs or giving them some water for drinking and some water seal or pit latrines. If the people are starving, really starving, and the only funds available are to increase income or nutrition, the problem may be how to provide some life sustenance rather than how to decrease the diseases involving the community. But if there is an agricultural or other income base, if people are getting some sort of a living through their everyday activities, then the problem may be not to perform a cost-benefit study, but to see, through another kind of study perhaps, if it makes sense to put money into water supply and sanitation instead of another field. It is not always possible to put in streams of income and costs and to do the mental gymnastics that we are forced to do on some projects. If we are to act on more than a gut feeling it must be with some knowledge of the community and of what the desired effect is to be.

CARL STEVENS:

I think that Steve Sinding's question is being slightly misunderstood. As I understand it, he starts with the premise of potable water at some source, let's say at a standpipe, as a necessary but not sufficient condition for health impact. What additional strategies — health education — I don't know precisely what all these strategies would be — but I think he is asking, what additional strategies should the planner plan on in order to realize a health impact. In other words, what are the sufficient conditions? And I think he was suggesting that somewhere in the water community there ought to be more information from technical experts on this. To just put it practically, suppose you had yourself a project, you got clean water and water pipes in the village — what next? What strategies do you accompany that clean water strategy with?

ANNE TINKER:

I would be interested in reactions to Bob Grosse's thesis which is that health impacts of projects are significantly affected by socioeconomic levels of countries and that middle income countries receive the greatest health impacts from water and sanitation interventions and that lower income countries receive less impact because of other significant variables — environmental, health and otherwise. Would anybody care to comment on this question of the allocation of resources as determined by socioeconomic levels?

DR. OKUN:

This fits in with the other. It is one of the conditions that certainly would involve helping make a determination. Are there others that someone would like to suggest? I think we should stick to this specific question. It is very specific and there are specific answers.

MR. DONALDSON:

In trying to answer the question, I can't give a yes or no. But let's see if I can play with it a little bit. One of the things that you've got to realize is that everybody in this world has a water supply. I think that it is time to stop talking about building water supply. What we are doing is improving the water supply that somebody already has. Women going to a well with a bucket, drawing the water out, carrying it to the house, boiling it, storing it, using it, disposing of it, is exactly the same element as here in Washington, D.C. The issue is improvement. The problem becomes, where do we push and shove a little bit to get the thing to go forward, the thing that we call water supply.

Now, there is a set of problems at the head end. You have to get the project developed. In our experiences in Latin America we have found that as you move down into the village water supply area, people do not entirely know how to put together a water supply package which is going to be able to be presented to you for a decision. There is a whole training aspect that needs to be supported there, an infrastructure development on how to make projects.

We know how to make a project for Bogotá or Quito. That is basically an engineering problem. The former requires a management approach which we don't understand too well yet. Insofar as construction is concerned, however, we seem to be able to get the systems built.

Now we have the additional problem of teaching people how to build them faster. In one country in South America we have a hundred thousand communities that currently have built a thousand systems. The people are proud of what they have done and rightfully so. But each is only a pilot project. Managerial skill is needed for these people to learn how to build faster.

Then at the end you have the operation and maintenance that Martin (Beyer) speaks of. How do you teach people this? Call it what you want. This morning I was calling it "health education," perhaps misusing the term. Whatever you call it, it is one of the fundamental elements in teaching the people how to use the managerial skills because a village water program differs from an urban water program. An urban one is a solution of a unique problem. A village water program is putting together thousands of units. If I could help the decision maker with his problem of allocating resources it would be to teach the people how to handle the managerial aspect of the problem.

MR. SINDING:

I think there is a confusion here between those people who are responding to the question on the assumption that you have already made the decision to go ahead and build or improve the water supply, and my question which is how do you make the decision about where to do it. Here is my question. Since we cannot do water supply and sanitation projects in every village of the world simultaneously, how do we make judgments about where the payoff is likely to be greatest in health terms?

DR. BEYER:

I just want to say briefly, are we going to make the decision or are they? In the end the decision will be with the people and the governments. We can only weigh whatever resources we have and our policies and our mandates. Ours at UNICEF are different than yours at AID. You include much more of development sectors; we are restricted to basic services.

VICTOR WEHMAN:

Regarding Steve's question, I would like to give an example. If you travel in the developing world and stay at the continental hotels, you always wonder about the water in your room. Perhaps the laundry maid drew water from the toilet to fill the pitcher. Then you take a look out your window and a person is bathing along their dock location, defecating, bathing and washing his teeth all out of the same cove or river basin.

I think the issue reduces more to an economic situation; it comes down to a situation of development in which we are trying to determine whether or not and how we are going to make it possible for these people to begin to cope with the extremely dangerous and contaminated environments in which they live. Whether we call it primary health care, water supply and sanitation, rural development or whatever, these problems that we are talking about are basic interventions aimed at helping those people cope basically with their contaminated environment.

Many different types of intervention are made. For instance the World Health Organization data support "necessary but not sufficient" types of approach for water supply activities. That is well documented in a number of their publications. The problem is that no matter how well you design your epidemiological study, no matter how well you try to define your variables, it basically comes down to a political decision. That decision of how to best affect that individual in that community should be made in a development oriented organization, one that is not necessarily banking oriented.

COMMENT:

I want to make three or four observations. First, I am a little surprised that we talk about whether or not water has any impact on health. I think all of us have travelled in developing countries with serious disease problems. After several weeks in the country we have grown reckless and indulged in something we knew better of and found ourselves suffering the fate of the damned. At one point or another I think we have all resolved that question empirically to our own satisfaction, dissatisfaction, or certainly discomfort.

The second point that I would make is that no evidence indicates that dropping a water supply or sanitation project onto a community will necessarily improve health. There are numerous and abundant examples of clear failure. I think we have looked at some of them. We have seen failure attributable to poor utilization, failure attributable to poor maintenance, failure attributable to contamination between the source and utilization, failure attributable to community-wide effects where the individual may have made considerable efforts in sanitation and water supply, but his neighbors did not. It seems that we come

up very quickly to an unpleasant kind of question or situation and that is that those communities which appear most in need, those which have the most severe problems, are probably the most difficult to deal with. They have the lower capacity for maintenance operation and the most likely programs of utilization and therefore the lowest probability of achieving the kinds of health impacts we wish.

I would go further and say that I doubt very much that water is even a necessary condition to achieve these health objectives. I have stayed for a period of weeks in communities with extraordinarily serious waterborne disease problems and not gotten ill. I have done it without the benefit of a central water supply. I have done it without the benefit of an external assistance grant. I think the question that we face is, under what circumstances do we derive benefits from water supply and sanitation projects, and to what extent can we manipulate those circumstances. Can we improve them through management, centralized operations and maintenance, or through massive programs of health education?

I have found very little in the literature to illuminate those questions. People who failed in providing good wells and good sanitation systems now say that it wasn't their fault; it was the fault of the manager, the health educator, or the maintenance and operations department. I have not seen any evidence that we know how to deal with those other three problems and I think that is where we ought to be focusing our attention.

DR. OKUN:

Thank you. One last comment Mr. McDonald and then we will have to take a break.

AMBASSADOR McDONALD:

My question was really what kind of a payoff are you talking about? As a manager or a decision maker what audience are you trying to satisfy? Are you trying to satisfy the U.S. Congress or are you trying to satisfy the host country concerned?

I spent some time in Kenya two years ago and ran into the very confused and convoluted water problem there. You have 15 donor countries with over 150 million dollars in foreign exchange invested. Each one of those donor countries had established a project within a radius of 50 km from Nairobi. The rest of the country was totally barren. The reasons were very simple and political. They wanted a quick payoff. They wanted to be able to go back to their respective parliaments and say, "look what we did in black Africa." That is a kind of a payoff, a political one, but I don't think it is the right kind of a payoff. I think that is a factor that every manager has to take into consideration.

DR. OKUN:

Thank you very much. We will have to take a break now and I would urge you to come back because our next speaker is the one that has come the farthest to be with us and what he has to say is really quite important to us. So let's take a break now and continue to think about the questions raised.

The Cost-Effectiveness of Alternative Measures for Control of Enteric Diseases

Branko Cvjetanović, M.D., Physician - Epidemiologist, formerly Chief Medical Officer, Bacterial Disease, World Health Organization (WHO)

Mr. Chairman, I will present the problem assigned to me which is "The Cost-Effectiveness of Alternative Measures in Water Supply and Sanitation in Disease Control." Since we have people here from various disciplines, I will begin in a simple way and then go on to some more complex problems which need to be solved.

Cost-effectiveness is usually calculated by defining the cost of the program in dollars, whatever it is: immunization, health education, sanitation, surveillance and so on. And then, having measured the cost of that in terms of dollars or any other currency, we look at its effect on health which we describe in two ways. We describe it as the absence of disease—there is no more cholera or there is so much less cholera—and then we try to describe the positive effect on health, such as: is nutrition better, or in what way have we improved health? When we start to describe any positive aspect of health, then we are on very shaky grounds. The medical profession can describe diseases but not health, not exactly anyway.

The whole thing is very simple—you have a cost and you have the effect. But there are many things to be defined, and defined precisely, so that what we mean is very clear. Of course you have a total cost of your water supply, but water supply is used for vegetables, for some industries—for a number of things. There is the cost of the health component, but only part of water has a direct effect on health. That means that the other part has an indirect effect. Never in the programs I have seen do people try to divide the health component of the cost from the other components. If you make a lake on which tourists can hire a speed boat, that is a different thing than potable water. This has to be defined, yet I think it is very rarely done.

We also talk about the effect. There is a total socioeconomic effect that certainly goes beyond the health effect and that too should be taken into consideration. For example, we have water for washing, drinking, bathing, gardening, sewage, and so on. Now drinking, washing, and bathing, you can say, are 100 percent for health, although maybe they are not. We will have to solve that problem. Gardening and sewage, on the other hand, are 50:50 I would guess. Water for industry surely has no direct effect on health, but you could argue that with industry people have better incomes and they eat better. Therefore, because they have better water, they have better food. That is one way of looking at it. But in any case, this should be quantified and not be taken too simply.

We have alternative approaches, of course, and we try to determine which is most cost-effective. If you have an alternative measure, you first have to consider the link

between the socioeconomic conditions of a country and the health service system. It is possible that there will be no measure or policy. There are some countries where there are no measures whatsoever. This is the cheapest way—not to provide health services. We would have a good cost side, but surely not a good effect side.

An alternative is to provide primary health care—comprehensive health care. If you do that, you are committed to a cost. You may have a law requiring that a man who has a communicable disease must be treated at the hospital at government expense. That is part of a fixed pattern. If you have no measure or policy, that is a different matter. In any case, you have to keep in mind the actual socioeconomic and health services systems that exist. You cannot calculate cost-effectiveness out of the blue. When it comes to water supplies, we can say that there are many ways of using water supplies—many ways in which the water is provided. And it is provided with increments in quality and quantity. All this is reflected in the cost and in the effectiveness.

But you have other measures for control of enteric disease. You have nutrition, surveillance, and a disease control system. In each socioeconomic and health services system, this is defined. Dr. Hughes runs certain services which represent a commitment of this country but not necessarily of another. Other alternatives are represented as commitments to treatment. Then you have chemoprophylaxis, immunization, which you can accomplish through multiple vaccination, mass vaccination, and specific vaccination. Then there is health education, which you have to qualify according to whether it is focused on self care or communicable disease prevention and so on. Finally, you can make all kinds of combinations of these various interventions. You even can have combined measures which include all the supportive measures.

For example, if health education is considered, its impact on both cost and effect must first be taken into account. In the water supply program, there must be a health education component or else the system will not work. The people may break the pipes, or, if plans did not include instruction, they will not know how to use the system. This is a very important element of the effectiveness as well as of the cost. As we can see, any one of these components of a combined measure may be a component of another measure. As a result, the number of possible combinations is enormous.

I have said that we have to consider one thing that is very important: double disease prevention is only more costly, it is not more effective. If you kill a man with one bullet, it does not matter whether you use ten more bullets—it changes nothing. Here it is the same—if you have prevented one disease with one bullet, which is, for example, sanitation, you will change nothing if you put in four or seven other measures. This is very often forgotten in a typical human, "emotional" reaction: "Let us do everything we can do." Of course you pay for that ultimately.

Now, what is impact? An impact can be a cause as well as an expression of effect and effectiveness. There is the general impact of water which should be considered and about which I have my own concept. The effects of water interventions, and I can prove it if we go into discussion, have their impact in a basic socioeconomic way. Water interventions aid the transition from the subsistence to the market economy.

Facilitating this transition is the most essential action of water which we all have seen with our own eyes in a number of developing countries. This does not mean, necessarily, that you have these transitions from subsistence to market economies straight away. You

do not go suddenly from a situation where there was nothing to one which has a 100 percent market economy. But all the while, you push in the direction of the market economy. You instill, in many places, a knowledge of time, its value, and a number of other water values. Time is money. That is something that is clear to us, but in a subsistence economy it is not clear.

When water came to an Indian village, I heard a man say, "Now our women have plenty of time. What should they do with that time? We make money out of that time by having them make handicrafts and sell them to the tourists." Now that is also the effect of water.

Additional primary effects of water are increases in the level of education, nutrition, hygiene, and so on. And the health effects, to my mind, are only secondary, created, for example, by the improvements in nutrition. This is not always the case, however, particularly when you have a big problem of cholera, which is waterborne. Then, if you put in water, you may have a primary effect on health. So, nothing is absolute in any way.

Now we are coming to the specific health impact. We have a primary impact on the improvement of nutrition. That is very important. The second impact is on communicable diseases—waterborne communicable disease prevention. Then there is an impact on the other ectoparasites but we have discussed that matter, so we will not go into it now.

In addition to this general health impact, we have impacts on specific disease problems. A primary impact on a specific disease would result when the disease is exclusively waterborne. On the other hand, when it is waterborne and it is also food-borne, there will be a secondary effect.

Let us say, for example, that you have hydatidosis in the area. By improving nutrition you will also improve the marketing economy and finally people will have better and more food. Then, through health education, it will be possible to improve nutritious preparation of food and so on. This is a secondary kind of effect.

After this preliminary discussion, we come back to my assignment which is to talk about cost-effectiveness. How do we go about that? In cost-effectiveness, we have said that there is a total social cost of a specific illness. I am not talking about the alternative measure. I am talking about the illness with which you are dealing. You have to define your illness problem and you will find that illness costs. Then you are committed to whatever your country is doing about that illness, perhaps giving free treatment and immunizations for that particular disease.

The total cost of the disease is the part that society must cover plus the part that the individual covers, and you have to analyze all of that. Then you arrive at the total cost of your control program. The actual cost of the program will be the total cost of the program plus the cost of the disease—that assumes that you will not prevent 100 percent of the disease. You will still have to have your control program whatever the alternative approach is, plus a section of your commitment to deal with the disease through treatment and so on. That should not be forgotten.

There is another variable in that you will cover only a fraction of your commitment to treat the disease. This means the other fraction, the untreated amount, actually will go into financial benefits because you will not be obliged to cover this other fraction. The

whole calculation would be B, plus a fraction of A, minus the other fraction of A, whatever the part up to 100 percent. Now this is when you deal with the cost and this is forgotten. Usually the cost means taking the actual cost of the water supply and that is wrong.

The cost of water supply, that which is declared as the cost of the water supply, is not the actual cost because only part of that cost is for health. The other part is for the water sector. So you have to make this division. And secondly--because you are supplying the water or improving it, or whatever you do with the sanitation plus water--you are decreasing the disease load on the community, and, therefore the financial commitment to cover these problems. Consequently, you have to deduct that from the cost. And so we come to the cost-benefit and the benefit cost ratio which shows that you cannot consider the cost-effectiveness without considering the cost-benefits part.

I am now coming to a problem that is sometimes overlooked, although it has not been here, and this is the role of hidden, I call them "human," factors in relation to the degree of effectiveness of sanitary measures. We have conducted studies in some Philippine communities which have shown the effectiveness of sanitary measures. We tried to do the same study in another community in the Philippines, a Muslim community, and failed even to organize the study because part of the success of the first one was due to the high degree of cooperation on the part of the community. This is a hidden factor that is difficult to quantify. So, whenever we say that it is 30, 40, or 50 percent effective, we are saying, yes, it worked with Chinese, but it did not work with Polynesians or the other way around.

Now we can talk about alternative control measures. I have underlined the strategy. We have sanitation, immunization and so on, but you can use them in different ways. We have shown, for example, in immunization, that it makes a great difference when and whom you immunize--not the number immunized, not the doses of vaccine. It is the strategy, the knowledge that you put in the best utilization, that changes the cost and the effectiveness.

To be more explicit without going into excessive detail, I will discuss my favorite disease which is typhoid. Typhoid is waterborne as well as food-borne; it is epidemic as well as endemic. If it is contact-borne, then it is primarily endemic and you can apply sanitation, vaccination and personal hygiene measures. If you apply only sanitation measures to waterborne typhoid, you will get very good results. But, if it is food-borne, the results will not be so good, and, for the contact-borne typhoid, you will probably achieve nothing. Percentage effectiveness cannot be taken at face value unless you have extensive knowledge of the disease and the control measures. Vaccination, for example, will do very little if you have a food-borne disease. It would be more effective in waterborne.

There are some general things that will have to be considered in talking about alternative control measures. When you have alternative approaches to choose from, there is a question: does your solution of one specific problem create a new problem? You may create a new problem which will have its own cost. You may take a wrong measure, and while you solve one problem, you create a new one, and the cost has to be adjusted accordingly.

Historically, for example, water-carried sewage is, to my mind, a solution that has created problems that we now have to solve making the original cost estimates of a water-carried system incorrect. The cost must include all that we will have to do now in developing technology to get rid of this pollution. Our present situation requires us to deal with that problem created by our ancestors.

Is the cheapest solution the best? That must be answered. And is it really the cheapest. I just read an AID statement that oral rehydration is the most cost-effective approach "under the conditions"---what kind of conditions? This is an approach to cure a disease. It is not an approach to treat disease. In the long run, you will have to spend that amount of money for the next hundred years, unless you do something else. This is a kind of pitfall that will have to be avoided in considering cost-effectiveness.

And then last, but not least, whether we are immunologists or sanitary engineers: are we accepting the best solution or the only solution? There may be another sector that has a better solution than we have. If it is food-borne typhoid, maybe the market control authorities can deal with that. You do not have to deal with it. Or, can you perhaps combine your work with that of another sector and have a joint program?

I have distributed to you a paper that I wrote for a conference in London called, "Sanitation Versus Immunization."¹ Since I am an expert on immunization, I have a right to say how poor it is in solving the problem of enteric diseases. In that paper, I have one particular table that I think we may look at (Table 1). (I was asked what the advantages and disadvantages of sanitation are as opposed to vaccination.)

You can see that, in considering effectiveness, immunization protects against only these three diseases, not against the other diseases. It is giving short protection with decreasing effectiveness over time while sanitation offers protection for about 50 percent of all enteric infections, in addition to getting long-lasting and cumulative effects. When you come to the cost, immunization is relatively low in the beginning, but, if you are to maintain the immune status, the cost rises. In contrast, you have sanitation with a relatively high initial cost and a low maintenance cost.

When you consider advantages, immunization gives you an immediate effect and a low initial cost. Sanitation gives you a lasting effect, is cumulative and very favorable if you have a long-term projection. Personally, I think we have to look at everything in the world as a long-term projection. We should not live from today to tomorrow. I have also listed some disadvantages which repeat the characteristics of the two interventions. Taking into consideration the constraints with which you are operating, you will then be able to make your choice. What I have said should serve as a kind of general background.

Now we consider technology. Can we actually calculate cost-effectiveness and cost-benefit, which is a dynamic thing occurring, not just once, but going on forever? If you project ahead for five to ten years, what is cost-effective today may turn the other way around. As a result, we have to look very closely into that problem. We have made mathematical models using considerable information that was available on the natural history of disease and the pattern that disease has with no intervention. You can then introduce, at any time, into the model whatever interventions you want for a specified length of time, coverage, cost, and so on, and get the results of the interventions.

Let us look at the example of typhoid again. Among possible interventions, you see single vaccination, repeated vaccination, privy construction, and various combinations of these. If you take the balance between cost and benefit you will see that different policies give you different financial results. You can calculate the benefit. By having a program, you save money which you ordinarily would have spent on treatment. With another course, you get lower benefits. Perhaps you will make this choice as the one that gives you relatively high benefits for a relatively low cost. This is a projection for one to ten to twenty

TABLE I

SUMMARY PRESENTATION OF THE EFFECTIVENESS, COST, HEALTH AND ECONOMIC BENEFITS, ADVANTAGES AND DISADVANTAGES OF SANITATION AND VACCINATION IN THE CONTROL OF ENTERIC INFECTIONS

Criteria of comparison	Vaccination	Sanitation	
Effectiveness	<ul style="list-style-type: none"> - 50-80% protection against specific infections* - short duration of protection, constantly declining 	<ul style="list-style-type: none"> - 50% or so against all enteric infections - long lasting protection with cumulative effect 	
Cost	<ul style="list-style-type: none"> - initially relatively cheap - maintenance with repeated boosters with several specific vaccines very costly 	<ul style="list-style-type: none"> - initially relatively expensive - maintenance relatively cheap 	
Benefits	Health	<ul style="list-style-type: none"> - decrease of specific infections* for short period of time 	<ul style="list-style-type: none"> - decrease of all enteric infections for long period of time
	Economic	<ul style="list-style-type: none"> - prevents undue losses in trade and tourism temporarily - has little effect on economic development 	<ul style="list-style-type: none"> - facilitates and promotes trade and tourism - promotes economic development
Advantages	<ul style="list-style-type: none"> - immediate effect - initial cost: low 	<ul style="list-style-type: none"> - long lasting effect - cumulative effect - promotes general and especially economic development 	
Disadvantages	<ul style="list-style-type: none"> - short-lasting effect - gives a sense of false security - maintenance costs high - strict specificity of vaccine requires surveillance and/or surveys 	<ul style="list-style-type: none"> - initial investments high - if not supported by public cooperation, health education and economic development, is likely to become ineffective 	

*Typhoid, cholera and possibly dysentery.

years, and it is a rather dynamic process that cannot be done otherwise. We have worked out a nomogram method which is simple for rough determination of the cost-benefit and cost-effectiveness.

A more complex example is the intervention in cholera. We have seven possible policies including no policy at all, vaccination, regular and specific vaccination, sanitation, chemical prophylaxis, and so on. Even the coverages could be changed in many ways. You need to get some kind of orientation figures and then you can operate within this framework.

I would like to conclude by saying that it is extremely important, when considering the cost-effectiveness of alternative measures, to look at them from the professional standpoint whether you are focusing on the sanitary, epidemiological, or other aspects. It is important to do this before making statements such as AID's about oral rehydration being most effective. WHO has said that immunization against diphtheria, tetanus and pertussis is the most cost-effective approach. This is like saying that the most cost-effective way of looking at a television program is to buy a television set because if you buy a refrigerator or typewriter you cannot see the program. There is no choice. We know that there is no other way to control these diseases. There are no alternative approaches. Therefore, why should we go through the exercise of saying this is the cost, and this is the effect? You have no choice, and there is no reason to point that out. The decision is one that, as our colleague said, is essentially political. Do you want to have tetanus or not? If not, then you know what the cost is. But, when you have alternative approaches, then you must calculate the cost-effectiveness and you must do it very carefully.

I think that these studies in the field of water supply and waterborne diseases have not been done properly and carefully for the lack of a common language between the engineers, economists and the others involved. This has to be done if we are going to use the available resources in the best way. Thank you.

FOOTNOTES

1. Cvjetanović, B. "Sanitation Versus Immunization in Control of Enteric and Diarrheal Diseases", Prog. Wat. Tech. Vol. 11, No. 1/2, (1978) pp. 81-87.

DISCUSSION

DR. OKUN:

Are there any comments or questions of Dr. Cvjetanović?

DR. WHITE:

I think that the point regarding long-run benefits and the necessity to take into account today the present value of those benefits is extremely important and one that we overlook quite frequently in evaluating relative health projects. But where does that social discount rate properly come from? Water entails a high investment today, but it has low maintenance cost and a long-run time stream of benefits. Oral rehydration tomorrow morning at nine o'clock can save some lives that otherwise would be lost to dehydration. How does the planner properly set the social discount rate that permits one to value these different time streams of benefits and costs?

DR. CVJETANOVIĆ:

Your question is extremely pertinent and the answer is very simple. The decision maker can make a proper decision only if he is presented with the facts. Here we are extremely imprecise because we are trying to compare two quite different things that cannot be compared. The mechanisms, the dynamics of these two interventions, are completely different as we can show mathematically.

Oral rehydration is to prevent the children from dying. But it does not change the epidemiology of disease and the frequency of infection. Water supply, on the other hand, will change these frequencies and will ultimately solve the presence of the infection. These are two different mechanisms and unless this is explained to the decision maker, he will make a decision either by guess-work or preference. Providing decision makers with this information is our responsibility — medical, engineering and the other people. We must give all the facts. Instead we too often make sweeping statements without considering the full implications of what we are saying.

QUESTION:

I have two questions. You mentioned that the total cost of a health project includes calculation of a social cost. I was a little unclear as to what you define as a social cost and how you measure that. The second problem that I would like to ask you to deal with is how are you proposing to take the total cost of whatever type of water project and disaggregate the health component of that total cost. That seems to be important in your calculation.

DR. CVJETANOVIĆ:

To the first question, what is the social cost, it would be best to give you an example. In our modeling we attempt to minimize differences between various countries in the world by simulating simple examples. I took the ministry of health's responsibilities in health. Here cost is the direct cost of disease, its treatment. The benefit is what is saved on treatment in monetary terms.

But things are not so simple. The social cost of 120 cholera cases in Hong Kong in 1964 was 80 million dollars lost on export and tourism. You cannot consider cholera from the cost of treating 80 cases. This is minimal. The actual cost for Hong Kong was 80 million

dollars. This is the social cost. That is what we call social cost. Society has to pay. Hong Kong was short by that amount.

Regarding your second question, can you separate the cost which is for health from the cost that is for the other sectors. That I really don't know. It has to be worked out. Unless it is worked out, our calculations will be incorrect because we will then be forced to weigh the total cost of water against the health benefits. You need water regardless. You don't use water only for your health. You use water and have to pay for other activities; so this should be divided. Otherwise, there is no proper way of costing. But how to do it is to study more and to calculate more about the actual usage of water which has not yet been studied very much.

MR. DONALDSON:

One of the things being said here is that we need to change our thinking. As people who are trying to use water supply and sanitation to achieve an aim, we need to begin to look at what these things will do about solving a particular problem. I was trying to say this earlier.

In the situation in most developing countries, we have a crisis problem. We've got to improve rapidly a set of conditions, generally in relation to diarrheal diseases. We need to reduce morbidity figures as quickly as we can. Then, as we do that, the problem changes to maintenance and ultimately to prevention. We often say a water supply will take care of diseases — that is a shotgun. If I understand what you are saying, Dr. Cvjetanović, in your cost-benefit approach, you are attempting to focus in on what your intervention will do — your water supply and sanitation — in relation to particular things, particular disease, in this case diarrheal diseases, and your analysis goes against those rather than trying to cover the whole waterfront.

DR. CVJETANOVIĆ:

Or sometimes in practice the problem can be put the other way. A government, (and this is a real example), Western Samoa, wants to develop tourism. That is a decision following study of all economic possibilities. Currently there is a high incidence of typhoid and you can't invite American tourists when you have a high incidence of typhoid; so you have to cut your typhoid down. Here you have a benefit area already decided — tourism. Your problem area is typhoid. You want to cut typhoid as quickly as possible because the international airport has been built, but people don't want to land there. We then worked out, under these circumstances, a program that fits the requirements for economic development. We looked at that case a little bit differently. They wanted a quick effect and this cost would be immediately offset by the tourism. So the program was different than if Kenya would ask us to do that in a bush area where there is not any link with a specific development program. As I said before, this is a question of dialogue with the people who can explain their stance and define the problem and put that across to a sanitary engineer and an epidemiologist who can then say what is the most cost-effective solution under this particular requirement.

COMMENT:

The matter of assessing total social cost is, as anyone who has ever tried to do it realizes, a real can of worms. There are a great number of judgments that always need to be made as to what factors should be included and how to value them. It is important, though, and as I perceive it, one of three necessary programs of evaluation that have to go into planning an actual water supply and/or sanitation program. When you add up all

the opportunity costs including the opportunity cost of using scarce manpower and management resources and so forth, things that we haven't touched on here, you then add on all the likely benefits to see whether it comes out in a more or less reasonable balance. But there is a great deal of individual judgment exercised in that process.

There are two other important processes of evaluation that are crucial. One is the evaluation process that is engaged in by the beneficiaries themselves. No matter how well a project adds up to the economists or the policy maker in the capital, if it doesn't add up to the beneficiary, it's not going to fly.

The third is more limited than either of these, but it is more manageable. We might call it management evaluation. Feachem and others, particularly in their book on Lesotho, talked about this. They identified specific, measurable design benefits within a project. These design features affect not so much the health impacts as the conditions favoring health impacts -- improved quality, improved quantity, improved availability, improved reliability, improved percentage of use of constructive water use behaviors. Those things can be quantified and dealt with within a framework for making management decisions. You can then take a certain limited set of costs against this limited set of design benefits and make some judgments there.

As I see it, anybody that is really trying to put together a good national program is going to go through all those three separate kinds of evaluation. But I think we need to try to understand the limitations of each one. And certainly in dealing with total social costs, there are some real serious limitations in coming up with final hard figures as to what are the benefits and costs and so forth.

DR OKUN:

We are a few minutes past the time of adjournment. Let me take this occasion to thank all of our speakers and all of you who have provided such a good audience, participants actually, in the discussion. The session will be meeting again tomorrow morning in this room. I look forward to seeing you all at that time. Thank you very much.

Opening Remarks — Day Two

Gilbert F. White, Ph.D., Professor Emeritus, University of Colorado; Fellow, National Academy of Science; and Chairman, Commission on National Resources, National Research Council of the National Academy of Science

I thought it might be helpful to outline what seem to me to be the issues as they have evolved. Three questions have been very much on your minds, and I will try to articulate these to see if you agree that they come close to stating what is of basic concern. A number of you have asked what the relationship is between water supply and sanitation and public health. You have also asked what the relationship is between water supply and other aspects of social well-being as compared to alternative public health measures and alternative measures in the sectors of agriculture, transportation, and the like. Some of you have pressed for illumination as to what measures are sufficient to assure improvements in water supply and sanitation if it is judged that such improvements are necessary.

We have recognized that we have in all instances a water supply and sanitation system. We never have a society that is lacking in this. We are dealing with interventions in this system that are going to influence, in some way, at least four aspects of society. Interventions may influence health as well as the productive capacity of society in agriculture, manufacturing, transportation, or tourism. In addition they may influence the amenities of family life. And they may influence the sense of social community as well as a community's sense of direction and capacity for action.

We have heard in some of the discussions that there is a good deal of doubt about the relationship between water supply and health in certain health sectors. Much of what was presented yesterday was an effort to specify what we know and what we don't know in this field. We have also recognized that what is done to improve productive capacity may influence health. I think we are all aware that some very substantial improvements in health have resulted, not from direct interventions, but from indirect interventions that have increased income and improved the status of material living.

We have recognized that, for a number of communities, amenities have been important considerations and may be the reason that a community adopts a water supply or sanitation system. If you look back at the history of the United States, you will recognize that a good many of the communities that first adopted water supply did not do it for health reasons, no matter what the public health or engineering people tell us. They did it because of the convenience of these supplies; and in this regard, parts of the developing world are no different from the United States in earlier periods.

We have also recognized that in some communities the command of these facilities can be an important aspect of the sense of importance and direction of a community. The community's view of its own direction and its status with respect to other communities and to a more distant world (which may be perceived in a variety of ways) leads to its members stating what they want and the degree to which they are prepared to support measures for other purposes.

Most of the discussion yesterday explored our knowledge and ignorance in this field. Part of the discussion centered on why we have not had more adequate epidemiological studies to determine these relationships more precisely. I think we have to recognize that for a prolonged time in the western world, the relationship between water supply and sanitation and a few health threats--cholera and typhoid--was so generally accepted and used as a justification for any improvement that there was very little incentive for further research.

It has only been in recent years, when there has been more concern about other aspects of health as well as the relative importance of other sorts of interventions (other than water supply and sanitation) to improve health, that we have begun to be concerned with specifying these relationships. By and large, it has been a venture of faith. For much of the engineering profession, it has not been considered necessary to go far beyond that. This reflects an evolution in both engineering and economic thinking about this whole set of relationships.

Today we are going to discuss the relationship between water supply and sanitation and the productive capacity of communities. We will discuss what we know about what I loosely call "amenities" and a "sense of community" as they affect the capacity of any group to change the system which they have, hopefully for improvement.

Much of the discussion is representative of a broader debate that exists, not only among development agencies but in our society in general, on the problem of risk assessment. In the last year, I have been involved in negotiations between our National Academy of Science, the French academy and the Royal Society in London concerning points of common scientific interest and possible collaboration.

The one point that the French were most interested in discussing with the Americans, in terms of their experience, was how one goes about assessing risks. How do you judge the risk of a nuclear reactor? How do you judge the risk of a diffusion of SO_2 or CO_2 or PCB in an aquatic system? How do you judge the risk to society of any one of a number of interventions that are made in the environment?

The Royal Society similarly found that this was the point on which they had the greatest need for sharing experience and outlook. They have set up a committee on risk assessment and perception because they recognize that there are two aspects of the problem. One is the analysis of risk which includes judging both the future flow of costs and benefits from whatever kind of intervention is made--a very complex process as we have recognized. The second aspect of the problem is how people perceive the risk. The view held by a community of a particular risk, whether it is the risk of cholera or nuclear accident, may be quite different from that of the economic or biological analyst.

A risk has to be stated in terms of the magnitude of the possible effect and the frequency of that effect. When we talk about judgements, about the choice of a particular intervention, we are always dealing with a risk assessment. We are dealing with an estimate of the magnitude of possible effects and attachment of a probability to that magnitude in terms of occurrence over a specified time period.

I think it might be useful to us to have these general views in mind as we hear from the people who will participate today.

Beyond Access to Improved Water Supply and Sanitation: Impacts on and of Women and Children

Mary L. Elmendorf, Ph.D., Consulting Social Anthropologist, formerly CARE Country Director

Introduction and Background

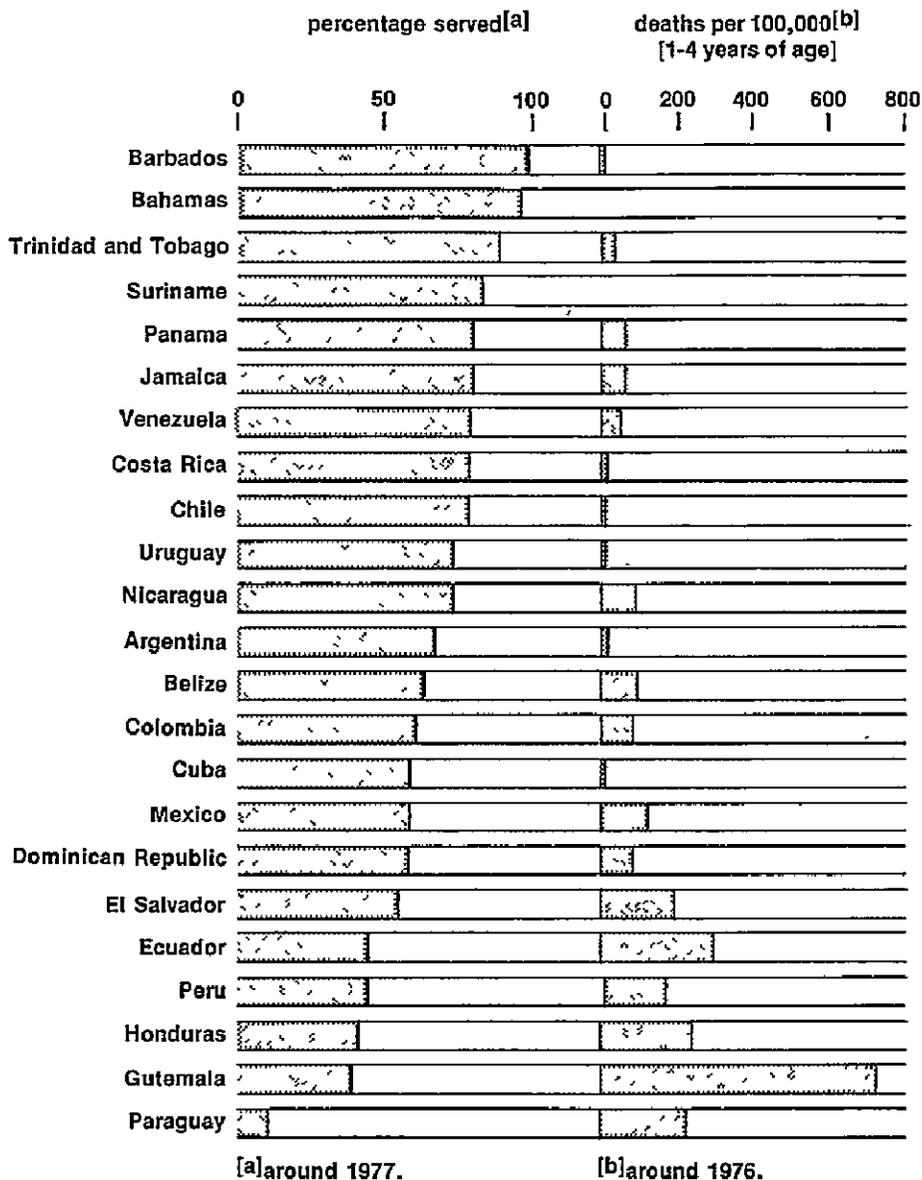
In attempts to meet the 1990 target for providing all peoples with safe drinking water and improved sanitation, and "health for all by the year 2,000," increased emphasis must be given to the interdependence of these laudable goals for enhancing the quality of life. Because a disproportionate number of the poor is made up of women and children, a concerted attempt must be made to assess the social impact of interventions in water supply and sanitation on this group. The major thrust of this paper, therefore, will be to: (1) examine the impact of improved water supply and sanitation programs on the lives of women and children and (2) highlight those ways in which women can be the key agents in assuring that such projects will have a more significant impact on all the target population.

It has been stated that: "If the drinking water of the world could be cleaned up overnight it would, by some estimates, cut the infant mortality worldwide by 50 percent."¹ Not everyone is in agreement with this statement, however. Feachem, in his excellent book on rural water supply programs in Lesotho, states: "...our conclusions are that no measurable reduction in water-related disease has resulted so far from village water supplies. It is possible that benefits might result were other health measures to be implemented together with water supply improvements."²

At the recent PAHO Conference, the Ministers of Health from Latin America pledged their full support for the Water Decade, reviewed the past accomplishments of their Ministries, and presented a revealing chart which showed a close correlation (in most of the 23 countries listed) between the percentage of the population served by potable water and the incidence of death among children under four years of age from gastro-intestinal and other diarrheal diseases. (See Figure One.) There are, however, some startling exceptions which need further analysis to determine why some countries with the same percentage of people served by potable water show a much higher infant mortality rate. For Guatemala and Honduras, the 1976 data indicate that although both countries have an equal percentage of the population served by potable water, the infant mortality rate for children in Guatemala was nearly 800 per 100,000 whereas in Honduras the death rate was approximately 200 per 100,000. Paraguay, with the same infant mortality rate as Honduras, had less than one-third the amount of water available. Cuba, for instance, with such a small percentage served, has one of the lowest infant mortality rates from enteritis and other diarrheal diseases of all the countries, even those that have greater access to water.³

To what extent can these substantial differences be attributed to a well-functioning primary health care program or responsible community participation? To what extent were women involved? As we now plan, we need to know more about the reasons for the variation in impacts in both the successful and unsuccessful programs. And yet, as Mr. McJunkin pointed out so succinctly, "the tortured, contrived estimates of monetary benefits for health improvements, reduction in the toil of housewives, increased gardening, etc., piling assumption upon assumption, to a preconceived answer... is a bureaucratic extravagance, a useless diversion of funds and manpower at the expense of the beneficiaries."⁴

Percentage of the population served by potable water and deaths from enteritis and other diarrheal diseases per 100,000 children ages 1-4 years, by country, 1977 or latest year.



Source: WHO. Strategies for Extending and Improving Potable Water Supply and Excreta Disposal during the Decade of the 1980s. PAHO, Scientific Publication No. 390 (Washington, D.C., 1979), p. 12.

Figure 1. Percentage of the Population Served by Potable Water and Deaths. . .

It is important to understand both the constraints and motivations in order to promote activities and programs that will have positive impacts.

Before looking specifically at some of the other impacts on women, I want to review this world-wide tragedy of infant death caused by diarrhea and dehydration. Recognizing that the value of children is a universal one and that infant mortality takes a serious toll on the psychological and physical well-being of mothers, there is no way to separate the incidence of water and sanitation-related morbidity and mortality from the overall social impact, particularly on women.

Aware of this serious health problem resulting in high infant mortality, the United States Agency for International Development has, among other activities, launched a five-year Mass Media and Health Practice Project aimed at rural mothers and other child-rearing family members. An integral part of this mass media campaign is the use of face to face intervention in promoting the adoption of practices that will help to treat and alleviate acute infant diarrhea. Midwives will serve as one vital link in the development communication process, reinforcing project messages relevant to environmental sanitation, personal hygiene, continued breastfeeding and oral rehydration.

Sanitation and Behavior

But here, once again, we are offering primarily curative—not preventive—solutions. To a greater extent, diarrheal diseases are related to a lack of adequate sanitation or safe water. And yet, as far as I know, there has been no attempt to investigate the integration of other health sector programs, such as rehydration, nutrition, and population, with planning for increased investment in water supply and sanitation—and particularly with the need for scatalogical data in order to understand attitudes toward human excreta and diarrheal infection.

The perception that children's feces are "harmless" can be a continuing link in chains of reinfection, whether the feces are thrown on a nearby garbage heap or baby diapers are washed with dishes in an urban home with a newly installed standpipe.⁵ These practices should be understood and analysis of them included in the preparation of audiovisual messages. In the Yucatan, no diapers are used, but mothers are so attuned to their children's needs that they merely hold them away from them, usually over the dirt floor of the hut or just outside, to urinate or defecate.

Evidence shows as mothers begin to understand the dangers of even infant feces—not necessarily the "germ theory," but the cause/effect relationship between water and diarrhea—they will change their behavior. For instance, Chan Kom, the Maya village where I have lived off and on for the last ten years, has had piped water since 1974. In 1976, when the water system was inoperable for the first time, the women started complaining that their children were suffering from diarrheal illness. They clearly saw the relationship between the lack of clean water and the increased incidence of illness and went to the mayor to complain.

Mothers are the socializers, the teachers of their children in personal hygiene and sanitation practices. Where are the toddlers to defecate? In many villages where latrines have been installed they have not been used because: (1) the distance from the house makes trips during the day infrequent and at night impossible and (2) the size of the hole and the dark pit below frightens mothers and children. Dire tales of children falling into the pit abound.

What can be done? Do latrines have to continue to be so far from the homes when there is no well to pollute? Do privies have to emit such an unpleasant odor that they cannot be nearer to or attached to the home? Sanitary engineers say there are ways to make aesthetically pleasing as well as healthy and safe latrines. Rather than continue to spend millions of dollars on malodorous, unattractive, inconvenient latrines as we enter the Water Decade, let us focus on the accelerated interventions in water and sanitation characterized by more appropriate technologies.

Another point to think about is the relationship of water availability to the latrine. The fecal-oral reinfection route is well known, but there has been very little designing of facilities to help break this vicious circle. How can water for hand-washing be made easily available to the latrine? How might people be successfully motivated to adopt hygienic practices such as hand-washing? What are the usual behavior patterns? Can there be more dialogue with the women with respect to where they wash clothes, dishes, hands, their children, and themselves? Behavioral mapping, as well as participant observation, are needed as we work together on designing culturally acceptable solutions. If water development projects are to have a successful impact, considerable attention must be paid to certain socioeconomic variables, such as minimum equipment to use it (water) effectively.

As more water is made available from pumps or standpipes, there will be a need for appropriate vessels and safe patterns of use and reuse of water to enhance the health aspects. We cannot expect women to bring their stones from the river to their backyards to wash. If water is being used for laundry and bathing, can it be reused in an aqua-privy? Do we only think of bathroom planning for urban areas?

In various remote villages, bathing areas have been set aside. This may be a stone inset in the dirt floor of a Yucatec-Maya hut. In Guatemala and Chiapas, a temascal, the water-efficient sweat bath, is usually used. Small huts for bathing were also noted in Honduras and Nicaragua.

These existing patterns can be incorporated in a privy program as explored in designing "dream latrines" in rural Nicaragua.⁶ If there cannot be dream latrines, there can at least be recognition of the need to understand present attitudes, beliefs, and health knowledge to motivate behavioral change in latrine usage and hand-washing following the introduction of new technology.

In Guatemala, as an incentive to promoting personal hygiene, a simple package containing a wash basin, soap dish, pails, and shelf to attach to the latrine, was given as a reward to each household following inspection of their new privy. To such a kit, I would also add a mirror and soap.

With respect to the introduction of excreta disposal facilities, limited attention has been given to matters of pride and aesthetics. A case study of water supply and excreta disposal revealed that Colombian families preferred brightly colored cement stools and slabs over drab gray facilities. When asked about latrine preferences and practices in the Yucatan, women also cited their preference for an aesthetically⁸ attractive latrine with a shiny porcelain seat or a brightly painted cement floor or stool.

The low impact of past programs on women and children is primarily attributable to nonuse and misuse. In thinking through the whole cycle of water supply and waste disposal, it is important to go beyond the number of water pails carried by the women or the

number of latrines built, to a consideration of the overall impact once the technology is in place.

In Bangladesh, a study of 120 villages showed usage of the latrine by only 12.8 percent of the children, while adult usage (mostly women) was 59.9 percent. A similar study of 525 latrines in India also revealed that many more women used the latrines than did men, while the children's feces were thrown on garbage heaps.¹⁰ This behavior ties in with the widespread belief that the children's excreta is harmless. It is also interesting to note that the adopters of latrines in Gorakhpur, India, appreciated the privacy and convenience more than a decrease in disease. This was noted in most of the World Bank Studies. A commonly held belief in Honduras, that women should not use the same latrine as men lest they become pregnant,¹² limits the use of even household latrines to female members of the family.¹³ In Tanzania it was noted that the excreta of fathers and daughters should not be mixed.

In some areas, women and children use the same latrines, but in many places the children defecate just outside since they are afraid of falling through the large opening. In our case studies concerning water supply and waste disposal in Latin America, we found that this fear was widespread. In fact, in Nicaragua several women in the urban barrios of Managua, who had just installed flush toilets, had kept their older, stepped latrine with two openings—the smaller, lower one for children. These UNICEF model latrines were being maintained as training devices for children. A similar model was well accepted in Yugoslavia.

Even in the United States as recently as 1972, Belcher reported that although many families built toilets in their homes, many people, especially men, continued to use the old privies or the fields:

one man . . . said that he just did not feel comfortable responding to nature in the home. To him, this was an act that could not be satisfactorily carried on within the confines of a house because it was something that was rated as unclean and he felt compelled to get away from living quarters to carry out such functions.¹⁴

The occurrence of regular patterns for excreta disposal in the field has been reported in many countries.¹⁵ As we noted in our Latin American case studies, defecation habits in the field may point to informal uses of excreta for productive purposes:

Reuse of human excreta in Latin America is an understood technology and is practiced traditionally in a less advanced and systematic form than in Asia. Reuse is informal—often not verbalized because of the taboo nature of the subject—and it takes place primarily in the individual households. Defecation in cornfields or on coffee plants is considered to have a fertilizing function. Similarly, fruit trees are purposely planted over old, filled latrine pits. In some areas, human excreta deposited near the house is consumed by pigs as an aid to maintaining sanitation. This last practice is sometimes formalized when penned pigs are released periodically to clean areas designated for depositing human waste.

Perhaps these various findings indicate a need to include latrines in the field—similar to our portable johns—but designed as demonstrations for the introduction of latrines with fertilizer reuse capacity. Such a program might also be used in fields where schistosomiasis

is a problem, such as in Egypt.¹⁷ If we are looking at the impact on women and children, greater care should be taken in designing segregated facilities which would solve not only the problem of decreased use in the home, but also of inadequate facilities in the field for men.

It is, however, significant to mention the observation made in a recent World Bank study of the sociocultural aspects of water supply and excreta disposal.¹⁸ Findings indicated the practice of latrine sharing, even in urban slums, among relatives or intimate friends who had previously established a relationship through daily interactions in their work.¹⁹

The design of the facility for excreta disposal may not be in accordance with the local motoric patterns, of which latrines not adapted to a squatting position are the best known examples.²⁰ The opposite may also occur. In a case study in Yucatan, squat plate latrines were not acceptable for the majority of the population who knew about flush toilets through their work in the tourist industry,²¹ and other outside contacts. These people wanted a stool-type rather than a squat plate.²² In Guatemala, seats were preferred also—as a place to rest and to prevent falling in.

Sociocultural variations among villages and sexes in the same country, as well as those of different continents and climates, are to be expected. However, amazing similarities with respect to fears and constraints appear in cross-cultural studies. For purposes of effective project design, more detailed information concerning these constraints is needed.

In the Moslem world, cleaning after defecation is performed using bare hands and water as opposed to cloth, leaves, or paper. Women here, as in many parts of the world, wait to relieve themselves until after dusk or in the dark of early morning for reasons of female modesty and dignity. In Yucatan and Guatemala, where women wear wide skirts, many urinate standing in market areas since no private facilities are available.

Impact of Women on Intervention in Water Supply and Sanitation

Because cultural inhibitions can and do provoke the misuse and underuse of safe water supply and waste disposal systems, it is critical that adequate health education and community participation efforts involving women become integral components of planning strategies for eradicating this problem. Third World women, the traditional drawers and carriers of water, can play a significant role in promoting community acceptance of improved water supply and sanitation programs. During the 1977 United Nations Water Conference in Mar del Plata, 30 non-governmental organizations recommended that developing countries give serious consideration in their national plans to the following five points:

- o Include strategies to develop human resources at the community level to meet local needs
- o Ensure equal access for women to training with regard to the maintenance, management, and technology of water sources and supplies
- o Ensure that women be included in any educational programs on the use of water and its protection from contamination.
- o Ensure the participation of women in local councils and planning boards responsible for making decisions on community water supply

- o Recognize the increasingly effective role that women, NGOs and other women's organizations can play in the education of public opinion for needed change.

In 1975, the World Plan of Action, adopted at the International Women's Year Conference in Mexico City, stressed that "improved, easily accessible safe water supplies (including wells, dams, catchments, piping, etc.), sewage disposal and other sanitation measures should be provided both to improve health conditions of families and to reduce the burden of carrying water which falls mainly on women and children."

How much has happened since 1975?—since 1977? What is going to happen before 1990?—before the year 2000? Jane Stein noted in 1977 in her informative report entitled Water: Life or Death, that planners had begun to include women in development schemes. As an adjunct to an agricultural development project in Bolivia, a program was underway to train young women, 17-25 years of age, to administer immunization shots, provide information on good nutrition for children, and lecture on the proper maintenance of water and sanitation facilities.²⁵ A number of these young women now are in complete charge of repair and maintenance of the facilities, not just to keep them clean.

Such examples, however, are still rare. There are successful pilot projects, such as the ones in Mexico in 1958 where women/village workers played key roles in community participation in multi-sectoral programs with water supply and sanitation components. Women supervisors and planners were also relevant to the success of these projects. These projects are easily replicable but have not become the model. Usually women-oriented projects last through one administration at most. Others dwindle as private agencies change focus.²⁴

Training programs such as those in Mexico bode well in terms of ensuring that inhabitants will benefit from development projects. Moreover, the utilization of indigenous resources for diffusing information will enable many developing countries to realize their self-reliance objective. With respect to community water supply and waste disposal facilities, it is important to recognize that the target population may accept facilities without altering their hygienic behavior. For this reason, "good" planners stress the relevance of creating educational programs which focus upon the "intended" as well as "perceived" benefits if development efforts are to exceed the mere adoption of the innovation.²⁵

Understanding the needs for better sanitary habits is not a simple process, particularly in the area of human defecation—a taboo subject in many cultures, with overtones of magic and witchcraft, or just Victorian prudishness in others. One key concept central to diffusion of appropriate technology in sanitation is understanding the way taboo subjects are communicated. Taboo subjects are perceived as extremely private and personal in nature because they deal with proscribed behavior. As we know and as the literature confirms, taboo communication occurs between individuals who are highly similar in certain characteristics such as social status, education, beliefs, and often sex. This limiting factor is a barrier to widespread and rapid diffusion of taboo messages/information which, in turn, "perpetuates the taboo status of the topic."²⁶ Another recognized characteristic of taboo communication is that it usually occurs in interlocking, closed networks rather than in open, radical networks.

The implications of these facts for effective programs in the field of improving or changing behavior patterns or technologies related to human defecation and personal hygiene are obvious: The decision-makers/leaders in the communities and in the agencies are usually

men and they communicate with other men and not with the women. Until women are involved and understand the importance of good sanitation, we can expect limited acceptance. Once the women understand, they can play key roles in household decisions relating to changing behavioral patterns and to socializing children in similar behavior and attitudes in areas such as personal hygiene and sanitation.

As we enter the Mid-Decade Conference of Women in Development and the Decade of Water and Sanitation within the context of health for all, we have the opportunity--the challenge, really--to combine our development strategies. Intersectoral, multidisciplinary planning should involve women at all levels, from the village household to the policy-making level.

Rhetoric about including women in development will become a reality when we go beyond access. Women are the key to the realization of our goals of water and health for all. But even with the help of women these goals cannot be achieved unless more is done.

Beyond Access

As soon as there is a demonstrable relationship, not necessarily the germ theory, between childhood deaths caused by diarrheal diseases and use of improved water supply and sanitation, the mothers will become the caretakers of these resources/facilities.

Some say that people will not change their unhygienic personal habits because of custom, religion, education, economics, or laziness, but: "No one wants to be sick or die. . . . Regardless of history or culture, people learn to protect themselves when given the opportunity and understanding."²⁷

Neither the peasants nor the scientists seem to be able to prove that interventions in water supply and sanitation (WS/S) bring about better health. The problems in our programs today are not primarily in the engineering aspects but in the ways they are introduced and the missing links in the effective use of them.

We have recognized the first point--the importance of community participation--but until the fecal/oral route of infection is, in fact, broken we cannot expect much improvement in health.

Village mothers will not know how to break this vicious circle until they have some important bits of equipment--primarily soap and a hand basin, adequate carrying and storage containers, along with these conveniently located, unsmelly, safe latrines. And with these, they need instructions on how to use the new equipment.

At the present time we cannot say that all interventions in water supply and sanitation bring improved health. Recent research points out that there is a certain level of socioeconomic development necessary before our present programs in WS/S correlate with better health.²⁸ To accept these findings as a reason not to make WS/S available to the marginal people--the poorest of the poor, is unthinkable. Instead it should give us cause to reexamine our past approaches. Along with the introduction of improved community facilities there should be provision for new, appropriate household equipment to maximize effective use and appropriate, relevant instructions in their use.

If there is only one pail and no money to buy another, of course it will be used for everything. If there is no top for the pail, a covering with leaves is a poor substitute. To use a dipper or cup is much easier than trying to lift a heavy pail or jug.

Making available at inexpensive, subsidized prices or even as rewards in recognition of labor and/or time contributed, inexpensive, ancillary kitchen, laundry and bathroom equipment, and soap will make it possible for the villages to take advantage of the improved interventions in water and sanitation. In several countries brightly-colored, lightweight plastic water jugs and tubs have had ready acceptance. Audiovisual messages and health education should relate specifically to the effective use of the new equipment—both community and household—so that they can be used efficiently with pride and pleasure resulting in better health and productivity.

Summary

In summary, development planners and implementors must be cognizant of the fact there is as much to learn as there is to impart if development schemes for improved water supply and sanitation are to go beyond increased access. It is important that programs include actions plans and techniques for reducing the waste of human energy in developing nations.

Women and children continue to expend inordinate amounts of time and energy on arduous tasks that can be alleviated by the acceptance and continued use of appropriate village technology. Concerted efforts to ease their burdens would provide released time and renewed energy for a variety of useful and pleasurable activities including adult education and the training of children. Increased emphasis needs to be placed on training opportunities which enable women, the ultimate primary care workers, to serve as interpersonal contacts in persuading people to accept and continue using innovations for improved basic living conditions.

Not only must barriers be understood, but acceptable incentives for change must be identified and considered. Foster suggests that:

...people will change traditional behavior, i.e. innovate (1) if they perceive personal, economic, social, psychological, health, or other advantages in so doing; (2) if they perceive change as a realistic possibility for them; (3) if the economic costs are within their capabilities; or (4) if the social costs do not outweigh the perceived advantage.

Together we can explore new and more appropriate techniques, both hardware and software, to help the poorest of the poor, the marginal people, meet their basic needs—including water, sanitation, and health. There is much fugitive data concerning problems and situations in social analyses of programs, in available ethnographic studies, and in anecdotal material which need to be gathered, shared, and made a part of program designs.

More research to obtain relevant sociocultural data to identify these problems and constraints should be conducted. There is a dearth of information on the roles of women in this field. More specific research is needed to find existing data as well as to have case studies in various regions with different technologies to evaluate impact.³⁰ Much of this research can and should be an integral part of development strategies, particularly if a problem-solving dialogue approach is used. If we really believe that community participation

is the key to more effective use and maintenance of technological innovations in WS/S, then women, as the primary users, must be involved both in the selection and implementation of programs and as behavioral change agents within the homes.

FOOTNOTES

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DISCUSSION

DR. G. WHITE:

We have had in this last presentation a review of much of what is known about the impact on women and children, and on their family life. We have also had some suggestions of the very important role they can play in affecting the design and the maintenance of a system of improvement.

DR. McJUNKIN:

I guess I have one comment, not a question, that goes to your comments on energy use. When you look at the literature on tropical pediatrics, invariably one of the primary recommendations is to continue breast feeding as long as possible. Many pediatricians say that breast feeding is probably the best protection that these infants have against enteric diseases. And of course as this baby grows larger and you are carrying it in addition to the water jug and using up all this energy, then the problems of adequate lactation are exacerbated, particularly in a population that has only marginal nutrition levels to start with. And there may also be side benefits to breast feeding such as birth control, although there is some argument about this.

I would add one other benefit for which I may be called a male chauvinist pig. I was the guest of honor at a community meeting in East Africa. It was about water supply and one of the village sub-chiefs spoke to me with great pride about their water system that was by then several years old. This was in an area where they used to walk many miles and it was quite steep terrain. The women had to get down into steep valleys and come back with the water. He said, "You know, the best thing about our water system is that our women don't grow old so fast any more."

MR. DONALDSON:

A question I would like to formulate goes something like this: accepting the fact that women and children play extremely important roles in water and sanitation, the experiences that you have recounted appear nonetheless to be individual cases. My question is, how do we scale this up. This is the fundamental problem. I continually hear and I know of examples of these things being done, but I don't see how they are being integrated into the program and then scaled up to the fact that we have to build thousands of water systems in which we are going to take all of these things into account. Could you perhaps address the point of how this is being done?

DR. ELMENDORF:

Well one of the things that I just indicated was the need for more knowledge of the scattered information we have. There is a kind of summary research which I understand is underway with AID support. My special interest is community organization and the role of women within it rather than just the women. If you try to find out what is known about women and their perceptions and the roles they can play, it appears that no one has, as yet, taken a look at this literature. We need that pulled together so that planners have it. It should not be lost as anecdotal fugitive material because it is terribly important. And then once we have it, I would hope that it be given the importance that would make it useful.

There are two things here -- knowing what is known and then having the planners, men, and hopefully the women, look at it and talk with the people in the country. The

other is being aware of it and using it at the village level. It takes a long time to find out about a lot of these things that have been discovered, but being aware of such things as fears or constraints will make it possible to plan more effectively. I think this is where the multiplier effect would be.

CRAIG HAFNER:

I have two points as a follow-up to Gene. I was in Kenya where I visited 34 self-help rural water projects and met with the committees of each one of those this last November. Of the 34 there were 7 that included women on them. Two had some officers and none were chairman. One question is, how would you suggest altering or effecting the change of the membership on these committees. From an outside agency, what would be the strategy for doing that?

- That's one question, and then a response to David's concern about how to bring this up to a national level. It seems to me that the issue of a multidisciplinary or interministerial committee is essential. How do you get that kind of commitment from government if you are going at it on a large scale? It seems to me that your project in Mexico really emphasized the importance of an interdisciplinary team but it was very localized.

Maybe an approach for AID would be to look at both strategies and to do small scale things at a local level with other donors through the PVO's. Then work also at the national level where there is a strong commitment from government and where there is an interagency committee. Work through the Decade effort that has the ministries of health and the ministries of water, but also, most importantly, I think, through the ministries that handle community development. In Kenya, most of the conversations have been with the ministries of water and the ministries of health; but the ministries of water in particular did not have an extension service that really was dealing with rural villages. The only ministry that had people at the village level, was the Ministry of Housing and Social Services; it had community development workers there.

DR. ELMENDORF:

I agree completely with you that one way to approach this would be to have more pilot projects because with the voluntary agencies you can do things and test things and test them culturally. Hopefully, if full information is kept on the process, this could be then fed in at the national level and incorporated into the planning. I too agree that we must work with more than just the ministry of health and must have multisectoral cooperation. And in some of the countries where they have the national planning committees, this might be a way to get coordination. On a project that I did in Kenya too, I found that this Ministry of Housing and Community Development was the one where there was the most information about human resources and possibilities for community participation.

I also think that we accept assumptions about how people feel and believe. For instance, I was on a World Bank mission which was looking at the feasibility study for an irrigation project in Kenya where we were also going to have household connections. The Bank mission assumed or accepted the selection criterion which was males between the age of 35 and 50 as the settlement pattern. By talking to the Ministry of Housing and Community Participation, I found and got data from them revealing I think that 70 percent of the women in the area where they were selecting the people were female-headed households.

Too many times we take our false assumptions about other cultures and we impose them and don't even let them accept the participation of their women as much as we might. We should look within their government and agencies for the women to work with in the planning. This was put into the selection criteria on the recommendations from the Kenyans and they have followed through on it even though the original feeling of the Bank mission was that this was imposing a U.S. perception. But it really was a Kenyan perception and they followed through.

ABBY BLOOM:

Most international organizations, at least in their policies, endorse the involvement of women in all aspects of water and sanitation programs, from the planning right through the operation and maintenance of these systems. You alluded earlier to the existence of some examples of the involvement of women in the maintenance functions. I'm wondering if you or anyone else here can give us some specific examples of strategies to involve women in maintenance which have been successful - not policy pronouncements. In particular, I am interested in examples that may come from countries where women are not traditionally involved in repairing mechanical equipment.

DR. ELMENDORF:

I haven't visited the project, but in Bolivia I understand the women are being used on maintenance in an area where they have not ordinarily been involved in this. Has anyone here seen it?

COMMENT:

In the city of Tuxtla Gutierrez in Mexico, the entire meter repair shop for the urban water supply system is run by women. The man that runs the water system is a proponent of trying to do exactly what you are interested in. When he took over the system, he sent a group of young ladies to the meter factory in Mexico City for training. At this time, in a city of about 250,000 people, I think there are about 12 ladies involved in this. I don't know if it is still going on, but about 2 years ago they were responsible for the entire operation of managing the meter shop, repairing and calibrating the meters.

GUNNAR SCHULTZBERG:

I have come across one case where they systematically involved the women in maintenance and operation. I was in Malawi in the central province where they had a big program of shallow wells with very simple handpumps on them. Each well served about one hundred people. They had a committee of three for each well, of which two were women and one was a man, and that was a consistent system. The man went through a simple training course to maintain the pump. We went to one where there were a couple of different wells and asked to see the committee. I got the chap out. He had a wrench, he could get the pump out and take it apart, and he said what sometimes went wrong and how he fixed it. The women were there primarily to keep the area around the well clean. That was their involvement. That was that.

In Malawi they also have gravity fed supplies in the Mulanje hills and also up in the North. That is one of the few countries where I have seen that the maintenance really works. They have very complex organization of these systems before they build them. Maybe a year before construction starts they begin to organize the people on these major gravity schemes. They have one committee for the whole scheme, one for each branch line and one for each village. The village committee has certain guidelines. They are told they will get 5 communal water points in their village, and are invited to say where they

want them. So there they have involvement already at the design stage. I don't know to what extent the women are involved in these gravity scheme committees, but certainly that is an area where I have seen it working.

DR. G. WHITE:
Recess for lunch.

Economic Impacts of Water Supply

Robert J. Saunders, Ph.D., Chief, Telecommunication Division and Economist with the World Bank; co-author of Village Water Supply: Economics and Policy in the Developing World

At the World Bank, we have thought a lot about the so-called economic benefits and the economic and social impact of water supply investment in developing countries. However, while we have been looking at the water supply benefit problem for about ten years, this does not necessarily mean that we now know very much more about it than USAID or that we make our decisions on where to put investment, or how to put it, or at what mix and level, or by what standards, much better than anyone else. In fact, all we may know is that we know a bit more about what we don't know. That is a somewhat pessimistic assessment, but in general that is, in my opinion, the situation today.

One way to begin this talk is to attempt to enumerate the many claims about the benefits of investment in water supply in developing countries—that if you put water supply systems in villages, they will slow the migration to the big cities; that the population will be healthier; that a population can produce more; that women and children will have more free time; and so on. We list and discuss a number of such claims in Village Water Supply.

It is, of course, easy to make such claims. The difficult thing, as we all know, is trying to substantiate or quantify them in some way that doubters, whoever they may be, will be convinced. Unfortunately, we are not very far along the measurement route. However, I think it is only fair to say that, in general, this also seems to be the case in many other sectors: education, nutrition, population control, and so forth. I do not think that measurement, or analysis or quantification of benefits is significantly better than in water supply, if as good, in many of these other sectors.

At the World Bank we found, in attempting to analyze the impact of specific water supply projects on a country, a region, or a locality, that the cost-benefit ratio, or the quantified net result of project impact, is usually almost totally dependent on the assumptions made in the analysis; and, depending upon the project analyst and the terms of reference given to him, you can come up with whatever result you want.

As an example, you could take two bright Ph.D. analysts and tell one, "Look, we think this is a poor project. Analyze the benefits and the costs and show us conclusively that it is a poor project." And then we could instruct the other, "Look, this is a good project. There are good reasons for going ahead with it. Please measure the benefits and the costs and show us it's good." Ultimately both analysts would present quite thorough, somewhat rigorous analyses conclusively demonstrating what they were instructed to do with the difference being, of course, a few small assumptions here and there.

Given this state of affairs, in the early 1970's we began an extensive research program into the impact of water supply investment on economic and social development. We also decided that, in the interim, in attempting to evaluate water supply projects, we would enumerate possible benefits, but we would not attempt to quantify these benefits, except in instances in which accurate information on the consumers, willingness to pay was available.²

In urban areas, some information on consumer willingness to pay is generally available and, hence, we can have some minimum analysis of benefit measurement. Generally, we look at it purely in a financial sense. We attempt to calculate the incremental revenues resulting from a water supply investment and compare those with the incremental costs. We calculate a financial internal rate of return: the incremental revenues versus incremental costs. If this minimum estimate of the rate of return on the investment is equal to or greater than the opportunity cost of capital in the country, then by definition it is clearly a good investment on economic efficiency grounds. Of course, we also attempt to correct for market distortions through shadow pricing and we eliminate any purely transfer payments from the cost side.

This approach is clear and straightforward with a couple of exceptions. One is that it is difficult to gauge what the opportunity cost of capital is in a developing country, and it is clearly a number that can range greatly depending again on your assumptions. Generally, in our water supply projects, we like to see total project returns of around 10 to 12 percent.

Along with this evaluation exercise, we try to derive some estimate of the incremental cost, or marginal cost, of supply. We then very much encourage the water supply authority to set the price of its metered output equal to the marginal cost of supply with perhaps some lifeline bracket below that. Perhaps the first two thousand gallons a month would be sold at a lower rate so that presumably no one connected to the system would be excluded from consuming a minimum amount of water necessary to sustain a healthful and productive existence. But for all water in excess of that 2000 gallons, metered consumers would have to pay a price equal to the marginal cost of supply.

If this is done and there is still excess demand, which in developing countries there normally is, there is a good justification for putting additional investment in the sector and expanding the system until everyone willing to pay the marginal cost price is served. That is basically what we advocate and press for.

In general, setting price equal to marginal cost for urban water supply systems usually will generate financial surpluses. This is simply because the cheapest sources of supply are developed first, and the incremental costs or the costs of additional supplies of water tend to be higher than the average historical costs. So, with marginal cost pricing you generate financial surpluses in the short run, and these can be used to finance expansion into areas without service or to subsidize public standpost service.

In some instances it is not immediately justifiable to provide house connections to urban squatter settlements particularly where there are problems with land tenure and no fixed dwellings. These, however, should be served with public fountain supplies or public standpost supplies. And generally, if price is set equal to marginal cost for the metered supplies—except for the lifeline rate—there would be financial surpluses to subsidize the general public standpost supplies. Whether or not you charge for the standpost supplies depends on the place, the scarcity of water, the security of the tap, local custom, and so

on. In many cases it is not possible. In other cases, it pays to have a vendor sell water, particularly in places like Mombasa, Kenya, where the incremental cost of supply is extremely high. In Mombasa, they control the public hydrants with a vendor which seems to work quite well. Of course there are also places where the vendor system has not worked.

This marginal cost pricing-internal rate of return investment analysis strategy depends on most of the supplies being metered and on the meters functioning properly. Of course, in developing countries meters do not always function properly.

The way we approach the metering decision at the World Bank is to ask the water supply authority to do a short cost-benefit exercise. We ask them to estimate the incremental cost of supply and to calculate the probable present value of the stream of metering costs. With regard to metering costs, it is not necessarily the first round physical cost of the meters that is the problem; it is setting up a system³ to read the meters, keep the meters repaired, and keep damage to them to a minimum.

Once we have the present value of the stream of metering costs and the incremental cost of water supply, the relevant question is: "Is the value of the water (or future investment in water supply) that would be saved by metering greater than the cost of metering?" It is a very simple question. You are going to save some quantity of water and water investment over a period of time by slowing down demand. Is the value of that saved water investment greater than the cost of metering?

While the question is simple, the answer to it is not necessarily apparent. It is not clear how you estimate how much water is going to be saved in a particular case. You can never be certain in the case of a city in a developing country that is not metered, how much water consumption will be reduced by metering.

The way we tend to approach this problem is to look, with the local authorities, at the cost of metering and compare it with the incremental cost of the water, and if, in fact, we find that a five percent reduction in consumption would pay for metering, then we would conclude that metering would probably be a good idea. On the other hand, if we find that we would need a 90 percent reduction in consumption to cover the costs of metering, it is clear that metering would not be such a good idea.

That, of course, is a big range. In most cases, however, it is not too difficult to gather enough local evidence to narrow the range substantially and make a reasonably intelligent decision. If you get to a more narrow middle range and you still do not have enough evidence to make a decision, then, in actuality, it does not matter whether you meter or not. You are not going to make a big mistake either way. If you have a bright young man in the water company who wants an interesting and challenging job, go ahead and meter and put him in charge of it. If it is going to be a headache, do not meter.

QUESTION:

It seems to me that if metering is necessary to charge and you cannot meter, you lose a lot. Because, as you've said, the attractive thing about hanging a price on it is that it makes your investment decision for you if you are pricing it at marginal cost. And I was just thinking to myself that we are out of the woods because you know wherever we can do that, we can quit fretting about epidemiological studies showing the effect on health. But if you cannot meter and you cannot put a price on it, how do you make your rate of investment decision?

DR. SAUNDERS:

You are right. Without marginal cost pricing and the metering of supplies, your investment tool is gone. We have done a number of metering exercises. In general, for the big urban areas in developing countries, we have concluded that metering seems like a good idea down through about the half-inch lines—for all your big users clearly and usually down through your half-inch lines.

One place where we found that metering was not worthwhile, and this was in about 1974—and I understand conditions may have changed since then—was Lahore, Pakistan, where they were sitting on a huge aquifer. Every time you wanted more water, you punched a well down and pumped it out. The incremental costs of supply were very low, and it clearly was not worth metering. But, in general, I think you are right. Most places we have looked at have justified metering, certainly for the big users.

HOWARD KELLER:

How hopeful can you be that the meters will be repaired and maintained? I can remember from my childhood in the United States that people in New York and Pittsburgh, Pennsylvania, consistently broke water meters because it has been cheaper to have a broken water meter and to pay a flat rate. If that happens in New York City and Pittsburgh, I think it certainly would have happened in Lahore if you had put the meters in.

DR. SAUNDERS:

There is no doubt about that.

HOWARD KELLER:

Isn't it fairly standard for people to break water meters?

DR. SAUNDERS:

I do not know of any place in the developing world where tampering with meters is not a problem. There is the physical tampering with water meters, and there is the difficulty encountered when a water supply system is not at full pressure all the time so that air sometimes blows through the meters or sand and sediment get into the lines. In every place I have been associated with, the tampering with meters is a problem, and in most instances there are money fines levied for such tampering. If the fine is large enough, it may retard tampering a bit, but it is a problem.

The key in making the metering decision is to recognize in advance that maintenance, reading, and enforcement are going to be a problem. In estimating the cost of metering, you have to recognize that you are going to have a big policing function and a large meter repair shop. In many instances, the costs of metering turn out to be much higher than initially forecast because of the expense of maintaining an effectively metered system.

HOWARD KELLER:

What you are telling us is that we should pass over the question of metering quickly because it is semi-, if not completely irrelevant.

DR. SAUNDERS:

No, I hope I haven't said that.

QUESTION:

I think we have to recognize that there is an ethnological difference here: there are New Yorkers, and then there are other people. It is notable that in the United States these cantankerous New Yorkers have been the very last to get on the metering bandwagon. But if you look around the developing world, and I hope Gene McJunkin and others will comment on this, the record is that metering works. There are problems with manipulation, breakage, and inspection, but generally metering systems have worked. I wish Gene McJunkin would speak on that.

DR. McJUNKIN:

I did want to say something because you were going into rural systems, and the metering argument becomes much more complex as you undoubtedly will point out. You used the word "saved"—"Water that is saved"—and some use the word "wasted"—"water that is wasted." But I would suggest that it is money, not water, that is saved or wasted. The law of the conservation of matter means that there is no new water, and there is no water destroyed. The water, particularly surface water, is going to flow to the sea anyway. It is the wasted opportunity for other investment that might be considered.

The second point about metering is that you have to look at the design of the entire system. In other words, the pipelines, storage capacity, and treatment plant have to be larger as well as the intake, the reservoir, and so forth. So there is an increase in cost, and that has to become part of the equation.

Also, with metering you are implying a certain level of service, and, as you have already pointed out, you are really talking about house connections. There are central water points that are metered, but that takes away, in a sense, some of the psychological initiative of the individual user. When we talk about house connections in rural systems the costs go up dramatically compared to the costs of a central water point. The house connection system may cost, for example in Kenya, six times per capita what the central water point costs.

If you look at rural Kenya, taking the goal that has been set for the decade, and consider the investment cost, amortization, depreciation, and the operating cost of a house connection system for the entire country, then you begin to look at the total investment. You begin to see what the operating costs of these systems in the year 1990 or the year 2000 will be, and you discover that the government of Kenya will be operating water supplies and not anything else. Then you have to go back to what level of service is feasible, not from the point of view of marginal cost, but simply from the point of view of how much total income is available in the country. That may overcome other considerations related to this whole question of metering—that is, what is really feasible in terms of the total development budget of the country.

DR. SAUNDERS:

I do not think you have said anything with which very many here would disagree. Your comments are good. In developing countries, the metering decision is generally an urban decision. I think we would want to concentrate on metering big metropolitan areas or large towns and cities. If you are going to use incremental rate of return, marginal cost pricing, and that kind of justification for investment in the urban area, metering is, by definition, necessary. But it is not worth spending a lot of time agonizing over the metering decision at the margin.

DR. HUGHES:

I quite agree, and I will try to make this very short. I think this question of metering points out one thing: Often the systems that we set up for control and for collecting money are in relation to technologies that we have, not in relationship to the people's ability to pay or their customs of payment. Many people in Latin America have ten cents a day, but they don't have three dollars a month. Now we set up a metering system that responds to our understanding of financial systems and not to their methods of paying. I am very interested to hear Bob's comments now on the rural areas, and, once we get into that, I will have some suggestions and comments on alternatives to a physical meter. Bob and I have talked about this many times.

DR. SAUNDERS:

When considering investing money in water supply in small population centers—small villages and towns—we have to think about the following questions: what is the most cost-effective standard of service, how are the finances to be handled, and will the system operate and be maintained for more than a couple of months after the construction engineer leaves and the local people take charge? These are all interesting questions associated with rural water supply, and I think, in general, that there are no simple formulae for deriving good solutions that are replicable in different countries, in different areas of the world.

I do not have much to say about the economic benefits of rural water supply given that other speakers have already talked about health. The conclusion that we reached after writing Village Water Supply and reviewing the studies which were undertaken, is essentially that it is safest to base your investment justification on health. In general, on the average, potable water supply systems should make people healthier.

Of course many project analysts and economists would prefer to have explicit production functions and cost-benefit ratios. Unfortunately, however, it is not even altogether clear what the output of a rural water supply investment is. What sort of output do you ultimately affect?

You can claim that the outcome of rural water supply investment will be healthier people or less migration to urban areas, but it is difficult to demonstrate that in any country, region, or set of villages, that A, B, and C are going to happen, but D, E and F will not. You might put water supply in a group of rural villages to keep people from migrating to the big city, and, in fact, it might have the opposite effect and serve as a kind of migration stimulus. The people might be healthier, feel better, be underemployed in the rural areas, and feel motivated to go to the urban areas for work. A good argument can be made that rural water supply might increase the migration to urban areas.

You can, of course, argue the other way as well. In fact, there have been exercises published in the regional science literature and some of the economic geography literature that show both results in similar situations.

In the Bank, we have through time been interested in trying to quantify the health effects of water supply, and we have reviewed numerous studies on water supply health impacts and health effects. Several years ago we asked David Bradley, of the Ross Institute of Tropical Medicine and Hygiene in London, to write a paper on this. (He is co-author with Gilbert and Ann White of the excellent book, Drawers of Water.) Bradley produced the paper, and then we assembled a panel of the leading epidemiologists in the world who were familiar with water supply benefits and the effects of water on disease incidence. Dr. Cvjetanović, who is participating in this seminar, was a member of the panel.

The panel deliberated in Washington for a week, and we reviewed a lot of literature and evidence. It was an informative session, and an interesting paper was produced as a result of it. But I think the point of the exercise was that it more or less convinced us that, given what is currently known about the association between water supply and health, it is not at this time prudent to attempt to quantify health benefits of investments in rural water supply projects.

There are so many different factors affecting health and the ways in which available water is used by any given population that it is simply not possible to predict the impact on the incidence of a given set of diseases if water supply systems are put in a fixed group of villages. Different things will happen in different places. In one place, good things may occur. In another place, nothing may happen.

Our general view at this point in time is that there is no strong evidence to suggest that potable water supply is not a necessary condition for long-run economic development; clearly, you can argue that a potable water supply and healthy people are necessary conditions for economic development to take place. But, generally, potable water supply is not a sufficient condition. Of course it may be a sufficient condition in some cases in which a lack of potable water supply is the overwhelming bottleneck, but you cannot demonstrate such a situation in most instances.

JOE FREEDMAN (Senior Sanitary Engineer at the World Bank):

I would like to emphasize what you have said. I have been reviewing some of our old World Bank loans, going back five years, looking for rural water supply and sanitation components, and I have found that the Bank has done about ten times as much work in rural water supply and sanitation in rural development and agricultural projects as it has done specifically in the sector. The Bank contributions to this have ranged from projects of less than a million dollars to some over 20 million dollars. But in almost all cases, they represent a small percentage of the agricultural and integrated development project loans.

In the water supply sector as such, we have financed about 20 or 30 projects, some in combination with urban water supply projects when the government has been interested. Some of these are simple extensions of urban water systems. This implies to me that the projects in few cases have been able to stand by themselves and have had to be included in parts of other programs.

DR. SAUNDERS:

The way I understand it now, in the absence of our ability to quantify benefits of water supply in rural areas, the World Bank simply accepts the proposition that putting some minimum level of potable water supplies in small towns and villages is a good idea. The big problem, however, is preparing these projects and organizing them so that the facilities and program will function through time. The investment decision on how much total investment the World Bank can put into rural water supply is essentially determined by the number of good projects that can be generated.

If you go to many developing countries and review their rural water supply programs, in many cases you will be lucky to see a functioning system. It is easy to construct water supply systems and to borrow the necessary foreign exchange from international or bilateral sources. The difficult part is the operation and maintenance of the systems through time.

Several years ago, when we were reviewing rural water supplies in some detail, we found a number of countries in which these systems were failing and going out of operation more rapidly than they were being built. There was a clear lack of an operation and maintenance capacity and of a detailed training and implementation program to generate such a capacity.

Our conclusion was that it is of overwhelming importance to get the village or the town population very much involved in their water supply system—in building it, and, most certainly, in contributing something toward its operation and maintenance. We concluded that, if these systems were to have a reasonable chance of operating one year after installation, the funds to operate and maintain them had to come from the local population. When rural villages have to rely on central or regional government revenues for operation and maintenance funds, every time there is a macro-economic fiscal problem the funds can be cut, and the system can fall into disrepair.

It does not really matter whether you encourage communities to attempt to pay off the total capital investment from rural village water charges. Some communities may contribute funds toward capital repayment, and some may not. It does not matter. For unmetered village supplies there is usually no investment decision related to the willingness to pay. The important point is to be sure that there are adequate funds available to keep the systems operating and maintained through time.

JOE FREEDMAN:

This preoccupation with an evaluation of all the operation and maintenance systems is an important facet of the strategy the World Bank is following. It is intended partially to follow up a policy paper indicating that the Bank will participate in the Decade of Water and what the objectives will be. One of the important parts of the Bank proposal is to consider operation and maintenance an essential part in any project that we propose to finance. This is an extension of what you just described: designing into the project features that will provide for minimum payment toward operation and maintenance of water systems. This will depend upon the type of system and, again, on how cleverly the engineers can design the system to require the lowest cost for operation and maintenance.

However, additional support will be required from outside the village, as you pointed out. The cost of this additional support, which would be administrative and technical will have to be borne by either the central or the regional government. It would probably come from some general tax revenue or the internal generation of funds by the government. How this will be organized and carried out is something we will have to learn about.

There have been several regions in the world where this has been tried—in some parts of India, for example. You must consider any group or any project composed of numerous small water systems as an overall unit or unified water system, like an urban water system in some aspects, which also requires operation and maintenance. But there is a greater distance in standardization of material and more personnel involved in the operation, maintenance, and supervision of these villages. It will require considerable analysis and agreement or acceptance on the part of government that this will be an additional cost, whereas, in the past, they simply allocated funds for the construction of the systems.

As you said, there are innumerable cases where water systems have been built, fallen into disrepair, and now are being rehabilitated to some extent. After working with AID,

PAHO, and IDB in Honduras, I think I can say that this is the fourth time systems will be rebuilt there in a period of 20 years. So the investment in operation and maintenance is very important, and the techniques and organization that will have to be developed for this comprises one of the most important aspects of any water supply program.

QUESTION:

If the money could be made available for good water projects, that puts you in a far more enviable position than AID finds itself in and leads to a question regarding the kinds of things the Bank looks at in trying to predict whether or not a water and sanitation project will work. If you have more or less unlimited resources, then you can continue to invest and invest and invest until it does work. That, apparently, is what is happening in Honduras. But if you do not have those kinds of resources and you are trying to look for investment opportunities in water and sanitation that have the highest probability of being successful, what kinds of things would the Bank look at? What are the sufficient conditions?

DR. SAUNDERS:

One of the constraints in proposing a project to management in the Bank for approval is that assurances must be provided to the effect that it embodies a least-cost technical solution that makes good sense given the conditions in the country—that it is a technical solution that can be maintained given the staff and personnel in the operating entity. It would be irresponsible to finance high cost solutions in developing countries if we were not fairly certain they would continue to function through time.

Also, we do not have unlimited funds to invest in a variety of difficult water supply systems. Hence, in water supply, as in other projects, we attempt to ascertain whether there is a demand for whatever it is we are helping to supply. If the demand is not there, but a lack of potable water is judged to be a constraint on development, then we might consider some sort of supplementary education program along with the water supply program.

Then there is the question of the level and quality of service. What is the minimum level of service that can be provided that will be used by the population? Will public standposts be satisfactory? Will a few house connections here and there with mostly standposts make sense? We want to know how the population is going to react so that we can be assured that sufficient benefits will be derived from the system. Then we would review the least-cost technical solution and see what costs are involved in maintaining this minimum level of service. In concept, the next step would then be to compare those costs with any estimated benefits and to finally make the decision about whether or not to go through with the investment.

Usually, if you do not have any reason to believe the benefits are going to be vastly different among a large number of villages, you give the least-cost places, where you are sure the systems can be maintained, the highest priority.

After those kinds of decisions had been made, the big emphasis would be on upgrading the institution or organization that is going to provide or help with the installation and operation of the facilities. We would look at the implementation capacity of the institution and its training programs and attempt to ascertain if there were sufficient village water supply promoters or whether they were necessary. We would also try to determine whether the institution could attract qualified staff with the salaries it was paying and could provide adequate technical support to the ongoing operation and maintenance of numerous small water supply systems throughout the country or region.

It requires major concentration on organization and management to ensure continued operation and maintenance of small systems. It is that part of the effort that is the difficult part and that should be the emphasis and focus. This question of operation and maintenance is the basic constraint on the amount of investment funds going into the sector.

QUESTION:

I would just like to ask whether the Bank or any other agency has systematically looked at our investments in water to try to learn lessons about where they are most likely to work or not work. Have you looked across your whole portfolio to try to reach some general conclusions about where your projects have been most successful?

DR. SAUNDERS:

Yes, I think that has and is being done. That was the initial effort in our village water supply research program back in the early 1970s and the basis for Village Water Supply in 1976. More recently Chuck Pineo did a brief exercise for the Bank in which he visited several countries to try to review what worked, what did not work, why, what the problems were, and so on. And I am sure that our cumulative work was helpful to Joe Freedman and John Kalbermatten when they were preparing input for the Bank policy paper on water supply.

I want to make an additional point about metering. In the very small towns or villages of developing countries, you generally would not meter. If you did meter, you would meter only the big users. Of course, this depends on the size of the town, the consumption, the incremental cost of water, and so on. However, the costs of metering--reading the meters, sending out the bills, maintaining a meter shop, or shipping meters off so that they can be repaired--are usually much larger than is normally thought for rural and small village areas. So, in most cases, the supplies are not metered unless there are a lot of house connections or several big users. For the very small system, this would not be the case.

In small systems, you might use flow-limiting devices--fordilla valves--or something like that, or you might just put an orifice in the pipe so that even if the tap were left on all day not very much would come out. In Argentina, there is a system in which they have different-sized tanks on the roofs of houses. If a user pays a higher fixed monthly fee, he can get a bigger tank with a bigger orifice, so it fills faster. If a user pays a smaller monthly fee, he gets a smaller tank on his roof with a smaller orifice and it fills more slowly. It is possible to drain the tank in the morning and come back at mid-day or in the evening to find it full again. It is an effective flow-limiting device without all the problems and headaches of meters and meter reading.

There are, of course, many different solutions available for limiting water wastage including the use of community persuasion. In some cases in Latin America, where if everyone leaves their tap open the village runs out of water by noon, people vigorously encourage each other to conserve water. These kinds of solutions should be considered before taking a very expensive metering decision.

RIFAT BAROKAS:

Your finding as well as Chuck Pineo's findings in the studies that you mentioned and Chuck's findings in a study that we did together recently in Thailand indicate that community participation is a critical factor. This is true not only in water supply projects, but in a number of other micro-projects in which you are dealing with people directly, and you are

not building a dam or something that tangentially affects their lives. Given that this is true and given that you have made recommendations as such a number of years ago, my question is: what are the methodologies that have been evolved by the Bank to include community participation in the decision-making process and in the implementation of such projects at the present time and in the future? Or are there any?

DR. SAUNDERS:

I would like to ask Joe Freedman to answer that question. He is more up to date on the details of recent Bank water supply project work than I am.

MR. FREEDMAN:

As you know and as many people have stated, the preparation of the project is the problem. The Bank has now what we call a project preparation facility which goes up to a million dollars. However, this money is available only for certain countries, depending on their economic level. Consequently, it would be most utilized by the least developed countries where it is most needed. To prepare the project or program to utilize these funds is the first step, and that is a problem because it is difficult to find people who can assist the governments in preparing the outline of the project for which they propose eventual construction financing.

As Bank policy, especially for these rural water supply systems, we are asking and requiring to know how the communities will participate—from the very decision to have a water system, to the type of water system, to their participation in the construction and eventual operation and maintenance. This will be an integral part of the rural water supply program. It has been done in other projects, but not in such an organized manner.

If I could add one parenthesis to what Mr. Saunders answered before—most international lending institutions do not finance 100 percent of any project. We mostly finance the foreign exchange costs, technical assistance, training, consulting services, and occasionally some part of the local costs. This means that the balance of the cost of the project must come from local sources. Therefore, the government must set its priorities concerning how it will utilize its own resources.

Many governments—we know there are about 50 who have already established targets for the Decade of Water—do have some type of national water supply programs, and a tentative allocation of these resources. So the size of the water program in many countries may be much less than we are assuming because the statistics that have been collected are based on the total need of the country. We have to look at it from the other end. How much money is available within the country to determine the size of the program from a financial viewpoint? And that was the reason I mentioned the cost of operation and maintenance. As more national funds are allocated for the operation and maintenance aspect, this means there will be a corresponding reduction in the amount of unutilized investment in small villages.

DR. SAUNDERS:

To conclude this talk I would like to emphasize a point which I made at the beginning. Just because we cannot measure the economic impact of water supply in developing countries does not imply that the water supply sector is inferior to other sectors.

I see that Mary Elmendorf is going to speak later about the impact of more convenient supplies on women and children. Clearly a major impact that the installation of a water

supply system in a village center or on the edge of a village is that the women and children do not have to spend much of their day carrying water. While this is clearly important to the women and children, its importance cannot be explicitly quantified.

There have, of course, been several attempts (to quantify this change). For example, there was one exercise in which estimates were made of the calories saved by women and children since they were not going to have to carry water long distances. There was another study in which women were surveyed, and it was found that with a convenient water source they were going to spend more time doing productive work in the fields and a value was estimated for this additional output.

In general, however, such exercises are burdened with many unknowns, and the assumptions which must be made, in my opinion, can predetermine the results. I do not foresee the day when a water supply analyst will be able to conclusively argue that his water supply project will yield a 38 percent return to a developing country, while a competing education or transportation project will yield only a 22 percent return. And, in fact, I am not sure much effort should be directed toward such a goal. In the near term, all of our effort is needed to help improve water supply institutions and organizations, to improve training programs and salary structures, and to help assure that internal cash generation is available so that existing and future investment is properly allocated, operated, and maintained. It is through encouraging the creation of sound, well-managed water supply institutions that we can make our greatest contribution.

FOOTNOTES

1. Robert J. Saunders and Jeremy J. Warford, Village Water Supply: Economics and Policy in the Developing World, (The Johns Hopkins University Press: Baltimore, 1976).
2. For several exceptions to this see: Robert J. Saunders, Jeremy J. Warford, and Patrick Mann. Alternative Concepts of Marginal Cost for Public Utility Pricing: Problems of Application in the Water Supply Sector, World Bank Staff Working Paper No. 259. May 1977.
3. For a detailed description of how the metering decision should be approached see: R. M. Middleton, Robert J. Saunders, and Jeremy J. Warford, "The Costs and Benefits of Water Metering", Journal of the Institution of Water Engineers and Scientists, Vol. 32, No. 2, March 1978, pp. 111-122.
4. Measurement of the Health Benefits of Investments in Water Supply P.U. Report No. PUN 20, Transportation Water and Telecommunications Dept., The World Bank, Washington, D.C. Jan. 1976.

The Role of the Community in Water Supply and Sanitation Projects

Anne U. White, Geographer, co-author of Drawers of Water; Domestic Water Use in East Africa

The World Bank estimates that by 1990, at present rates of change, over 2 billion people will need additional provisions for access to safe water and for the safe disposal of their bodily wastes. The anticipated growth of projects in this area, resulting from the efforts of the developing countries themselves and from the multitude of donors in the field, is enormous. What the realities will be in terms of numbers of people affected, we have yet to see. We have discussed some of the impacts this activity will have on the rural communities of the developing world.

Perhaps more important, and the question I would like to discuss today, is what impact will the habits of behavior and decision-making held by the people in these communities have on the projects being planned in Washington, New York, Stockholm, Bangkok, New Delhi, and all the other seats of power in this endeavor. There is increasing evidence that this latter factor is of critical importance to the long-term success of the programs.

The success of the Water Decade should be measured by the number of people served at the end of it, not by the number of water and sanitation projects built during it or the amount of money put out by donors. For this reason, it is essential to determine the elements which contribute to a stable system operating satisfactorily over a long period of time and capable of adjusting to the changing needs of its rural users.

The question was raised yesterday as to what are the other conditions, in addition to clean water, that will enable water supply and sanitation projects to have the greatest impact on health. To arrive at these we need to consider: the major elements in the overall design of water and sanitation facilities in rural areas; the choices local people have as to use of a project once it is built; the points in the design process at which they can affect decisions; some of the motivations and preferences they bring to decision making, and some of the tools of social science by which these can be brought into plan to produce an effective project.

In the large cities, where there are few, if any, alternative sources to the municipal supply of water, the user in the older parts of the city is likely to have little effect on the engineering design and the distribution pattern of the system. This is not true for the squatter settlements where the inhabitants can have considerable effect on the level of service chosen and can affect maintenance costs very much by the amount of cooperation they give by paying for service and keeping the facilities in good order.

In the rural situation in which new water and sanitation systems are being installed and large outside resources are not available, the major components to be taken into account in the design situation are: the range of possible physical designs, the prevailing behavior

patterns of the potential users, and the nature of educational and informational activities that are carried on or will be introduced in connection with the project. The design must include not only the physical facilities of supply, treatment, transportation, and distribution, but the administrative design for means of construction and maintenance, and the arrangement for pricing or other means of payment for the cost of the improvement and its operation and maintenance.

Whatever the technique followed for the design of the system, once it is installed people have four choices open to them: they may use the facilities without any significant change in their current behavior patterns; they may change their behavioral habits in order to make use of the new facility; they may misuse the facility or destroy it; or, they may utterly reject the facility.

Some of these actions are supportive of the project and others destructive. They all point to the importance of considering the factors which account for actions of support, misuse, or rejection.

Participation by the community throughout the design process with all its aspects, which we have noted, seems the most likely way to take preferences and motivations into account and to allow for changes and growth in the community over time as they affect the system.

However, community participation is a widely-used term and needs to be more specifically defined as to when and how people can have a voice in selecting the different elements involved in a facility and the subsequent operation and maintenance of it and in determining what the costs are for this process.

There are five major points at which local people can take a significant role in the decision making regarding a project. First, they can decide whether or not to apply for a project, thus establishing their own local priorities, and examining, in a preliminary fashion, their abilities to command the local money, labor, and management abilities needed to carry it out.

Second they can examine the technology involved to see if it suits their own preferences. Will the standpipes be in a convenient place? Could individual taps be added on later? Is there enough space or privacy for the latrine? Will what they want cost more than they can afford and, if so, what is a reasonable substitute?

Third, they can influence cost and pricing policies including the provisions that are made for funding operation and maintenance. They can decide on the kinds of labor contributions that are feasible and what kinds of billing or payment procedures will be most suitable for them in relation to their income flows.

Fourth, they can influence the management policies so that these take into account the structure of the community, both the formal government structure and the informal network of associations and information flows, through which actions are taken and priorities are set.

Finally, they can be effective in monitoring the system once it is built, seeing that maintenance programs are effective and whether or not the project is meeting its aims.

We can take a look at how these decision points fit into various approaches which can be taken towards a new water or sanitation project.

The first case (Figure 1) is one in which the design and construction are imposed upon a community. They have nothing to do with it until the local politician turns on a tap or lifts a pump handle with suitable oratory. As we have noted earlier, at this point the local people may behave in one of four ways. They may accept the facility and use it, as when a family begins to use a patio connection of their own instead of the standpipe shared by a larger group. They may change their habits, as when a family commences depositing excreta in a new latrine instead of in the fields. They may misuse the facility or destroy it, as when they break a valve in a standpipe to let the water flow more freely. They may reject the facility, as when they refuse to patronize a community latrine or bypass a new borehole to go for water to the nearby stream.

In the second case (Figure 2) there is much more participation and no modification of behavior. In the first place, the community has a role in deciding whether or not to apply for a project. The action of application denotes some enthusiasm and in certain countries is a necessary condition before government assistance is granted. Then the community, through suitable consultation, has the opportunity to comment on particular designs, to modify them to suit its preferences, and to face some of the hard choices regarding the costs of different technologies. After interactions between the designers and the community, a final choice of design is made. The villagers then have the opportunity to respond to the construction plans. What do they contribute in labor, land, or supplies? Does the construction prepare them to take part in subsequent maintenance? This process is likely to lead to the acceptance of the project and has a higher potential for adequate operation and maintenance.

A third and probably more realistic case (Figure 3) is one of participation in which the discussion and consultations between the designers and the community modify both the design and community behavior. Here the potential users apply for the project, have an opportunity to modify the preliminary design, and to comment on the final design. In the course of this process, they may learn that their own behavior makes it difficult for them to obtain the facilities they want. They may want a toilet with fewer odors, but find that their traditional wiping material would clog up a pour-flush type. They may want individual taps in the house, but find that they can barely afford a patio connection. The interaction between the designer and the community and within the community itself is likely to affect the final design, the amount of labor or materials contributed, the pricing system adopted, and a program of health education which seeks to deal with the gaps. The community is more likely to accept the facility, to use it, and to work out the questions of operation and maintenance that lie within its capacity.

As an extreme, there could also be an imposed system in which the community had no voice in the design or construction (Figure 4) but, through a combination of educational activities and consultation as to preferences, is led to accept the system. This has been the case with some health projects, such as vaccination programs, but seems unlikely to lead to continued use of many water or sanitation facilities.

We can discuss the kinds of motivations and preferences that people are likely to bring to the decision processes described here. These are drawn from the literature, from some work with the recent World Bank project on appropriate technology for water supply and sanitation, and from our own field studies.

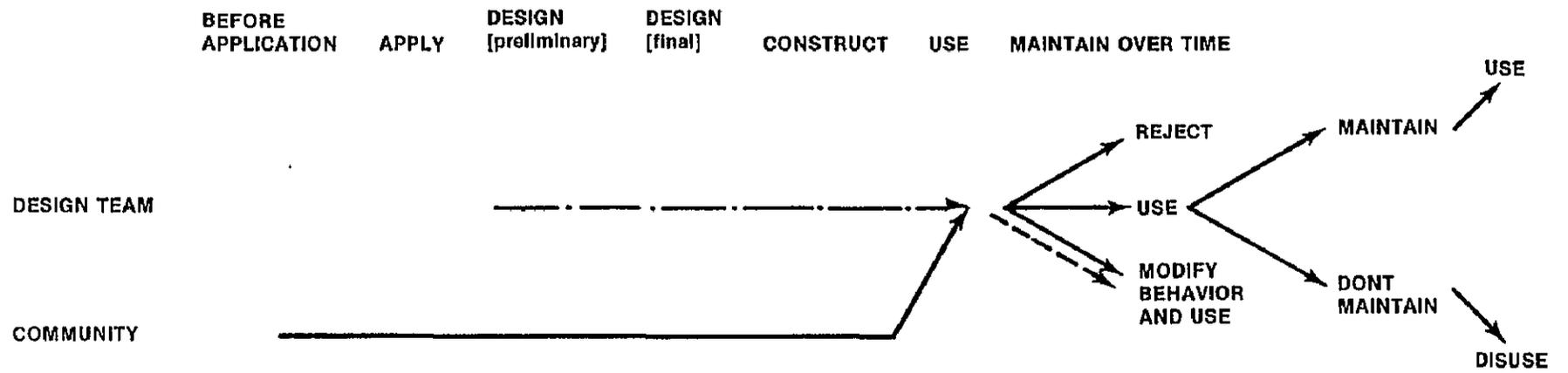


Figure 1. The System Is Imposed: The Community Can Only Accept or Reject It

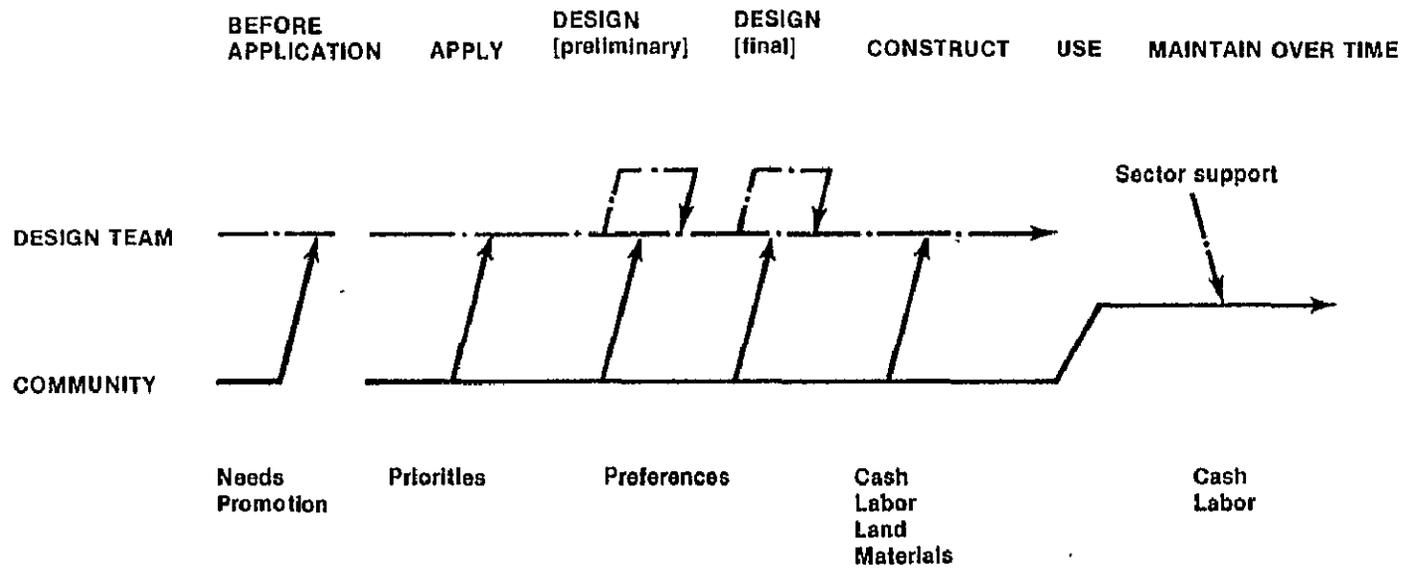


Figure 2. The Community Participates and Modifies the Design

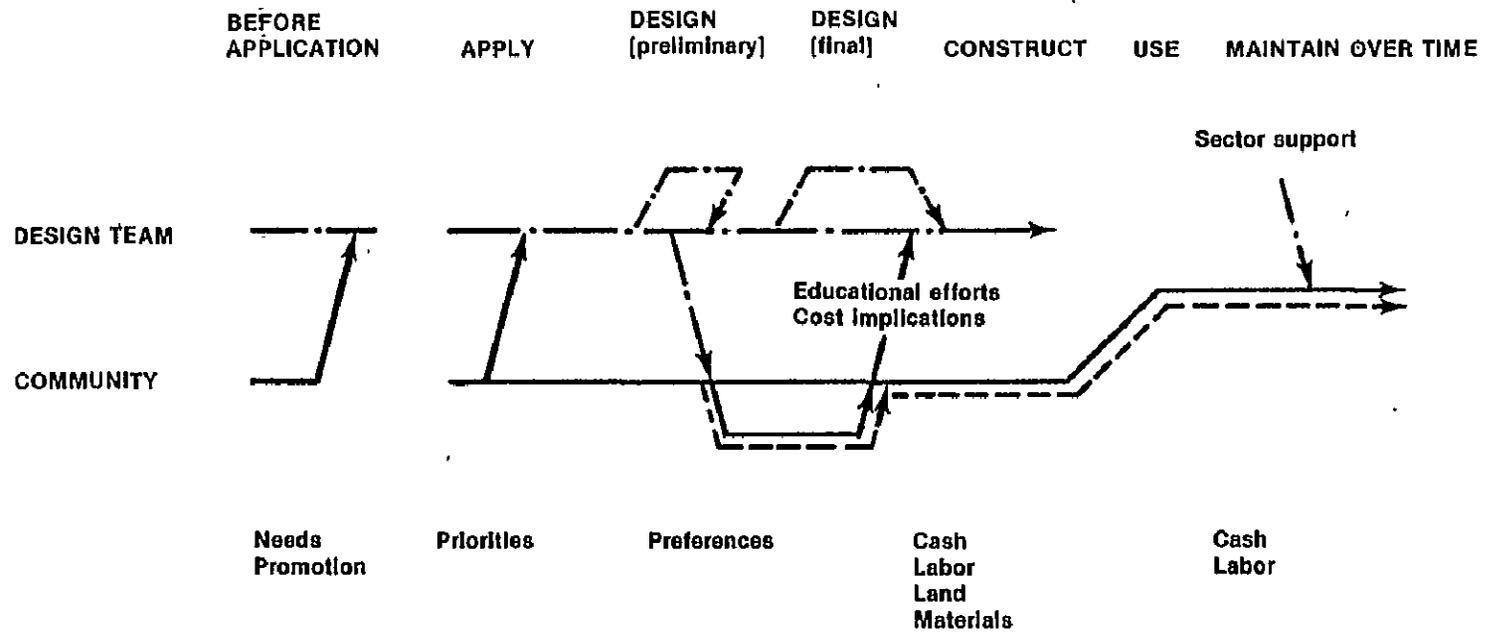


Figure 3. The Community Participates, Modifies the Design, and in the Process Modifies Its Own Behavior

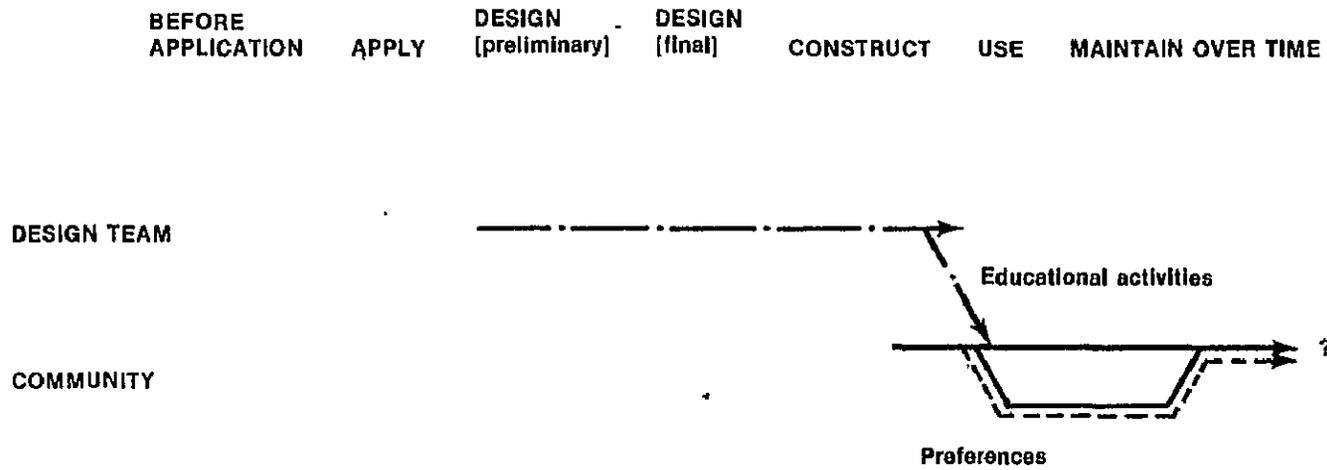


Figure 4. The System Is Imposed, and by Strenuous Educational Efforts Community Behavior Is Modified

Improved water supplies have long been high on the list of community "felt needs."³ This frequently has to do with convenience, better phrased as relief from the drudgery of long walks with heavy loads. We found in East Africa that rural women were expending a mean of about an hour each day fetching water and about 12 percent of their caloric intake of energy for the day.⁴

Political implications are another motivation for both the community, national and international authorities. A local community, and those in power in it, can gain prestige as well as convenience from a project. Foreign donors seek a visible action of development which can be completed within a five year plan. It is interesting that sanitation facilities, which lag considerably behind water supplies, are less visible, command less popular acclaim, and may or may not be more convenient to the user.

A sense of individual health may be a strong motivation for improvements even though the perception of disease transmission routes may be quite different from that of project designers.⁵

Individual desire for privacy is a widespread and powerful motive. For example, there is a longstanding belief that women like to gossip at the well. We have found that in many parts of the world they would much prefer, given the opportunity, to get their water quickly, without standing in line, from a private source. They would find other opportunities to do their chatting. In most parts of the world, though not all, people prefer to defecate alone and their tastes as to the preferred setting vary enormously including their choice of color for the floor.

Whether or not the facility is easy to operate is another consideration. If a pump handle is too heavy, small women and children cannot use it. If people lack the skill and knowledge to make equipment run properly and to repair it, they may let it fall into disrepair, not because they are opposed to its use, but because they feel inadequate to deal with it.

Status in the community, or keeping up with the Jones', can be a powerful motivational force. Individuals may be reluctant to try something new unless there is support from community leaders. Membership on a water committee may become an important role especially for a woman. One needs to examine, for example, why women in parts of Latin America appear to play a more important role in community organization for water supply than women do in Africa.

A sense of community well-being, of doing one's part for the group welfare, may be important quite aside from individual health or status. An example is the Spanish-American community in New Mexico where some households subscribe to a water-supply system because they do not wish to offend neighbors who are deeply committed to the improvement.⁶ The obverse of this may be a factor where a community is divided already; witness the plaintive complaint voiced in Lesotho by a village committee member writing to the District Community Development Officer: "Why are you dealing with these people when you know they are not of our Party?"⁷

An important component of individual well-being is the sense of control over one's own activities. A village may reject a water supply because it feels it needs a new road more urgently, if the government machinery allows this choice. People discriminate frequently in choosing water supplies and means of excreta disposal. In Indonesia, among the 1.3

million families who use community piped water supplies, at least 52 percent make the distinction between potable water for drinking and cooking purposes and unpotable water that they carry from rivers to use for washing and bathing. Prior experience with development activities may affect this sense. If the experience was a bad one, they may look unfavorably on a new project.

Other motivations and preferences might be noted, but these may indicate their range and power in influencing the degree of support or the destructive responses that will emerge as a project unfolds.

How, then, can these preferences and motivations, which differ from culture to culture, be taken into account in a particular place as an essential part of the design process?

We have noted earlier five points at which the potential users take part effectively in the decision process. There are a number of tools that can help the engineer or project director enable them to effectively play a role in the decisions made at each of these points. These tools involve, chiefly, two types of community investigations, or surveys, community consultation, and provision for continued monitoring of the project.

The most informal sort of community investigation is one in which an individual or a team enters a community and carries on a series of informal discussions with selected members. These would include its official leaders, selected family groups, unofficial leaders, and people well acquainted with the community. Such discussions give some indication as to how the community views its own health and convenience needs; how it regards these in priority with other needs; how it is able to mobilize itself for community action; and what sorts of networks of communication and power exist. Observations as to present habits of the community regarding water use and excreta disposal can be made, and relevant statistical or anecdotal material can be gathered at this time.

The informal survey may suggest that the time is not ripe for further action; that further educational or promotional activity is needed; or that the community is ready for a more intensive kind of community survey, and is looking for assistance in the design of a project.

It is not necessary to make an elaborate census of members of the community. A carefully selected sample stratified according to differences in income and social group can yield a large amount of information about the present habits of the people with regard to water supply or sanitation, their preferences with regard to improvements, and the kinds of social networks that might be used to support a project.

The results of these investigations, using the skills of anthropologists, geographers, sociologists, or others with extensive community experience, can be invaluable in helping the designer understand the current practices and information level of the community, its preferences regarding services, and how these might be met by design or modified by education. Consultation with the community about the results of the surveys is likely to start the process of modification on the parts of both the design team and the community.

Consultation is used here to mean a two-way flow of information between the design team and the community. As the project design is being modified to suit community preferences, questions of cost and contributions from the community in terms of labor,

materials, or land must enter into the discussion as will the responsibilities for operation and maintenance, for the collection and dispersal of funds, and for continuous monitoring of the project. Like any other tools, these have to be used with skill and care, and—like other tools—they cost money.

As an example of the lack of a two-way flow of information, consider the matter of operation and maintenance. Much of the responsibility for this in the past has been thrust on villagers who have been unable to cope with it, for a variety of reasons, or resent it as not part of their bargain. In one community where there was a strong self-help component, the attitude was: "We did what we promised in working to build the system, now it is up to the government to operate it and take care of it."¹⁰

Without neglecting the importance of institutional arrangements and training, it is possible and essential that the community have a much stronger role in planning for operation and maintenance. It can seek a clearer understanding of responsibilities before the facility is built. It can choose between labor and cash contributions. There can be consideration of non-monetary rewards such as the status of being on a water committee, public recognition for service, or community festivities on clean-up days. A case in point is the apparently effective role of the community in Malawi in both construction and maintenance.

There is no easy formula for community participation, but a few "do's" and "don'ts" emerge from the experience with this so far:

- o Do assume from the very beginning that behavioral factors need to be taken into account.
- o Do find out as quickly as possible how the community functions and what its present habits are.
- o Don't assume that communities are all the same.
- o Don't take for granted that designated or elected leaders are necessarily those with the most influence in the community.
- o Don't rely on movies or leaflets to persuade people on an alternative that seems contrary to their preferences. They may be polite, but use and maintenance may suffer.

FOOTNOTES

1. The World Bank. 1979. "Appropriate Sanitation Alternatives: A Technical and Economic Appraisal, Summary Report".
2. White, G.F. 1978. "Water Supply Service for the Urban Poor: Issues". Water Supply and Management 2, pp. 425-454.
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DISCUSSION

DR. G. WHITE:

Well does this open up any questions on your part about community participation?

CHARLES PINEO:

I think we have come a long way. I am particularly pleased to see the real vital participation, not only of the women, but of the social sciences. I think we have neglected this part of our endeavor too long. We've gone at it strictly as an engineering program. We've paid no attention to the users and frankly I was afraid this meeting was going to go that way too. Only today have we begun to hear about the beneficiaries. Before, we looked at it from the level of the central office, the planning office, etc., with very little actual concern for the person for whom we are trying to provide these benefits.

I would like to refer briefly to Dr. Cvjetanović's "why" instead of "where". Some of you may have seen the study that I did for PAHO in the Dominican Republic some several years ago in which I identified at least a dozen different reasons for the success of the rural water supply program in the Dominican Republic. We did more or less the same thing on a study with John Kalbermatten of 8 countries 2 or 3 years ago. Some of the important features were community participation, health education, and promotion. One of the things that came out of the Dominican Republic study was the enthusiastic support of the government for the program. If you don't have that, you can't do very much.

It's been about 3 years, I think, since I've seen the Dominican Republic, and I don't know what the situation is there now, but at that time, and previously, the program in the Dominican Republic for me was a beautiful example of what a successful rural water supply program could be. It is a small island, but they did not try to do it all from Santo Domingo. They divided the island, first into four sections, then into six sections so that they could be in constant touch from the zone office to the villages with which they were concerned. They changed from the use of promoters to what they called commercial agents as they had more systems installed. The necessity for promotion was supplanted by the necessity for a monthly contact to collect the water rates, to review the situation of the water supply systems, and to report back to the zone office the condition of the systems.

All of these things are really vital. I don't think we have touched, at least to my point of view, we have not emphasized enough the need for organizational backup. We talk about organization and operation and maintenance. Of course we have to depend on the village to carry the main brunt of it but they have to have some recourse, some backup to which they can go when they need help beyond their possibilities.

I'm also glad to see that we are finally not only talking about water and sanitation, but we are going to the second paragraph and we are still talking about sanitation. In the past, we have started out with water supply and sanitation and in two paragraphs we have forgotten about sanitation and it is all water supply. We are finally talking about sanitation.

I was hoping that Dr. Cvjetanović was going to mention some of the studies that he has participated in which I ran across back in 1970 when we were doing a study of the water supply and sanitation situation in the developing world for WHO. These studies

suggest that water supply alone is not the answer. Sanitation alone is not the answer. To get the best benefit, you need at least those three components, plus your community participation.

I'm particularly interested to hear about the comments -- I've forgotten who it was -- where he had been in 34 villages, and there were at least 7 or 8 of the committees which had women as members of the committee. Max Batavia, Rifat Barokas and I did this same sort of thing in Thailand 3 or 4 months ago. We visited 40 villages, northeast, north central, northwest -- talked with the people of the village -- admittedly too short -- about an hour, an hour and a half, and in each village talked with the committee, with the people of the village. We asked in each place if they had any women on their health committee, on the water committee, whatever committee they had. In 2 villages, I think, we found that of about 7 members they had 1 or 2 women and in 6 or 7 of another they had 1. I'm wondering whether our questioning will have any results in the future. I hope some of the women heard our questions and I hope this is going to lead to women being invited to form part of the committees.

We haven't spoken much about the village health workers. To me this is a really important program that is being stimulated, recently by AID, by the World Bank and by other organizations. It encompasses selection of people from the villages with a very short training course to act as the village health workers, sometimes paid and sometimes voluntary. I saw this very successfully in Nicaragua and 2 or 3 other places. It really works. My only fear is that we try to overload these workers with what we require for health and sanitation, and with what the agricultural people require. You can't have 16 voluntary workers working in each village, but there must be some happy medium.

Again I refer to the myths, the things that we believe at headquarters which when you come to the field are absolutely wrong. I hope that we can get away from these as soon as possible. Of course, we don't know they're myths. We think that is the way it is, but it isn't. You go to a country, talk to the people on the national level. They tell you thus and so. But until you go to the village, you can't begin to appreciate what the actual situation is.

MR. DONALDSON:

I have a couple of questions. One of my concerns about community participation is the cost of what we are trying to do. It is not only a cost in actual money, it is a cost in time. I think we have to face the fact that the politician is in office, a minister a head of an agency, is in the position for 3-4 years. He wants to get results within that time frame. Anything that we are going to do which might cut back, or lengthen the time frame in which we are going to have the system in operation is a very critical factor from the political point of view. Given that, do we have evidence that shows either good or bad, how community participation either shortens or lengthens time frames and how much? The question of maintenance is almost in direct conflict with this question of building. It would be very nice to put the two things together. But you have a political problem of the minister and you have a kind of long-term financial problem of the operation and maintenance.

The second part of the question is, do we have any figures on the cost for different ways of putting in the infrastructure and everything else for the community participation. You showed a number of different ways, one extreme being no participation until the thing was in service, and the other being the participation throughout the decisional process. Do we have any cost figures for those two?

ANNE WHITE:

With regard to the time frame and whether this process lengthens it or not, I would like to ask Gunnar Shultzberg whether he had any observations about that in Malawi where the committee system is used quite extensively. Then I have another word or two to say.

GUNNAR SHULTZBERG:

I think that in many countries they haven't got the patience to deal with community participation. I'm talking in general terms. Often they announce year by year what projects they are going to undertake within a year. They don't give advance information as to what is to be undertaken under a 5 year plan. Often it means that they announce that a project is going to be undertaken and then they get funds for that year. They don't spend a lot of time to prepare the community.

In Malawi they did not do it that way. They think in longer terms and the preparatory period before they really start work is probably a year. During that year the communities are being organized and they try to identify as I said -- maybe not the elected leaders, but the influential people in the village area that is to have a water supply. They take them to see an already functioning project. They spend some time there. They learn from the people what happened, what they did, what their input was, and what problems they had. Then the leaders go back to their area and tell the people what the problems were and what the benefits were. So I think we must have patience in the beginning and in the long-run you gain time.

Another thing that is related to community participation is that you have to plan well. In many cases they mobilize the community to participate and be free laborers. But then the pipes are not delivered on time. The rains come. The ditches and trenches they dug do not exist any longer, and to get some enthusiasm to dig trenches once more is very very difficult. So the planning of logistic backup and support must be matched to community participation, or otherwise there will be failures.

ANNE WHITE:

Yes, I would certainly agree with that. It seems to me that a matter of national commitment is more important than the time period because the time is there in terms of planning. I understand it takes the World Bank a while to plan projects -- that there is a good deal of time involved. If it were clear that communities were going to be involved, there would be time for this community preparation and involvement to start. So it is perhaps more a matter of commitment than of actual time. But certainly the timeliness of the various steps is terribly important and a community can lose its forward momentum without much trouble. I think this is a very important part of it that has to be planned carefully.

With regard to the cost of putting in this kind of infrastructure, I don't think that there has been much real costing of it in terms of both money and people's time. I now understand, however, that there has been a little work done on what it costs to maintain a road, for instance, when it is being done by self-help methods. I think that probably needs to be done for water supply. What does it actually take? If you count the free labor and the cash and everything else, what are the recurring costs? And in terms of those recurring costs, it seems to me that the recipient countries have to look pretty carefully at the load of recurring costs that they are building up when they accept these outside projects. I think that this could get to be very heavy for them.

JOHN KALBERMATTEN:

Just because we don't carry the money in our briefcase doesn't mean it takes as long to prepare a project you know. I have a question on community participation, health education, and all the good things that implies because I have not found a proper definition of health education yet. How long does it take? How long must one continue the process of community participation, health education, hygiene training, and so forth, after the system has been constructed and at what level? I find, for example, one can go back to a successful water supply project or sanitation project, and people will nevertheless use polluted water even though they have very easy access to a source of clean water such as a standpipe. And when you try to investigate the reasons why, it is impossible, at least for me and the people I talk to, it is impossible to find out why. There doesn't seem to be any obvious reason -- not the taste, not the convenience -- a matter of habit. Maybe it is just not possible to change the behavior of people on a long-term basis in a short period of education and training. I wonder whether you have observations about how long one must continue this process. That certainly has something to do with the effectiveness of the investment made.

ANNE WHITE:

Here is the importance of this being built into any kind of primary health care program that is ongoing and that is carried out by the local people themselves. To some extent this may be the only way. It took Americans 20-30 years to learn to use and to check their water supplies, and I don't know why we should expect anybody else to be any faster. Some neighbors of ours in Colorado use individual wells. If you ask them what happens if they get a E. Coli count, they say, "well, nobody has been sick," and they go on using them. So it seems to me that this is human behavior rather than developing country behavior. The primary health care integration of that program seems to me to be the best bet. I don't know if anyone else has any observations on that. It seems like they do.

DR. ELMENDORF:

I don't think I have anything to add to what I said this morning except to try to relate any behavioral change to the behavior that was happening before so that it's integrated. If I may go back, I don't think I can say it too often. Tie the water use and the excreta use and the handwashing and get these into some circular thing with reinforcement. I think the community itself can be the one to reinforce and it becomes a social cost if you are not going along with the community. This came out very clearly in the Miller-Cone study. It is the community which can set the new standards. Then it becomes acceptable behavior and it is reinforced that way. I think that is one of the best keys and why the village health worker can be the link.

DANIEL W. DWORIKIN:

There is an interesting study that I was participating in in Thailand in which people have piped chlorinated water delivered right to their homes. In many cases they would continue to go to shallow wells to get water for drinking, and that confounded us for a while. Then we started looking to see to what extent this was a pervasive activity on the part of the whole community. We found very interestingly that it was the older people that continued to drink the shallow well water, but the newer families and the younger people relied more completely on the piped chlorinated water. And they just wouldn't go to the bother of going out and getting it at the shallow well. So we probably have a generation span if you are talking about how long does it take.

DR. OKUN:

I'm very much impressed over the years with the sort of quantum jump in the concern for community participation as contrasted with the imposition of something that is good for people from central government or from some international agency and I should like to emphasize it. It comes through time and time again.

But it is not only participation, because we are even getting a good dose of community participation in the United States. It's the quality of the participation. Are the real decisions being impacted by what the community decides or is it just that we have to get a sort of a vote of approval of what we have decided in the capital?

I'm reminded of a village in Guatemala that I had visited before they had a water supply. The women had to go down a hill to get water from a polluted river and then had to carry it up. They were furnished with a good quality of water through a fordilla system and we inquired of the women how this had changed their lives. What had been different? Did they like the system? They were not allowed to respond. The men sort of pushed them away and answered and they did not like the system at all.

Why didn't they like the system? Well they didn't like it because they had seen other systems where you could turn the faucet on and the water would run continuously. That was the kind of system they wanted. You can't blame them because they were getting what seemed to be a second rate system. This system was a big improvement but it had been provided by Guatemala City. They had no choice in it. They had no financial commitment. If they had been asked to make this kind of financial contribution for this level of supply or a higher financial commitment for a higher level of supply, then they would have had some appreciation for what they were getting. But if someone was to give them something from the central government and the maintenance cost was not very high, they were going to accept it as a gift and do very little in return. One can't be blamed for wanting a first quality system such as had been seen existing in Guatemala City and Antigua and other places.

I think the participation has to be a real one. I want to tie it to the fact that the local participants -- those who will benefit -- have to make some kind of a payment. It should be not only in kind, but generally more than that because there is some operation and maintenance which is higher the better the quality of the system. And without some kind of payment, I don't believe there is the real concern for the system that is necessary if it is going to continue in operation.

RIFAT BAROKAS:

I feel some provision must be made for community participation, say at the project identification or project paper level in the case of an AID project or at the reconnaissance or feasibility level of a bank project, be it at the World Bank, Asian Development Bank, or Inter-American Bank, and how it is going to be. Otherwise all we're doing is a lot of talk without actually following up with action in the field.

Community participation depends on the presence or absence of a mechanism and a methodology to include the people in the decision-making process while the project is being designed. If this is built in, it might happen successfully, or unsuccessfully; but it has to be built in.

My second point might sound a little silly to you -- but the incorporation of community participation is based on the personality of the design and implementation team. A design team consisting of an engineer, a sociologist, an economist, and a sanitarian, can sit down in the capital city, talk to a bunch of government agencies, talk to the representatives of the Banks or AID or whatever, and design a project based on the soil maps, the topographical maps, etc. Or it can go into the field and talk to the people. The question that I pose is how many design teams actually go through the mud and spend a lot of time talking to the farmers, to the potential beneficiaries? How many actually sit down for 1, 2, or 3 hours and find out what bugs them, what their priorities are, what their preferences are and how a system can be developed so that they can provide some information to the planning of the design and implementation of the project?

Now sometimes there is very little time for this. There might not even be funds for this. When we were in Thailand, Chuck Pineo, Max Batavia and I, we worked for only about 3-4 weeks. We spent a lot of time visiting 40 villages getting up at 5-6 in the morning and working to about 10-11 at night, because we felt it was important to find out what the people wanted, needed, or expressed as their preferences. We didn't have to do it: we preferred to do it that way.

So my basic conclusion is we can talk a lot about it but unless there is a mechanism, nothing will happen.

To cite another example, I just returned from the Philippines where a number of projects will be initiated to benefit some ethnic minorities. The government has been talking about helping them for the last 20-30 years and very little really has been done. I don't know if any of the recommendations that our team made are going to make any sense or be followed, but again, we made recommendations for these communities to select representatives so that there is some sort of a flow of communication in the planning of projects which are supposed to benefit them.

ANNE WHITE:

I would just like to comment, why isn't this a perfectly legitimate cost of design? It seems to me that it is; but that it has not really been very often incorporated as such. And I think you are quite right. Unless you have the mechanism, the time allowance and the funds, nothing much is likely to happen. There are different kinds of personnel and there may be much more emphasis on the local level and training of those people; but the funding, and the time and the mechanisms do have to exist.

DR. G. WHITE:

We must move on to the next topic, but with the understanding that we will have opportunity thereafter to come back to a whole set of issues that have been considered in the course of the day.

I would remind you that we began yesterday with a review of what we know and don't know about health effects, from several standpoints. We tried to see how this was related to the notion of primary health care in villages and how cost-effective interventions might be selected. Then this morning we turned to examine in a broader context what we know and again don't know about economic impacts and social impacts, on various sectors of the communities. We haven't yet tried to draw this together; and I hope we will have a chance to do that before we close this afternoon. But to put this in a national context, as far as the United States is concerned, we ought to try to ask what seems to

be the unfolding view as to the role of the United States in the U.N. Drinking Water and Sanitation Decade and for this, we turn to Ambassador John McDonald who carries responsibility for putting together this position for the United States.

The United Nations Drinking Water and Sanitation Decade

John W. McDonald, Jr., Ambassador, Department of State and U.S. Coordinator for the U.N. Drinking Water and Sanitation Decade

I should start off by saying that I am not an engineer and I am not a medical doctor. I am a lawyer-diplomat who has been involved in the development process for the last 25 years. I have spent some 20 years outside of the United States in many parts of the world, and I am personally interested in this whole process that we are talking about. I also spent three and one-half years as Executive Secretary of AID in the later 1950s so I have some understanding of AID, and I can assure you the mechanisms have not changed that much. I was three and one-half years an international civil servant as Deputy Director General of the I.L.O. I have been on both sides of the conference table.

Lucy Benson, the Under-Secretary of State, and Governor Gilligan, head of AID, asked me last year if I would take on the task of U.S. Coordinator for the Decade. Since I am not an expert, I look upon my role as being one of trying to move bureaucracies of all kinds—national, international, and local—to take a more effective role in the Water and Sanitation Decade and to develop the appropriate mechanisms for action with regard to it. This afternoon I would first like to move from the village level to the global level and talk about the U.N.'s role and then talk about the U.S. role as I see it, pointing out some of the weaknesses of the latter role for your consideration and discussion.

I think we all recognize the need (for water supply and sanitation interventions). One set of figures that has impressed me particularly was put together by WHO in 1975 and states that 22 percent of the world's rural population are without reasonable access to safe water. These figures will grow by the end of this decade to 40 percent of the urban population and 83 percent of the rural population unless some major changes take place in the course of this decade to improve that situation.

It was in the light of these figures that the United Nations, on a global basis, became involved first, as you have heard, at the Habitat Conference in Vancouver in 1976 and at the Mar del Plata Conference on Water in March of 1977. The latter conference came forward with the concept of "safe water for all by the year 1990." The United States was a strong supporter at that conference and has been a strong supporter of this concept since that time.

Unfortunately, the U.N. bureaucracy did not move very rapidly, and it was only in March of 1979 that the first follow-up conference to Mar del Plata took place in New York. This was one of the committees of the Economic and Social Council. This first meeting was, in effect, an attempt to structure the United Nations system so that it could begin to cope with the challenges of this Decade. We felt that if we could achieve five major steps at this meeting we would make an important contribution to this total process. We proposed the following five actions:

- o That the United Nations General Assembly, in its collective will and wisdom, launch the Decade officially in a one-day special session of the General Assembly in November of this year.
- o That a seven agency steering committee, which had been operating informally on a strictly ad hoc basis from time to time, be formally recognized and formally structured as the focal point within the U.N. Secretariat's operation for responsibility for the Decade. (These seven agencies are the U.N., the Bank, WHO, UNDP, UNICEF, ILO and FAO.)
- o That a consultative group mechanism be established. (There had been one informal meeting sponsored by WHO, but we sought to institutionalize this in order to bring donor countries together on a more formal basis.)
- o That reports setting out national plans and priorities be prepared by every developing country and forwarded to New York. (Following this, some kind of a global overview could be put together in time for this one day special session.)
- o That each UNDP resident representative, now operating in some 120 countries around the world—150 entities I believe the latest figure is—be responsible, in-country, for coordination with regard to the United Nations Decade. (This is to provide an in-country mechanism which we all recognize as extremely important.)

These five proposals were formally accepted by the 54 nations at this meeting. We then presented these same recommendations to the full Economic and Social Council the following month, to the World Health Organization in May, to the UNDP Governing Council in June, and to the U.N. General Assembly last December. They were consistently and unanimously approved by all governments in each of these particular fora.

We ran into one small difficulty at the General Assembly—there were other difficulties along the way, but I think this one is particularly amusing if you have a morbid sense of humor. The Secretariat of the General Assembly decided that they really did not like the idea of a one-day special session of the General Assembly. It probably involved a bit too much work. So, when we tabled our resolution with the Secretariat for translation and circulation, they lost it for ten days. It just happened that that was a critical ten days because the filing date passed during that period and we had to use all kinds of devices, first to find the resolution, to get an exception to the rules, and, finally, to get it passed. But the unexpected often happens in New York.

Let me mention briefly what has been happening in recent months with the U.N. agencies themselves. I am a little loathe to talk about this with John Kalbermatten on my right, but I will try in any event. The United Nations Development Program became the formal chairman of the steering committee. I think that was the right decision. There were some battles over whether it should be WHO or some other agency, but I look on UNDP as the funding mechanism and I feel that is where the chairmanship should lie. They have had four meetings of the steering committee in recent months with the most recent one held last week.

Some 50 countries have already filed their national reports with the Secretariat in New York in preparation for the November meeting. That is a pretty good record at this stage of the game. A questionnaire has been sent to all resident representatives by Peter Bourne, the UNDP Coordinator for the Water Decade. Some interesting figures have turned up in the 56 questionnaires that have been returned, and I think this relates to some of the questions that have been discussed in the last two days here.

First of all, some 36 countries have set up what the U.N. calls, "technical support teams." Obviously the resident representative does not have the expertise himself to coordinate and carry out his responsibilities, although he does chair the meetings. These support teams, made up of WHO, UNICEF, and other representatives, are helping to bring the impact of the Decade to bear on the countries themselves.

The most fascinating figure of all, in my opinion, is that the 56 questionnaires returned indicate that 46 countries have already established national action committees. This is the question that was asked this morning. I absolutely agree that an interministerial mechanism is essential to make the Decade concept work—and 46 countries have established this kind of a mechanism. To me, that is very encouraging. Twenty-five heads of state are aware of the Decade and its goals and have accepted this as a useful challenge to their own development process. Based on a scale of one to ten, there were seven "tens" in the group. That is quite good. There were two "nines", ten "eights" and ten "sevens." You can see there is a great deal of in-country, national, political support for this whole Decade concept. And, as was mentioned a moment ago, this is absolutely essential if there is going to be any forward progress. It requires the governments' political as well as economic backing to make the kind of progress we are talking about.

An interagency task force for public relations has been set up in the United Nations to stress the Decade. This consultative group, which I talked about, will have its next meeting on the 16th of June in Geneva. The Common Market will hold a meeting of the Decade after the November launching date, and we are talking to the Development Assistance Committee of the OECD to try to hold a special session on the decade.

With regard to the role of the Bank, it is my understanding, and my figures bear correction, that from 1963 to 1978, the Bank spent about a billion dollars on water and sanitation programs. From 1978 to 1979, they spent one billion dollars on water and sanitation programs. Mr. McNamara is dedicated to the support of this concept. He made important commitments at Belgrade and he gave this very high priority at the last meeting of the Bank Fund. Informal projections would lead me to expect that, over the course of the Decade, the Bank, when one takes all of its programs and projects together, will do everything it can to maintain that one billion dollars per year figure.

John Kalbermatten has played a major role in leadership within the Bank itself. One of the things that I have been particularly impressed with is the UNDP-funded team—an interdisciplinary team—that he has put together over the last year and a half. I have met with them on two separate occasions, and I can assure you it was a major learning experience for me in both instances. They are working in approximately eleven countries around the world, going out into the field, doing exactly the kind of thing that was talked about a moment ago—sitting down with the villagers, and, if there is an existing system, trying to find out what is wrong with it, why it is in disrepair and how one can design a project to meet the criteria of that particular area. I understand that by the end of this year the Bank team expects to have identified something like a hundred million dollars in foreign

exchange costs worth of projects for consideration by donor countries. Obviously, the whole concept of project design is something that AID and other bilateral donors could spend a great deal more time on. My understanding is that for 1979 the Bank allocated about nine percent of its total funds for water and sanitation programs.

WHO has certainly been a long-time leader in the field. Dr. Mahler is a strong supporter of the Decade because he views this as an integral part of "Health for All by the Year 2000," the Alma Ata Conference follow-up. He sees this as an integrated whole and gives strong support to this concept through the entire WHO mechanism. They, of course, are working closely with the Bank in project design. There is a Bank-WHO agreement of some years standing which is 75 percent supported by the Bank and is a very useful device.

We heard yesterday that UNICEF is now spending 25 percent of its budget on water and sanitation projects, so you get some idea of the total commitment on the part of multilateral agencies to this concept.

This July in Copenhagen there will be a mid-decade conference, as it is called, on "Women and Development." We are already drafting a resolution which the U.S. will put forward on the Decade and the impact that it can have on women and the development process.

My real purpose in going into this kind of detail is to show you that, in my opinion, many of the countries of the developing world are ready to move into this particular process and many of the multilateral agencies involved fall into the same category. Where does the U.S. stand? Sandy Levin said yesterday, and I think it was certainly the right statement, that there is a U.S. commitment to a Water Decade. How do we make good on that commitment? To me, that is the real question.

There is no doubt about the spoken commitment. Delegation after delegation has supported this in international fora. The State Department has publicly stated its support for the concept. Mr. Ehrlich of IDCA, and Mr. Bennett at AID have supported the Decade in congressional testimony. The Senate appropriations committee has asked that AID put more money into water and sanitation. Clearly all of the spoken words are extremely supportive insofar as the government is concerned.

I think it is fair to say that there is broad support in the private sector too. A number of non-governmental organizations interested in various aspects of the water process are strong supporters of the Decade and its long-range objectives. They have come out with resolutions and have held conferences and meetings on this. I think, then, that there is a base on which one can build.

What about AID? In October of 1978, Governor Gilligan and Mrs. Benson signed a paper in which they said that they would support a 2.5 billion dollar commitment over the Decade for rural water subject to four conditions; (1) that the developing countries come forward with their share; (2) that the U.S. share of the total package would be 25 percent--that other donor countries, in other words, would come forward with the balance; (3) that projects could be developed; and (4) that AID's budget for this could increase without crippling other key efforts.

Based on what I have said, it seems that one can fairly say that the first three conditions are being met. In other words, the developing world is ready. I believe that other donors will be forthcoming over the next few years. I believe that the Bank and the multilateral agencies are already there and that the projects can be found.

The key question is: can the fourth criterion be fulfilled? The AID budget--is it going to increase? In the last few weeks it has been decreasing, but we are talking in terms of a Decade, not in terms of a presidential election. I believe, if one can construe that the first three criteria are met, the real focus is on how AID can begin to prepare itself and how it can do a more effective job over a decade.

I am treading on some toes here, but I look upon this as my role; so, I will continue to do so. I believe that AID is going about this in the wrong way. I believe that they are trying to put the Decade completely into the health program. What they are, in effect, saying is--and I understand it from the standpoint of monetary constraints--if you are going to increase the Decade program for water and sanitation, it will have to come out of the health program. In other words, they are looking upon this on a small, sectoral basis. On the other hand, the people who are managing the health program have little interest in reducing that program to help the water program. This is my opinion. I say this is wrong because I think that water supply and sanitation, as we have indicated time and again here, is far, far larger than health.

To me, the Decade criteria and the programs that we are discussing go to the very heart of what AID is all about and are totally supportive of the entire congressional mandate which calls for a basic needs philosophy in the AID development approach. We know that congressional concern and criteria are important and I believe that they can be supportive in this regard.

The Water Decade does not concern only health--it includes such issues as productivity, women, employment, rural development, community development, transfer of technology, and agriculture. In other words, it goes across the entire development horizon. I believe that water should break out of the health syndrome in AID. It should stand on its own and compete for funds on its own.

Look at what has happened to AID in the past on a structural basis. At one point, nutrition and population were parts of health. They are not today; they have their own separate offices.

I believe that, rather than have a water division in the Office of Health, you should have a separate Office of Water as you have a separate Office of Health. Let the competition for limited funds take place on that kind of a basis. I would also suggest that there be a separate line item in AID's program budget for the Water Decade and for water and sanitation.

If one looks again at the verbal commitment and at the monetary commitment, the figures that I have show that there is a decline, not an upsurge, in AID funding. In fiscal year 1980, supporting assistance amounted to 135 million dollars and development assistance to 44 million dollars for a total of 179 million dollars. Most of this is supporting assistance that does not support rural projects. In fiscal year 1981, 111 million dollars will go for supporting assistance and 35 million for development assistance making a total of 146 million dollars. From fiscal year 1980 to fiscal year 1981 the drop was from 179 million to 146

million. This is not, in my opinion, the way for the United States to exercise its leadership as it enters into a major decade process.

I am strongly urging that for fiscal year 1982 this figure increase. The rhetoric is there, and now it is time for some policy direction. I would encourage, not a 60 page or 15 page policy paper, but a one page policy paper in support of the Decade so that the word can get out to the field and so that people can understand that this is important to the Washington bureaucracy. Any mission director worth his salt who gets that word is going to begin to look around and see how he can be responsive to those concerns from Washington.

As I have said earlier, there is a great deal of support in the Third World, particularly in the least developed countries, for this particular process. By going to the ministries and agencies concerned, AID can find the kind of programs and projects that it would like to fund, assuming it has the will to do so.

I would urge also that AID focus a great deal more attention on the whole training question. I was involved with AID in the 1950s and 1960s and third country training was a very important facet to the whole development process. Tens of thousands of people were trained by AID worldwide—in this country and in other countries. The training process has declined dramatically in the last ten years. I would like to see that trend reversed, and I would like to see major emphasis placed on training in this whole water and sanitation sector. As has been said again and again here these last two days, you have to have a year's preparation for some of these programs and projects, and training should start now before you start putting funds into this whole development arena.

I believe that AID should also pay more attention to project design and take some leads from the Bank in this regard because they have some experience now. In the 1950s, USAID was the world leader in development of water and sanitation programs and the impact of that leadership is recognizable all over Latin America today. Latin America, as a region, is ahead of the rest of the developing world because of AID's leadership role.

That world leadership at AID no longer exists. The manpower is not there and, in my opinion, the will is not there. I would like to see this Decade used and looked upon as an opportunity to be seized by this government.

DISCUSSION

DR. G. WHITE:

Are there questions or comments growing out of Ambassador McDonald's statement?

JOHN KALBERMATTEN:

Good luck!

CHARLES PINEO:

I won't be quite as brief as that, but being probably one of the very few people who is not tied to any agency, but who has worked with several of the agencies concerned, I can appreciate the situation that AID is in now. It's not a question of money. It is a question of staff. And if AID doesn't staff up for the decade, it just isn't going to have a program. You can't possibly do it with one or two people in Washington and practically no water supply experts in the field.

You speak about training. One of the most important things, as you pointed out, that we did in the 40's, 50's and 60's was to train people locally, outside of the countries, at the middle level; in-service training as well as graduate training. But to develop candidates for this type of training a person in the field is needed who is pushing that training.

It's strange. When I was a youngster I would have given a left or even a right arm to get a graduate training program. But in the Latin American countries, particularly, and I guess most of the other countries, the candidates that we want to train have at least two, maybe three jobs. They work with the Ministry of Health. They work at the university. They have their own private practices. And to pry one of these people loose for a year's training outside the country is almost impossible. The stipends that AID and WHO pay to participants is, to say the least, miserable. These people are professionals. They have to break up their family, or they have to leave their family to go to get this type of training and it is very difficult.

On the other hand, the type of training programs that we need do not exist. AID used to fund training programs. There was one at the University of North Carolina. The International Sanitary Engineering Training Program was developed specifically for engineers from the developing countries. It included six months refresher training in design in Chapel Hill; a month in-service in a water supply or sewage treatment plant to see what type of equipment is used, how it is used, why it is there; and the rest of the year in a consulting engineering office. Terrific program. Why was it eliminated? The reason that I have heard is that most of the participants were financed by WHO, not by AID. Why should AID finance a training program for other sponsored participants? For my money, this is the best way to do it. You pay part of the cost and the other agencies pick up the participant cost.

So, to get back to the staffing thing -- you need people in Washington; and I am going to be specific -- Vic Wehman has done a terrific job in pulling the WASH Project together. He and McJunkin have done a terrific job in pulling this seminar together. But two or three people cannot do it. If we are to talk in terms of billions of dollars or even hundreds of millions -- it takes more than three or four staff in Washington to backstop it. And it takes a whole lot more than one or two people in the field. You can't do it

with consultants. But if you don't have in-house staff, you have to use consultants even though it costs you more money.

DR. ELMENDORF:

I was very pleased to hear your emphasis on training and also your mention of the Mid-decade Conference on Women. I would just like to go back and add a few comments on this. I was appointed to the U.S. delegation to the Mar del Plata Conference just before it started and there were already 21 issues papers prepared, but nothing was specifically on impact of water on women and children. Pat Rosenfeld and I got our heads together and at our recommendations and suggestions the statement prepared by the 30 NGOs of the special situation in regard to women was included as one of the official documents added on at the very end. We discussed it and as we are looking now at the Mid-decade Conference on Women and Development, I would urge that we look again at the paper. I had copies put out this morning of the recommendations that were made by the 30 voluntary agencies as to how women could be involved and how the whole impact of water and sanitation on the basic needs of the whole family could be improved.

There were 50 points and most of them, if you look at them, have to do with training. But it is not just training of sanitary engineers as Chuck Pineo mentioned. We have to think of training and education at the village level as well as at the professional level. Point one, for instance, was to include strategies -- this could be within the AID missions -- to develop human resources at the community level. The second point was to insure equal access for women to training, with regard to maintenance, management and technology of water resources and supplies. We tried to point out, and it has come up over and over again, why has there been no use or understanding. This is the opportunity to include the women from the very beginning in the design to insure that they also will be included in any educational programs, including sanitary engineering.

We had here as a visitor yesterday a sanitary engineer from Argentina who was working as a trained engineer. Let there be more women in local councils and planning boards. We can take a positive step in making sure that they are involved. We talk about local participation -- they are more than half the community, so let's listen and get them involved both as informal and formal leaders.

Then the fifth point was to recognize the increasingly effective role that women in the voluntary agencies and in the indigenous women's organizations--national and local--can play in the education of public opinion at the village level, the country level, and at the international level. I would urge that we see how much of this has happened in five years and how much can happen during the next five.

DR. OKUN:

I would like to commend John McDonald for his fine and very forthright statement. I'm only sorry that he wasn't asked to make it yesterday morning, or yesterday afternoon as well as now because most of those who needed this message, I'm afraid, are gone. I would like to encourage him to take every venue, every occasion, to repeat what he said to us today, because certainly what he is saying is really at the heart of what AID's responsibilities ought to be.

I very much appreciate Chuck Pineo's statement about the training program affirming what Mr. McDonald said about the early work in Latin America, and what it has meant for the state of water supply and sanitation in South America. I certainly appreciate the

comments he made about our international program at North Carolina. We have had a training program at the University of North Carolina sponsored by AID and its predecessor agencies continuously since 1954, and we are most proud of Gene McJunkin's involvement in this project which ran for 12 years.

We would not like to repeat the program in that form, however, because there has been a lot that has changed since it was initiated and completed. One of the major changes is that there are educational institutions of a wide variety in the developing countries themselves and these ought to be used. The training that could be given within the countries themselves would be much more appropriate to the needs of each country. The costs would be much less. The language would be the local language. I think that AID can assist by providing help to establish these in Cairo, in Lima, in Africa, and in Asia. There are many institutions that we can build upon, and in building upon them, not only will we get training for those people who will manage the projects we will help to set up, but we will help to develop these institutions as well.

This training does two things: it helps the institutions in which it takes place, and it helps those as well being trained. So rather than just putting in money, ad hoc for training, we could do it through the institutions themselves.

But again, I would just like to say that I hope Mr. McDonald just keeps going on the circuit and getting his message across.

CRAIG HAFFNER:

I just want to comment on my total agreement with Mr. Okun's comments. Over the last 19 years the Peace Corps has been training over 80,000 volunteers that have gone overseas. We have seen a real transition from the early 60's where a number of us were trained at universities to a total emphasis of in-country training, trying to get the best developed institutions in those countries to assist in the training of Peace Corps volunteers. We have now found that by bringing qualified, skilled trainers from the U.S. over to do the training in more rural areas, that some of their training ideas and methodologies can be established and institutionalized in training institutions. So I think I would really argue very strongly for greater emphasis on getting training as close to the level that the participants would be working at. I think maybe some of the managerial kinds of issues could be done here in the U.S., but I think our level of technology, the appropriateness of it, the sensitivity to the culture and the language are all concerns that need to be considered in setting up training programs.

As an example, this spring the Peace Corps is working in collaboration with the Center for Disease Control and the Indian Health Service in doing some training in Kenya. I think we have found that we haven't been able to find a large number of good, qualified, skilled trainers that have the knowledge about the appropriate level of technology we are talking about. But we have found in the Indian Health Service and in the Center for Disease Control, some of those sorts of people.

MR. KALBERMATTEN:

If John McDonald goes circuit riding with his message, I would like to help him saddle the horse because I think, indeed, what you said is very pertinent and I think that we can all agree to it. I'm a little bit more at ease saying that today since about 4 weeks ago Mr. McNamara rather enthusiastically endorsed the basic needs paper on water supply and sanitation which makes some of the very same points.

It is important to look at water supply and sanitation, not in isolation, but as part of a package of community services including health care and so forth, with strong emphasis on training and all the related aspects which are necessary to make water supply and sanitation investment a success.

I don't pretend to advise USAID on how they should develop their program, but I would like to at least offer one thought, and that is in program development. They might consider the possibility or the advantages of coordinating with other agencies in trying to concentrate on things for which they have particular qualifications, particular strengths which some other agencies do not have. To get back to training, I said this about 2 or 3 years ago at an interagency meeting to which I was invited. Since I have never been invited back, I am not sure whether there is a message there, but let me repeat what I said at the time.

AID did a terrific job in training, as we already heard. I think they are better qualified to do training than the World Bank. There are many reasons for that which I don't need to go into now; but I'll be perfectly willing to elaborate to those who want to know why. There are very good reasons why AID could do a much better job in training as a bilateral agency than we can as a multilateral agency. They could make a very significant contribution by doing a lot of work in training which would permit others such as the Bank to come in and assist in the financing of facilities based on training programs, and even on the training programs themselves.

It doesn't make sense for somebody like the Bank to keep struggling with investment programs if the main power base does not exist. One of the fundamental questions that we will have to answer as the Decade progresses is whether in fact we ought to go and try to increase our lending programs even more than they are right now, at a time when systems which have been installed relatively recently are deteriorating and do not provide the service for which they were designed.

So just a thought -- in developing a program maybe there is some virtue in trying to determine what other agencies are doing, are qualified to, and seeing whether in fact one can do a bit more coordination, and as a consequence, help each other do the job better.

MAX BATAVIA:

As I understand, one of the reasons for the seminar is to make AID employees more familiar with the issues bearing on water supply and sanitation. As a followup to what Daniel Okun said, it is unfortunate that there are not too many representatives from the AID regional bureaus. I would like to request that the ones who are here pass the very important message that has come across this afternoon -- from several people -- on to their decision makers. And when it is time, internal AID representatives can bring this issue to a head.

MR. SCHULTZBERG:

We have talked about volume of aid. Most of the money will come from the developing countries, and only part of it will come as aid. But it is not only a question of volume, it is also one of flexibility in the way of utilizing these resources. I think several have brought up examples like Tanzania, Kenya, Sri Lanka -- where you have maybe 15 bilateral agencies, 4-5 banks, and a number of non-governmental organizations involved. Such difficulties in preparing projects that satisfy all these various agencies -- they each

have their system for preparation of projects, appraisals, supervision, reporting requirements, evaluation, etc. I think we contribute to a lot of the institutional problems if we make life too complicated for the developing countries in our requirements of projects. It also applies to the commodity contribution. Many countries have such a variety of pumps, drilling equipment, etc. in order to satisfy the various donors who have been involved in the sector. Flexibility in the use of resources is something I would like to stress.

DR. G. WHITE:

It seems to me that we have had a couple of very challenging observations growing out of discussion of community participation and how AID can best help. One is that there ought to be heavy emphasis upon training people in developing countries to successfully generate and carry through community participation and indeed to deal with the very complexity of coping with a multitude of bilateral activities. It should be recognized that an expansion in training programs could be beneficial or it could be counter-productive. We have seen that some of the people who have been trained have not been able to develop programs that are sustaining programs. We are facing this problem today. As John Kalbermatten was saying, a very considerable number of systems that have been built in the last decade are not in operating shape now, and that is a very sobering kind of lesson for us. We have to ask how we can help people to develop such programs in a fashion that realistically will be viable.

I think we also know that the training that was very appropriate in the earlier surge of AID interest in this regard is probably, as Dan Okun says, not appropriate now, in part because there has been the development of indigenous educational institutions which need support, in part because the view of what constitutes suitable skills and outlooks has changed, as has been indicated so plainly here around the table in the last couple of days. There is a very urgent need for the kind of assistance which Dave Donaldson has been calling for of people coming out of national offices who can be very sensitive to community needs and who know how to work effectively at that level. So we have to be careful that an expansion of training is a productive rather than a counter-productive venture.

The other suggestion I think is one that perhaps was not intended, but may be inferred, which is that AID ought to devote its efforts for the next few years to helping people get more money from the World Bank, which is crying out for suitable projects and lacks only people in the field to prepare adequate proposals. And I am very happy that you have made that suggestion, John, as a suitable contribution for the United States and this effort.

AMBASSADOR McDONALD:

Mr. Chairman, my comment is very brief. I do appreciate the support that has been given to the statements that I have made and I can assure you I will go on the circuit and I will carry my message.

Final Discussion

GILBERT WHITE:

Are there any final questions which you would like to put before us before we come to a summing up?

HOWARD KELLER:

During the break I was asking Mary Elmendorf a question, which she answered, but I think a lot of people are wondering about the same thing. In the film of the Mexican village, the key agent for change there was the young woman, Juana.* She really flew right into the face of cultural taboos by disobeying her elders and her family and taking that child to the doctor. I have been involved in situations where even more sophisticated and educated people than Juana just could not attack the person who was holding back their program, where a doctor could not attack another doctor who was holding down his program because that other doctor had been his professor and you just do not attack your former professor. So I would like to ask Mary Elmendorf to give us some idea of just how this came about. Was it a question of motivation or is it a long-term process of education?

DR. ELMENDORF:

I do wish we had more of this. When someone like Juana is selected by the village, for a very short period of training, upon returning he or she is often the most educated and has a new prestige that changes his or her relationship with the old system and the traditional leaders. I think Juana was operating within this, and there are many Juanas that I have seen do this in other villages.

Another thing was happening there. There was a network of female support for Juana. The local supervisor was a young woman. She was supervising Juana and the other village promoters. This gives them support outside the village. If women talk to women, we become role models for each other. If we give them another way of seeing a woman act I think this can change the way young women behave at the village level and give them really an opportunity to become change agents. So this is the way I interpret what was happening and we've seen this many times.

DR. JOHN ALDEN:

This is a little follow-on to the last discussion, but I would like to request one thing of John McDonald if he is successful in establishing another categorical program within AID. I'm not really disagreeing with what he is trying to do if it is formulated in the proper way. I think if such an agency or such a program is set up, we should make very sure that it is mandated for rural water development and not just water development. I feel very strongly that rural water development, as we see it, is a combination of behavioral as well as engineering components and if we set up the category of water, it is all too likely that it is going to become urban water development as such. I think the sanitation aspects of the rural sector are very behavioral in orientation and I don't think we will see

*Editor's Note: This comment refers to a UNICEF film about diffusion of innovation which was shown between sessions.

this if it becomes heavily capital intensive and focuses on the urban areas. There is a great deal to be discussed and worked out in such a proposal.

DR. G. WHITE:

Do others want to speak to this? I would like to offer one comment on this. Our discussion in the last two days has been almost totally and by definition on rural, and yet there have been passing comments on the special problems raised by the squatter settlements in urban areas. I think we all recognize that this is one of the great problem areas in the developing world today, the large proportion of urban populations that are in the squatter settlements. It is interesting that the World Bank has been giving very special attention to these. I would suggest that if you are thinking of getting the maximum health impacts per dollar expended, in a number of the periurban areas you probably can get surer and larger impacts than in many rural areas. They lend themselves to a different kind of strategy. It is not a strategy that ignores community participation in any way; but it is a different sort of strategy. And this may very well be a matter of intense concern. Perhaps some of you would like to discuss this — why the very heavy emphasis on rural vs. urban.

ABBY BLOOM:

I agree that there will have to be some consideration given to periurban fringe squatter settlements, but I think it is a question first of balance and second of what we discussed earlier regarding areas of development in which AID has a comparative advantage. In the first instance, we all know that when one gets involved in urban water and sanitation systems you can very easily absorb an enormous amount in technologies that are quite a bit more sophisticated and much more costly than what one normally does at the village level. We have examples of projects of a hundred million dollars that represent fifty percent of what is normally our combined funding level for water and sanitation annually.

The second thing is the question of comparative advantage. I appreciated what Dr. John Kalbermatten said earlier because this discussion is going on within AID as well. AID does have a proven track record in particular types of things, mostly in the software of water and sanitation systems. And what I have seen at least is that it is precisely these target group communities of less than 500 people and in some cases less than 2000 people who are often left out of national programs that are supported by other donors because they are too isolated and too difficult to get to. These are precisely the groups that AID, with its rural focus, tries to reach with water and sanitation programs. So, while I agree with Dr. Alden, and think there needs to be a principal focus on rural areas, I suspect that AID will start acknowledging that there needs to be a balance and that we need to look at urban-fringe settlements as well.

DR. ALDEN:

In the remarks I made, I am not trying to exclude urban water development. I think within us the capital development people are carrying this one right now. Eighty percent of the water development being done in AID I think is being done by the Near East Bureau and most of that is in urban development and is handled very well by engineers over in project development. I am saying that if we within the agency develop a whole new focus, I think we've got to be very careful that it does not slide over into just engineering.

DANIEL DWORKIN:

I just wanted to make the point that Ambassador McDonald did. The emphasis in rhetoric is on rural but our funds are going to urban rather than rural water supply in a great preponderance. I think over three fourths of the funding is on urban.

DR. G. WHITE:

If I recall the figures that I have seen on AID funding in the water supply/sanitation field, a very large proportion is in the Near East Bureau and that is in three projects. Isn't it?

ABBY BLOOM:

Yes. Without getting into details that would bore a lot of people, I just want to make you aware of the fact that we do have two different types of funding that go to water and sanitation. One category is development assistance and the programs we support there are predominantly rural. The other category is security supporting assistance which goes principally to the Near East although there are funds going to other areas as well. The security supporting assistance funds, which represent 75-80 percent of water and sanitation funding, are used principally for urban programs.

My other point is in response to Dan Dworkin. One approach by which AID can evaluate its spending in the sector is to look at coverage versus the expenditures of funds. I would prefer to look at the degree of access versus the expenditure of funds. In particular, what degree of access are we giving rural dwellers as opposed to city dwellers and how does this ratio compare to the percentage of funds going into the urban projects versus that going into rural projects?

DR. G. WHITE:

Would anyone like to explore any other point?

QUESTION:

What are the relative costs per capita and where should your priorities be?

AMBASSADOR McDONALD:

I can answer one-half. According to Bank figures based on Nicaraguan programs, they're estimating \$25 a head for rural water, sanitation, and health education for 250,000 people. I consider that a very low cost per head. My guess is that depending on the size of your urban project, your cost would be far, far higher — maybe \$200 a head, something of that nature.

I think it is fair to say to the development planners, however, that it is much easier to put together an urban project than it is a rural project. Based on what we have heard these last few days it is fair to say that a successful rural development project is one of the most sophisticated development concepts that we know about. And except in one or two cases, we really have not taken it to the next step further, and that is what do you do with the woman's free time after you provide a spigot outside of her house? I really think that next stage is almost as important as the first stage because there you get your payoff. If you can bring education, training and handicrafts to that village; utilize the spare time; put them into a money income; you will have all kinds of payoffs resulting from this effective usage of free time. But it is very very difficult to achieve.

DR. KALBERMATTEN:

The problem with comparing to capital investment figures is that when you talk about water supply and sanitation in urban and rural areas, you are talking about something entirely different. An acceptable solution in a rural environment, let's say in a community of 500-2000 people, may be a number of wells with handpumps and an acceptable latrine. That is relatively inexpensive. It costs \$5-\$10 per capita for a very simple latrine, and perhaps an equal amount for the well and handpump, depending on local conditions, how deep you have to go for the water and so forth. But say it runs to a maximum of \$50. That solution is not in all likelihood acceptable in a densely populated slum area of Calcutta. You have to provide a different level of service and that is more expensive.

If we continue our traditional approach of going ahead with piped water systems which introduce 100, 200 or 300 liters per capita of water into a community, then you force that community into also putting in a system to dispose of that water. Now you are talking about \$100 per capita for the water system and maybe \$200-\$300 per capita for the sewer system. So your first decision has to be one of the service level standards to be selected. Unfortunately our engineers, and I'm guilty as an engineer myself, don't think enough of the service level standards which we wish to employ in the urban areas. In the rural areas it is relatively simple; you do the minimum required and leave it at that. In the urban areas we think we have to have the New York City system wherever we go around the world.

So we have to change the standards in order to bring the costs down. To give you an idea of what this translates into in the global context of the Drinking Water Decade, we are talking about ballpark figures which range anywhere from \$100-200 billion dollars in 10 years to as high as \$600 billion dollars and that is strictly the difference between service level standards that you change when you go and start in a project. There is no easy simple answer to the question of what it costs in the rural area and what it costs in the urban area. If you wish to use the same standards in the rural area that you employ in the urban area, it is vastly more expensive. In fact, it would be impossible to provide any service at all if you would have to make that sort of an investment.

I'm sorry, I probably confused the issue even more than it was before; but, this is one particular case where there is no globally applicable correct answer.

MR. DONALDSON:

I would like to go just a little bit further with what John was saying; I agree very much. There is one additional factor which you have in this and that is that we are trying to improve water systems. We are working in a dynamic system. Part of your cost depends on how fast you want to upgrade from one to the next. Ultimately all of our sanitary engineers want to provide piped water into the house. Now, how we get from people carrying water in buckets to water coming out the tap in every house -- the cost of that is a function of how fast we are going to get there, and the various steps that we go along in getting there. Is the first thing to put in handpumps in a manner which are upgradable into patio connections which are upgradable into something else, and something else? So your cost is not only, as John has pointed out, the service level, but how quickly you want to move from one service level to another.

DR. McJUNKIN:

John, going back to the earlier question in looking at the unit cost, and particularly in view of the congressional mandate at AID, I think you have to look at the ability to

pay or at the per capital income of the people involved. In the urban areas you have a lower unit cost yet you have an income that is five times what it is in rural areas. I think that would probably weigh in the strategy as much as relative unit costs of the water system being provided.

AMBASSADOR McDONALD:

I think it is also fair to point out, however, that of your total cost, I think foreign exchange costs of bilateral donors and multilateral donors come to about ten percent of the total project basis. The host country puts up ninety percent. Therefore the cost factor is also a political factor in so far as the country is concerned. If that country puts its own priority, high enough, it is willing to come up with the ninety percent figure. Then it seems to be this should be helpful to the donors in insuring that there is a political will there to bring the project to completion.

DR. ELMENDORF:

I can't help going back to what Ambassador McDonald was saying and also to what John Kalbermatten was saying. When we compare costs, the rural unit cost per person is very low, the actual cost. But learning how to use it is much more difficult, and this includes bringing about behavioral change. Somehow we have to account for that learning and training cost. Anybody can flush a toilet, but to know how to use a latrine or how to use water and do all these things — it must be built in as part of the cost. I think we are forgetting this in many places and we should add it in.

MR. DONALDSON:

If I could just point out one other thought that occurred to me. We have been using historical cost to arrive at unit cost. But as Mary just pointed out, in the past many of the programs did not have the things that we are saying should be in the future. In the past the health education and community participation element was very weak, so when you look at a figure, you have to understand where that figure came from and what was in the figure. In many cases those figures are very rough guidelines for what might be expected in the future.

Closing Remarks

Gilbert F. White

It seems to me that a number of concepts have been reinforced and that certain points of emphasis have emerged in the discussion that might be worth our considering as we close this seminar.

In a sense, much of this seminar has been an exercise in intellectual nudity in that it has revealed a great deal about what we do not know concerning many of the issues. I have been impressed by the candor with which people have stated what they do not know and the problems that bother them, not only from the standpoint of AID policy but also from the standpoint of people outside AID who are struggling with the design or evaluation of programs. I have found this to be a heartening kind of exchange. I have not found engineers or epidemiologists or anthropologists or geographers putting forward a particular position as one they wanted to defend. It has been more of a matter of them contributing their experiences and outlooks to help us with problems that none of us feels we have understood adequately and that certainly have not been solved.

We started out with a strong emphasis on the effect of the modification of an existing water supply and sanitation system. We have recognized that we are dealing with existing facilities used by people with their own patterns of behavior. We have recognized that there are certain links between water supply and sanitation and health that are very clear and that can be established. The relationships between inadequate water supply and sanitation systems and cholera and typhoid have historically provided a major motivation for the undertaking of these systems.

We have also recognized that there are a number of aspects that are not well understood. This is the result of weak epidemiological studies. For a long time, the medical and biological fraternity did not feel the need to explore these relationships. Some of them, for example, were looked into only in the last few years, stimulated by the World Bank Study, in an effort to be more specific about what had been taken for granted. But this relationship, or set or train of relationships, is uncertain in many respects. It is a very complex problem.

We have recognized that part of the effect of water supply and sanitation on health is indirect. Some of the benefits result from the system's influence on the productive system in the community or the social organization of the community; and that is even more difficult to quantify. We have heard that there is a relationship between the socioeconomic stage of a community and the degree to which it will be responsive to water supply and sanitation measures as they affect health. We have reviewed the state of our knowledge about impacts on production and the amenities of the community, as well as the social consciousness and sense of direction of the community. We have emphasized that the knowledge we have about a community's organization and its interaction with the design of water supply and sanitation systems influences the eventual success of the system. This is an interactive process.

One assertion that has emerged clearly as a policy position is that even now one cannot be highly specific and precise about the linkage between interventions in water supply and sanitation systems and health. There are sufficient grounds to assert that improvements in potable water supply are a good thing and that it is not necessary to push much further in order to justify the consideration of significant investments to improve rural water supply for health purposes—subject to a couple of conditions.

A strong theme that has continually emerged is that the sufficient conditions for achievement of successful water supply and sanitation involve strong linkages with the community and that these linkages are ones that need to be developed early, before the detailed engineering designs are completed. These designs must be created in an artful fashion so that they assure the continuance of community involvement and a sense of responsibility for facilities that the community, not only wants to, but from fiscal and economic standpoints, can sustain.

A theme that also seems to have recurred, which is closely related to the previous one, is the necessity of exploring ways to link water supply and sanitation interventions to other sectors of community development. It is probably a mistake, in most instances, to think of water supply and sanitation as being a distinct sector of work having no close relationship to what is done in other aspects of rural development, including agriculture, transportation, health, and the like. In most instances, it has to be considered as an activity that is linked, in some fashion, to these other sectors of community development. It would be a mistake not to explore all of the possible ways in which water supply and sanitation interventions could be integrated with other activities. This does not mean that the process of planning would have to be so complex and so laborious that it would be paralyzed in undertaking works that communities are clearly prepared to support if given proper assistance.

Another theme I have heard repeated is the need for suitably trained people. To assure the proper choice of service level for these improvements and systems, and to make certain there is community participation in that choice and in subsequent responsibilities, requires the training of a much larger cadre of people than we now have. They must be skilled in the art of human relations and technical choice and there is little point in considering elaborate technical plans unless communities can be provided from the very outset with suitably trained people. Beyond this, there is the necessity for national commitment not only to train these people but to support them in the kind of work they will be doing. One would need to be careful about training people who would have nothing to do or who would be obliged to work in a structural setting under policies that made it impossible for them to use their skills and experience.

In looking at the points that have emerged in our discussion, in terms of the questions initially posed, I suggest that one of the burning questions of yesterday is really not important: the question of how to compare water supply with other investment possibilities in related sectors. This leads us off on a false track. The related question of what measures are sufficient to secure improvements in water supply and sanitation is of utmost importance.

We have been able to marshal a body of evidence that suggests the existence of a large accumulation of experience about the technical knowledge of different service levels; the complications involved in achieving one or more levels; and the ways in which the design, construction, and operation and maintenance of the program chosen for improvement can be facilitated. But certainly I have heard no one who feels that we have a clear, easy, rule-of-thumb that can be applied to assure success in these regards. We have a good deal of experience on which we can draw. We have a good many "do's" and "don'ts" which we can offer, and we do not feel that improvement is an impossible job.