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WATER AND SANITATION FOR HEALTH PROJECT

COORDINATION AND INFORMATION CENTER

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PARTICIPANTS MANUAL FOR SESSIONS ON WATER SUPPLY AND SANITATION

USAID Workshop on Primary Health Care in Africa
November 15-20, 1981
Lome, Togo

WASH TECHNICAL REPORT NO. 13

FEBRUARY 1982

The WASH Project is managed by Camp Dresser & McKee Incorporated. Principal cooperating institutions and subcontractors are: International Science and Technology Institute; Research Triangle Institute; University of North Carolina at Chapel Hill; Georgia Institute of Technology Engineering Experiment Station.

Prepared For:
Africa Bureau
Agency for International Development
Order of Technical Direction No. 53

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USAID Workshop on Primary Health Care in Africa
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Prepared for Africa Bureau
Agency for International Development
under Order of Technical Direction No. 53

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February, 1982

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PREFACE

This manual has been included in the WASH Technical Report Series because of its successful use in the Water Supply and Sanitation Sessions of the USAID Health Officer's Continuing Education Session at Lome, Togo, 15-20 November, 1981.

The manual contains basically three types of documents: resource documents prepared by the speakers at the plenary sessions (pp. 4-27); background papers, checklists, worksheets, and case studies for each workshop, whether for planning, implementation, or evaluation (pp. 28-97); and appendices, consisting of a series of selected abstracts, lists of program leaders and participants, instructions given to group discussion leaders, and a succint reference from Contact on planning rural water supplies.

The workshop sessions on water supply and sanitation were designed to facilitate participation in the analysis of problems associated with planning, implementation, and evaluation of water supply and sanitation projects, and in the formulation of approaches to those problems. Checklists are provided as guides to asking questions, case studies as grist for the mill of applying the checklists, and worksheets for laying out analyses and strategies for both the case studies and the participants' own cases. Through participation in this process, hopefully the relevant skills of participants in this workshop and of the readers of this manual, may be enhanced.

Acknowledgements

The WASH staff are deeply indebted to WASH consultant Ms. Marjorie Kupper for the superb work she did in preparing the lesson plans and worksheets for this workshop. Her perceptive questions and flexibility illustrated well the role of an Educational Media Specialist in an interdisciplinary team. At the University of North Carolina Professor Morris Shiffman is to be thanked for the creation of the checklists, student Tom Talbert for writing the case studies, and Professor Dan Okun for overseeing the entire procedure. The entire staff of the WASH Coordination and Information Center contributed to getting the first draft completed for shipping to Lome. It was a real team effort. Lastly profound thanks are due to the organizers of the Lome conference and especially to the participants, whose comments have stimulated the creation of this revised version.

PROGRAM OBJECTIVES

At the conclusion of the program, you, as a participant, should be able to:

A. Analyze the planning, implementation, and evaluation phases necessary for a water and sanitation project to be successfully completed in your country.

B. Identify specific problem areas and possible solutions that reflect the cultural and political climate and resource constraints in your country.

AGENDA

Wednesday - November 18
9:00 - 11:15

Plenary Session

Introductions and Overview	Dr. Ray Isely
AID Commitment to Water and Sanitation	Mr. F. Eugene McJunki
AID Water and Sanitation Policy*	Dr. Abby Bloom
Relationship of Water and Sanitation Programs to Primary Health Care	Dr. David Sanders
Field Report - African Projects	Mr. Craig Hafner
Piped Water for Malawi (a film)	Mr. Craig Hafner
Technical Issues for African Projects	Dr. Daniel Okun
Summary	Dr. Ray Isely

11:15 - 11:30 Break

11:30 - 1:00

Group Session on Planning — Hafner, Isely, Okun

Introduction to Group Work
The Process of Planning
A Checklist for Planning
Case Study
Group Critique of Case Study
Discussion of Participant's Experiences

1:00 - 2:00 Lunch

2:00 - 3:15

Group Session on Planning (cont'd)

Participant Planning - Identification of Problem Areas and Possible Solutions
Discussion of Selected Participant Papers

3:15 - 3:30 Break

*Printed version of Policy Paper soon to be available from the Agency for International Development (Program Planning and Coordination Office), Washington, D.C.

AGENDA

3:30 - 5:30

Group Session on Implementation	Hafner, Isely, Okun

A Checklist for Implementation
Training Aspects for Implementation
Case Study
Group Critique of Case Study
Discussion of Participants' Experiences

Thursday - November 19
9:00 - 10:15

Group Session on Implementation (cont'd)

Participant Activity - Identification of Problem Areas & Possible Solutions in Implementation Phase
Discussion of Selected Participant Papers

10:15 - 10:30 Break

10:30 - 12:00

Group Session on Evaluation	Hafner, Isely, Okun

A Checklist for Evaluation
Types of Evaluation, Suggested Approaches
Development of Evaluation Scheme for Case Studies
Group Critique

12:00 - 1:00

Closing Session

Panel Discussion - Problem Areas in African Projects	Selected Participants
Reactors	McJunkin, Sanders
Closing Remarks, Summary	Isely

PLENARY SESSION PAPERS

U.S.A.I.D. TECHNICAL ASSISTANCE RESOURCES IN WATER SUPPLY AND SANITATION

ST/HEA/CWSS

1 November 1981

1. Discipline: Rural and Urban-Fringe Water Supply and Sanitation Technical Assistance to Inter-Sectoral Clients in A.I.D.

Project Title: Water and Sanitation for Health (WASH) (Pre-Paid Services - Not an IQC)

Camp Dresser and McKee, Inc.
One Center Plaza
Boston, Massachusetts 02108
Dr. Dennis Warner
(703) 243-8200
Contract Amount: Approximately $11.5 million

AID/W Servicing Office - ST/HEA
Effective Date Contract: 9/29/80
Expiration Date: 12/83
AID Contract No. AID/DSPE-C-0080
ST/HEA Officer - Mr. Victor Wehman
ST/HEA tel. no. (703) 235-9823

Services: See WASH Brochure (attached)

2. Discipline: Water Supply and Sanitation as part of Primary Health Care Technical Assistance

Project Title: Accelerated Delivery Systems Support (ADSS)

(Pre-Paid Services - Not an IQC)

American Public Health Association
1015 Fifteenth Street, NW
Washington, DC 20005
Dr. Susi Kessler
(202) 789-5600
Contract Amount: Approximately $7.5 million

AID/W Servicing Office - ST/HEA
Effective Date Contract: 9/29/79
Expiration Date: 9/29/82
AID Contract No. AID/DSPE-C-0053
ST/HEA Officer - Dr. Donald Ferguson
ST/HEA tel. no. (703) 235-9649

Services: The Contractor shall provide short-term, rapidly responding technical advisory services to AID missions, AID regional programs, government and non-government organizations in developing countries as requested through the Regional Bureaus and the technical Offices of AID in a wide range of activities aimed at the extension of essential health and family planning services.

The Contractor shall establish and maintain a register of consultants. A suggested minimum listing of the types of specialist and speciality areas to be included in said register are:

SPECIALISTS	SPECIALTY
Public Health Physician	Admin. & Management
Obstetrician/Gynecologist/Pediatrician	Statistics & Vital Data
Parasitologist	Community & National Planning
Epidemiologist	Health Care Financing
Malariologist	Project Evaluation
Malacologist	Operational Research
Toxicologist	Program Planning
Ecologist	Systems Analysis
Medical Etomologist	Community Participation, Organization & Education
Dentist	Manpower Training
Public Health Engineer	Clinical & Tech. Service
Vector Control Technician	Logistics & Transportation
Nurse	Architecture & Equipment
Nurse - Mid-wife	Cost Analysis
Public Health Administrator	Rural Development
Public Health Educator	Computer Technology
Public Health Trainer	Appropriate Technology
Family Planning Administrator	Source Reduction
Sanitary Engineer	Women in Development
Demographer	Info. & Communications Media
Economist	Urban and Rural Water Supply
Statistical Economist	Waste Water Treatment
Laboratory Technician	Excreta Disposal

SPECIALISTS

Pharmacologist
Computer Programmer
Pest Management Technician
Health Planner
Nutritionist
Sanitarian
Environmental Health Engineer
Environmental Science

The Contractor shall be capable of providing some or all of the following types of technical assistance in the field of public health and family planning:

(1) Developing research procedures and topics,

(2) Interpreting research results to program managers,

(3) Developing evaluation procedures and topics,

(4) Providing program evaluations; ongoing, final and follow-up,

(5) Providing needs assessment,

(6) Providing detailed planning for development of programs,

(7) Advising schools and universities in curriculum development and institutional building,

(8) Providing short courses in university/technical schools,

(9) Developing training curriculum and programs,

(10) Developing or strengthing training institutions and faculty, and training of trainers,

(11) Providing training,

(12) Developing information, education and communication plans, strategies and messages,

(13) Organizing and developing volunteer groups with particular emphasis on women's organizations,

(14) Assessing and planning the integration of women in the health-socio-welfare field,

(15) Planning and developing systematic long-range plans for demography and statistics,

(16) Analyzing demographic data,

(17) Applying census information to planning, development and implementation of programs,

(18) Providing data sources for socio-economic analysis and research,

(19) Planning, developing and implementing distribution and storage systems for program supplies and materials,

(20) Planning and developing equipment requisition and maintenance systems for equipment and materials,

(21) Planning and managing of manufacturing facilities,

(22) Defining scope of program services,

(23) Identifying obstacles to full utilization of programs and providing possible solutions,

(24) Advising on general administration of programs,

(25) Planning, conducting and attending workshops, conferences and seminars,

(26) Determining inter-relation of health and family planning programs with other socio-economic development programs,

(27) Planning and implementing of health aspects of integrated programs, and

(28) Analyzing, developing and implementing appropriate technology,

(29) Development of rural and urban water supply, water treatment, waste water treatment, excreta disposal, process evaluation and assessment of such projects in LDCs.

3. Discipline: Water Supply and Sanitation Studies as Part of Primary Health Care Technical Assistance

Project Title: Primary Health Care Operations Research (PRICOR)

(Pre-paid Services - Not an IQC) (Cooperative Agreement)

Center for Human Services
5530 Wisconsin Ave.
Suite 1600
Chevy Chase, Maryland 20185
Mr. Jack Reynolds
(301) 654-8338
Contract Amount: Approx. $9.0 million

AID/W Servicing Officer - ST/HEA
Effective Date Contract - 10/81
Expiration Date - 10/86
AID Contract No. AID/DSPE-5920-A-00-1048-00
ST/HEA Officer - Ms. Terri Lucas
ST/HEA tel. no. (703) 235-9649

Services: The goal of this 5-year project is to contribute to the improvement of the efficiency and effectiveness of primary health care (PHC) programs in developing countries. PRICOR is responsible for 3 major project components:

1. The direct provision of assistance in the design, management, and anaylsis of applied research directed at resolving country-specific issues which currently impede the implementation or extension of PHC programs.

2. The systematic analysis and dissemination of country findings for the adaptation and application of improvements in methodology, knowledge, and systems evolving from the research.

3. The development of an "institutional memory" and an analytic resource to assist in PHC program development.

Specific project activities include:

- Background/Methodology Studies: We will solicit proposals for, and fund, approximately 9 studies in the initial years of the project. They will provide initial methodological and theoretical guidance and serve as a basis for the development of comparable approaches to design, data collection and analysis in the country studies.

- Country Studies: Up to 28 country studies will be completed during the life of the project. These will be 1 to 2 years in length and will be implemented on a worldwide basis. The topics which operation research might address include: utilization of services, integration of traditional medical practitioners, trianing, supervision, appropriate technology, alternative financing mechanisms, pharmaceutical and commodity supply systems, and types of management and information systems.

- Comparative Studies: Approximately 3 comparative studies will be conducted in the later years of the project to examine findings from the country studies and identify common conclusions.

- Dissemination: We will disseminate study findings through reports, monographs, conferences, workshops and other means. Up to 4 workshops and 2 international conferences may be carried out during the life of the project to facilitate the exchange of information on research approaches.

4. Discipline: Handpump Technology Technical Assistance - Health IQC

Georgia institute of Technology (IQC)
Office of Contract Management - Intl.
Atlanta, Georgia 30332
Mr. Phillip Potts
(404) 894-3851

AID/W Servicing Office - ST/HEA
Effective Date Contract: 4/15/81
Expriation Date: 4/15/82
AID Contract No. PDC-1406-I-00-1006-00
ST/HEA Officer - Mr. Victor Wehman
ST/HEA tel. no. (703) 235-9823

Services: In this area or subsector the contractor shall have experience, skills, and competence and shall perform services which reflect competence and understanding:

a. Perform limited or expanded hand pump demand marketing surveys in LDC's.

b. Perform cost-effectiveness analysis of various hand pump options available to a LDC.

c. Coordinate with local manufacturer and obtain detailed production quotes on behalf of a USAID for particular hand pumps to be produced locally or partially locally.

d. Provide detailed technical assistance to local manufacturers to enable them to understand the inter-relationships of the manufacture of the pump and to improve production techniques.

e. Provide quality control in production technical assistance to the manufacturer or LDC government unit as necessary to ensure reasonable outputs for field use.

f. Provide technical assistance to USAID or LDC government units/POV's/ private sector as appropriate to effect understanding of how hand pump programs operate, problems that occur, options that implementing unit has, and recommended hardware or design standards to employ from an equipment or public health standpoint.

g. Develop training materials for implementing organization hand pump program workers, for trainers of trainees and for local village rural water supply technicians.

h. Provide training to implementing organization hand pump program workers, to trainers of trainers and supervise quality or training to local village rural water supply technicians as appropriate. Contractor would be expected to adapt and modify training materials or approaches as appropriate. Production and use of break-a-way training models is authorized.

i. Assist a USAID prepare a project paper relating to hand pump programs as appropriate.

j. Plan and implement pilot or demonstration projects for missions relating to the local manufacture of a series of hand pump prototypes and then the installation into wells, monitoring production and reporting of results,

at an appropriate number of sites, to determine consumer acceptance and cost effectiveness of hand pump options for mission/LDC use in large-scale projects or programs.

k. Provide technical assistance to the LDC implementing organization in operation and maintenance techniques and provide administrative and logistical support recommendations or technical assistance to improve implementing organization capability to work effectively in the rural areas of the LDC.

l. Provide specialized hand pump program technical assistance not identified above, but deemed necessary by the USAID to either initiate or improve a rural water supply (hand pump and wells) program taking place in an LDC.

The following suggests the kinds of technical skills which might be called upon to provide the above services in hand pump technical assistance. The list is intended to be illustrative, not comprehensive.

hand pump installation
water well design
water well construction
local LDC small foundary practices
local LDC small machine shop practices
management and organization
marketing analysis
training materials development
training of trainers skills
knowledge of materials fatigue engineering
interfacing of materials engineering
mechanical engineering
industrial engineering
environmental health aspects of rural water supply projects
technical assistance to implementing organization
hand pump mechanics
carpentry
research design
assessment and evaluation
sanitary engineering
public health engineering
geo-hydrology
hydraulics and fluid mechanics
chemical and bacteriological analysis of water
well drilling technology
logistics management
administration

5. Discipline: Water Supply and Sanitation - Health IQC

The Pragma Corporation (IQC)(8(a))
1011 Arlington Blvd.
Suite #224
Arlington, Virginia 22209
Mr. Rifat Barokas
(703) 525-9656

AID/W Servicing Officer - ST/HEA
Effective Date Contract: 9/28/81
Expiration Date: 9/27/83
AID Contract No. PDC-1406-I-00-1130-00
ST/HEA Officer - Mr. Victor Wehman
ST/HEA tel. no. (703) 235-9823

Services: See below

6. Discipline: Water Supply and Sanitation - Health IQC

Meta Metrics, Inc. (IQC)
2321 18th St., NW
Washington, DC 20009
Mr. Leo Surla
(703) 797-1330

AID/W Servicing Officer - ST/HEA
Effective Date Contract: 9/28/81
Expiration Date: 9/27/83
AID Contract No. PDC-1406-I-00-1131-00
ST/HEA Officer - Mr. Victor Wehman
ST/HEA tel. no. (703) 235-9823

Services: See below

7. Discipline: Water Supply and Sanitation - Health IQC

American Public Health Assoc. (IQC)
1015 15th St., NW
Washington, DC 20005
Ms. Susi Kessler
(703) 789-5600

AID/W Servicing Officer - ST/HEA
Effective Date Contract: 9/29/81
Expiration Date: 9/28/83
AID Contract No. PDC-1406-I-00-1128-00
ST/HEA Officer - Mr. Victor Wehman
ST/HEA tel. no. (703) 235-9823

Services: See below

8. Discipline: Water Supply and Sanitation - Health IQC

Westinghouse Health Systems (IQC)
Box 866, American City Bldg., #400
Columbia, Maryland 21044

AID/W Servicing Officer - ST/HEA
Effective Date Contract: 9/30/81
Expiration Date: 9/29/83
AID Contract No. PDC-1406-I-00-1129-00
ST/HEA Officer - Mr. Victor Wehman
ST/HEA tel. no. (703) 235-9823

Services: See below

SERVICES FOR ALL WATER SUPPLY AND SANITATION HEALTH IQCS

I. SCOPE OF WORK

A. Summary

The purpose of this contract is to provide AID and/or cooperating agencies with short-term adivsory services relating to the planning, design, and evaluation of programs and projects, and related Agency policies and procedures. These services include:

1. Country, sectoral and broad program analyses, including the assessment of economic, social and other relevant factors;

2. Studies related to the identification, preparation, design and evaluation of specific programs and projects; and

3. Services related to the development of design and evaluation methodologies, the development of suitable Agnecy and participating agency procedures, and the teaching of these concepts and procedures.

B. The Contractor will be required to conduct or assist in conducting the services described below primarily in the sector/subsector described in Section II.

1. Sectoral and inter-sectoral analyses helpful in defining the objectives and programs for United States foreign assistance; defining constraints, charting resource parameters, identifying alternative interventions; and developing quantitative and other measurable indicators or progress towards the objectives adopted.

2. Studies and analyses concerning the identification, appraisal, and design of projects and project sub-components with emphasis on factors appropriate to each activity. These factors may include but are not limited to technical, economic, and social feasibility, cost, efficiency, equitable distribution and benefits, impact on women and disadvantaged minorities, effects on population growth and distribution, time required for implementation, ease of management, degree of needed institutional change, institution-building requirements and effects, demand on scarce resources, environmental effects, risk, and host country commitment and ability to support post project activities. Such studies will integrate evaluative elements into project design, with provisions for periodic review and reformulation.

3. Designing and execution of evaluation and/or redesign studies and analyses of projects and project components, sectoral activities or programs.

4. Development of new, and adaptation of existing design and evaluation systems and methods for types of development assistance or for use by developing countries in their own development programs.

5. Preparing and conducting training courses in the planning, design and implementation of development activities and in evaluation methodology and techniques.

II. SECTORS OF SPECIFIC FIELDS

A. Rural Water Supply and Sanitation

Problems to be addressed in this area will include rural domestic water supply, rural human waste disposal, environmental sanitation, including but not limited to solid waste collection and disposal, water pollution and other environmental hazards to health.

In this area or sub-sector the Contractor shall have experience, skills, and competence in Rural Water Supply and Sanitation and shall perform services to include:

1. definition of sectoral and inter-sectoral factors affecting disease patterns;

2 identification and definition of health problems associated with water supply and sanitation problems;

3. identification of constraints to controlling diseases associated with poor sanitation;

4. identification and assessment of alternative strategies and interventions with particular emphasis on use of appropriate low-cost technologies in providing safe water supply and environmental sanitation services;

5. planning, design, and development of manpower training programs including identification of trained manpower needs, development of curricula and course material, planning of long-term training, and conduct of short-term, in country training;

6. development of research activities including development of guidelines for research directions, and review and development of research projects;

7. planning and design of rural water supply projects, either in conjunction with integrated health programs or separately.

The following list suggests the kinds of technical skills which might be called on to provide the above services in health planning and delivery systems. The list is intended to be illustrative, not comprehensive.

- Cultural Anthropology
- Social Anthropology
- Water Chemistry
- Water Microbiology
- Pump Mechanics
- Pump Design

- Pump Fabrication
- Carpentry
- Masonry
- Management
- Administration
- Logistics
- Public Health Education
- Manpower Development
- Research Design and Sampling
- Evaluation Design and Performance
- Health Economics
- Environmental Analysis
- Sanitary Engineering
- Public Health Engineering
- Hydrology
- Geology
- Hydraulics
- Solid Wastes
- Well Drilling Technology

9. Discipline: Sanitary Engineering including Water Supply

James M. Montgomery, Inc. (IQC)
250 North Madison Avenue
Pasadena, California 91101
Mr. Lee A. Francis
(213) 796-9141

AID/W Servicing Officer - ST/ENGR
Effective Date Contract: 7/1/81
Expiration Date: 6/30/83
AID Contract No. AID/OTR-C-1132
ST/ENGR Officer - Mr. Palmer Stearns
ST/ENGR tel. no. (703) 235-9827

Services: Water supply and treatment; sewerage and sewage treatment; storm sewers and drainage; solid waste systems; industrial water conservation and waste treatment; related construction management; related environmental analysis; air quality control; and noise abatement.

10. Discipline: Water Resources

Jordan/Avent & Assoc. (IQC) (8(a))
111 New Montgomery Street
San Francisco, California 94105
Mr. Frederick E. Jordan
(415) 989-1025

AID/W Servicing Officer - ST/ENGR
Effective Date Contract: 4/20/81
Expiration Date: 4/19/83
AID Contract No. AID/OTR-C-1101
ST/ENGR Officer - Mr. Palmer Stearns
ST/ENGR tel. no. (703) 235-9827

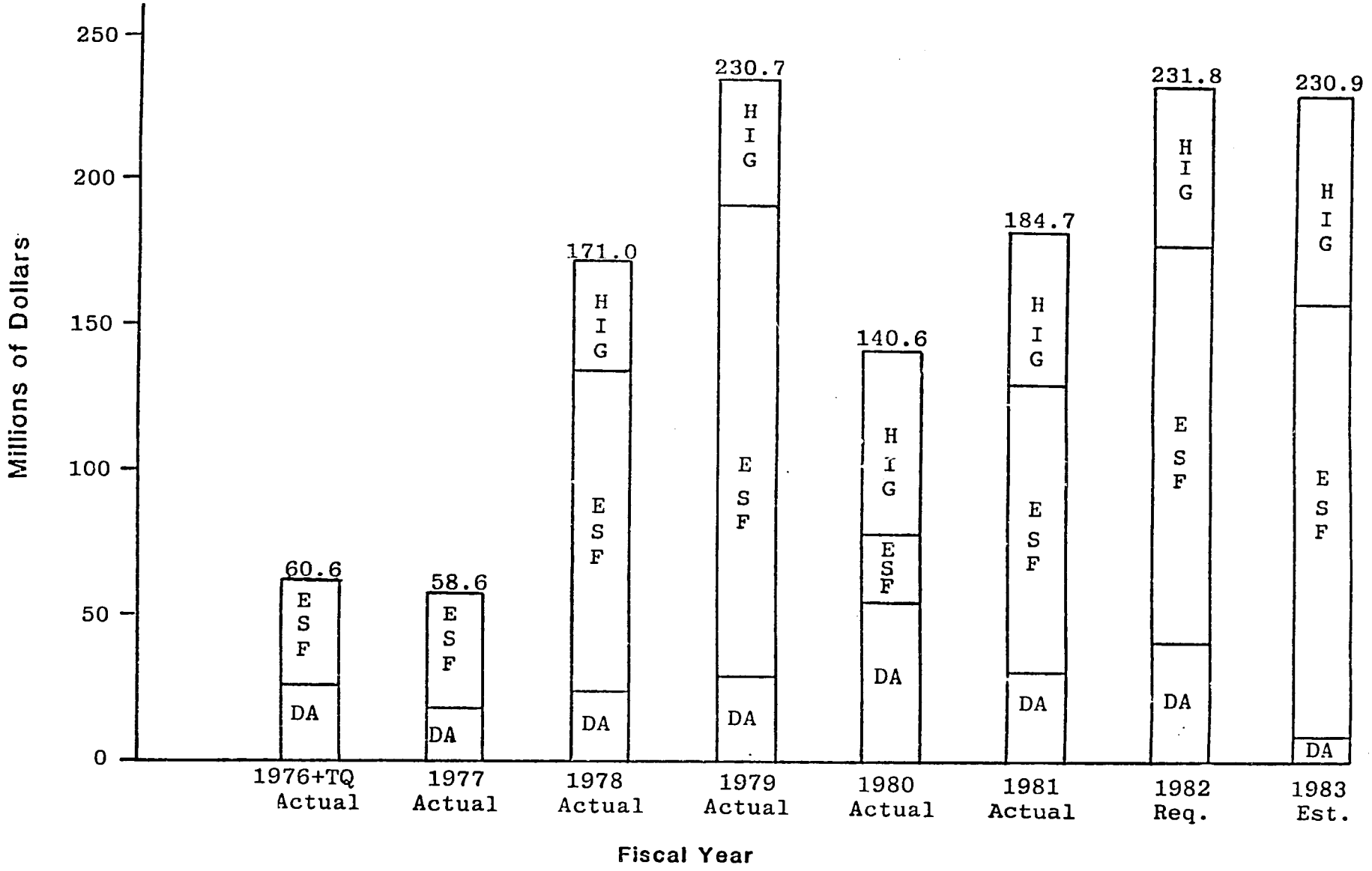
Services: Water resources development; hydrological and ground water studies and exploration; irrigation and hydraulic structures (small dams and canals) including operation and maintenance; water resources planning including basin development and related land uses; flood studies and control.

11. Discipline: Water Resources

Tippetts-Abbett-McCarthy-Stratton (IQC)
655 Third Avenue
New York, New York 10017
Mr. Robert E. Prasch
(212) 867-1777

AID/W Servicing Officer - ST/ENGR
Effective Date Contract: 6/15/81
Expiration Date: 6/14/83
AID Contract No. AID/OTR-C-1131
ST/ENGR Officer - Mr. Palmer Stearns
ST/ENGR tel. no. (703) 235-9827

Services: Water resources development; hydrological and ground water studies and exploration; irrigation and hydraulic structures (small dams and canals) including operation and maintenance; water resources planning including basin development and related land uses; flood studies and control.



AID Funding Obligations For Water And Sanitation By Fiscal Year

November 13, 1981

AID AFRICA Water/Sanitation Projects and Problems
Craig Hafner

In preparing for this workshop a cable was sent to each of the AID Africa missions asking them to respond to a number of questions. The first question asked for a listing of present operational water and sanitation projects or projects with a water and sanitation component in each country. This was requested in order to up date the information in Washington and summarize for AID officials the scope and variety of water and sanitation projeacts in Africa. The table that follows is that summary. It indicates the following:

- there are 28 AID water and sanitation projects in 20 countries in Africa
  - 15 of these projects are primarily water or sanitation (e.g. wells, water systems, latrine construction, etc.)
  - 8 of the projects are large health projects in which water or sanitation are components
  - 5 of the projects are agriculture and rural development in which water for domestic use in a component
- 18 of the projects are funded under the health sector
- 10 projects are funded under seven different funding sources (ranging from food and nutrition to refugee relief)
- 12 AID missions in Africa presently have no water or sanitation projects. (However, at least three missions: Kenya, Burundi and Uganda are exploring potential projects.)

The list does not include a wide variety of smaller funded water/sanitation projects (generally under $500,000) which are funded from the following sources:

Improved Rural Technology (IRT)
Accelerated Impact Programs (AIP)
Operational Program Grants (OPG's) to Private Voluntary Organizations
Embassy Self-Help Grants
Disaster Relief Funds
Refugee Refief Funds

We are anxious to update our inventory of water/sanitation projects and keep it as current as possible. We would welcome any additions or deletions to it from the missions.

AID Africa - Water/Sanitation Projects - November 13, 1981

(In $1,000,000)

Country	Project No.	Name	Sector	FY81 Actual Obligation	Estimated Life of Project Costs	Components
1. Benin	680-0201	Rural Water Supply	Health	4.7	6.7	Well, spring construction, health education training
2. Botswana	633-0084	Environmental Sanitation	Health	.18	.49	Latrine, refuse pit construction, health education training
3. Cameroon	631-0012	Mandara Mts. Water Resources	Ag. R.D.	2.3	6.9	Dam, latrine construction, health education training
4. Cameroon	631-0025	Mandara Area Wells	Health	.9	.45	Wells drilled, CARE
5. Cape Verde	655-0005	Sal Desalination/Power	Health	.9	4.7	Water/power plant construction, training
6. Lesotho	632-0088	Rural Water Supply	Health	2.0	12.1	Water supply wells construction, training health education
7. Liberia	669-0157	Hand Dug Wells	Health	.04	.3	Wells construction
8. Malawi	612-0207	Rural Water Supply	Health	1.7	6.0	Water supply, training, health education
9. Mali	625-0937	Tambacara Wells	Sahel Dev. Asst.	.15	.14	Wells construction
10. Mauritania	682-0202	Rural Medical Assistance	Health	.4	1.6	Training of VHW
11. Mauritania	682-0203	Rural Land Reclamation	Sahel Dev. Prog.	2.1	3.0	Dams, catchments, health education
12. Niger	683-0208	Rural Health Improvement	Health	2.0	12.0	Improve Sanitation, training, Africare
13. Senegal	685-0210	Sine Saloum Rural Health	Health	.8	1.8	Training of sanitarians
14. Sierra Leone		Royiena Water Supply	O.P.G.			Water supply construction OPG to PVO
15. Somalia	649-0102	Primary Health Care	Health	1.9	5.0	Training of VHW in sanitation
16. Somalia	649-0104	Comprehensive Ground-water Development	Health & Ag. R.D.	2.2	13.0	Wells drill, training
17. Sudan	650-0050	Port Sudan Refugee	Refugee Relief		2.0	Water supply construction
18. Swaziland	645-0087	Rural Water Borne Disease Control	Health	.8	3.2	Latrine construction, health education, trianing
19. Tanzania	621-0143	Arusha Regional Planning	Food/Nutrition	2.8	14.5	Village Water Systems
20. Tanzania	621-0150	School Health Program	Health	1.0	3.2	Training, school curriculum, health education, wells, latrine construction
21. Tanzania	621-0168	Kisongo Water Catchment	Disaster Refief	.08	.08	Dam construction
22. Tanzania	621-0170	Masai Village Water	Disaster Relief	.6	.6	Village Water Systems
23. Togo	693-0210	Rural Water Supply	Health	3.2	8.0	Wells (drilled), latrine, health education
24. Upper Volta	686-0228	Rural Water Supply	Health	2.8	12.3	Wells, health education
25. Zaire	660-0057	Health Systems Develop-	Health		2.2	Spring, latrine construction
26. Zaire	660-0067	Basic Family Health	OPG		3.0	Spring, latrine, refuse pits construction
27. Zaire	660-0086	Basic Rural Health	Health	.9	4.9	Springs, latrine construction PVO

The second question in the cable requested a listing from the missions of three major problems in planning, implementing or evaluating water and sanitation projects. Of the fourteen responses received, the three most frequently mentioned answers to this question were:

1. the lack of interministerial coordination and collaboration
2. the lack of trained personnel
3. logistical support breakdowns

Interministerial coordination and collaboration has been cited by many donors and development workers as one of the more delicate, time consuming and difficult issues to be addressed in water and sanitation project planning and implementation. Water is the responsibility of a variety of national government ministries as well as local authorities. There is an example in one country in which five different ministries have responsibility for wells construction and monitoring in various regions. It should be noted that this problem however, is not unique to the developing world but is found all too frequently in the developed nations as well.

The second problem cited by the missions was the lack of trained personnel for water and sanitation projects. Under this heading is included: the lack of appropriate training institutions and programs; the lack of skilled trainers; the lack of relevant curriculum that is learner and rural oriented; the lack of sufficient mathematics and science preparation of trainees for technical training programs; and the lack of clear job descriptions and detailed task analysis for those jobs prior to the designing of training programs.

The third major issue facing water and sanitation projects as indicated by the missions is logistical support breakdowns during implementation. This problem includes delays in the ordering and delivery of equipment, supplies, vehicles, fuel, and spare parts; inadequate storage facilities; and the lack of effective monitoring of vehicle use and warehouse inventories.

In addition to the three major problems facing water and sanitation projects a number of other issues were raised by one or more missions. They include:

- general lack of planning
- very little piloting of ideas in the planning stage
- optimistic implementation schedules
- limited financial resources of host country to support the project
- lack of integration of the water/sanitation components into other projects in agriculture, health

and rural development

- poor communication among donors doing similar projects
- lack of involvement of local community
- the difficulty in coordinating the preparation of target villages with technical equipment availability
- technical staff for rural projects being drawn off to work on urban projects
- delays in payment by villagers who have had experience or have heard that a new pump will break down quickly
- pressure from donors and/or governments to drill wells and install handpumps rather than having communities dig the wells and draw the water themselves.

It is evident that a great many problems are facing water and sanitation projects. It is hoped that some creative ideas and potential solutions to these problems will be forthcoming from the discussions during this workshop. The mission's response to these questions is appreciated.

For first plenary session

TECHNICAL ISSUES FOR WATER SUPPLY AND SANITATION PROJECTS

Daniel A. Okun

One characteristic of water supply and sanitation projects is that no two situations are alike. Even where the cultural and sociological settings are much the same, the natural, human and institutional resources needed to initiate, plan, and implement a water supply and/or sanitation project vary from place to place. Among some of the more important variables are the following:

Climate

The availability of water, which is often a function of climate, is generally seen as being more critical than its safety. In arid areas, the need for water is such that its value as a utility and for household watering is readily perceived and local initiative in seeking water supply can be expected. In humid areas, on the other hand, with water readily available, less incentive exists for developing safe community supplies. Accordingly, the approaches in promoting water supplies must be substantially different in these instances.

Similarly, the significance and importance of household sanitation facilities varies with the climate. In arid areas, the absence of proper sanitation facilities may not be as serious as in humid areas because of the dessicant effect of sun and heat in the absence of moisture.

Distribution of population

Where people live in villages, because of the economies of scale, the per capita cost of water supply facilities is likely to be substantially less than where people live in smaller units. On the other hand, the need for proper sanitation facilities is much greater in densely populated communities.

11/05/81

Community Organization and Resources

Where a community is organized for providing other services, or where a community is selected to serve as a center for the provision of other services, such as health centers, a project for water supply and sanitation is somewhat easier to initiate than in a community that is only a collection of homes with no other focus. The latter is apt to have a more primitive organizational structure.

Organization for the provision of a water supply may, on the other hand, be the instrument for creating a community organization that may serve to introduce other projects, such as street paving, markets, primary health care, and the like.

Topography

In hilly country, such as in Burundi and Malawi, springs may easily be developed and, because of their elevation, these may provide water by gravity. In level terrain, on the other hand, pumping is required which adds significantly to the complexity of a project. Where wells are required, the water table and soil permeability are factors which vary widely from place to place and need to be evaluated.

Stage of Development

In countries or regions with even a modest manufacturing infrastructure, the materials required for water supply systems, such as pipes, valves, pumps, and motors, together with replacement parts, may be available locally, so that implementation of projects does not need to await foreign intervention. Where the materials are not locally available, foreign currency is required and this almost always entails assistance from industrialized countries or international agencies which inevitably imposes delays and complicates what is essentially a simple process.

Where local repair facilities are available, such as for bicycles, tires, automobile engines, boats, etc., there can be

some assurance that simple waterworks facilities can be maintained. In the absence of such capacity, their provision may very well be a necessary element of a water project.

Water quality

Where water can be obtained from underground, either from protected free-flowing springs or from protected wells, it is likely to be of good sanitary quality, as passage through the ground removes bacteria. On the other hand, such waters may be high in iron or manganese which, while posing no threat to health, may be aesthetically unsatisfactory and thereby discouraging their use, forcing people to turn to contaminated sources that may provide water of satisfactory physical quality.

Some groundwaters may be high in fluorides, a problem common in Kenya. Either other sources need to be developed or treatment needs to be provided, both of which alternatives may complicate projects significantly.

Where surface waters are to be used, and these should be developed only if adequate supplies of good quality groundwater are not available, then some treatment is almost always mandatory. The minimum treatment is disinfection, generally with some form of chlorine, but disinfection alone is not likely to be adequate if the water is turbid; then, some form of filtration may be necessary.

These water quality considerations add substantially to the number of options from which planners are obliged to select.

Technical assistance

Water supply projects vary substantially in complexity. Some require technical assistance, such as for calculations of pipe size, system layout, pump and motor selection, treatment, and estimates of cost. Thus the availability of a central or regional office with technical expertise available to the community will be a determinant in the planning of the community water supply. It may well be that, in the absence of such resources,

the first stages of project planning and implementation will be the establishment of such technical resources.

Training and personnel development

Regardless of the nature of the system or systems to be provided, personnel will need to be educated and trained in the planning, design, construction, operation, maintenance, and management of the facilities. Often the lead time for training is greater than the lead time for construction. The availability of training resources will determine the level of effort necessary to assure the availability of personnel. In some settings, engineering schools, medical schools and public health schools may serve as a base for development of the higher level of personnel required and vocational and technical schools may be available for training of skilled labor. In the absence of such resources, projects need to be approached quite differently.

Financing

Among the greatest variables are the methods of financing. The more costly the project the more varied are the possibilities for financing. The most complex are those that draw upon several sources, such as from international agencies, bilateral agencies, and/or private voluntary organizations. Each of these impose constraints. Most important amongst sources of financing are contributions, often in labor or other local resources, from the community to be served. The success of a project, particularly its long-term operation and maintenance, is a function of the level of local commitment, including local financing. The method of charging selected may well be a function of earlier experiences in financing such facilities in that locality.

Summary

From the wide range of variables that must be considered in any water supply project, it can be appreciated that no two projects are likely to be identical, although the lessons from

one way well be applicable to another. What can be said to be a common characteristic of all such projects is that, because of the importance of institutional support locally and nationally, considerable time is required to assure that a project once initiated with foreign intervention will be self-sustaining. The Malawi program is a good example. More than a decade of patient effort was required to achieve a program that could sustain itself. Force-feeding may satisfy those who seek instant pay-offs for political purposes, but such efforts almost always become monuments to failure. More important than counting the numbers served, or the number of standposts, or kilometers of pipe, is the nature of the supporting institutions that can serve to operate, maintain and extend the system. Will the program continue when foreign inputs are ended?

PLANNING SESSION

Planning for Water Supply and Sanitation

The purpose to be served by this document is the provision of a concise guide for the preparation of a plan for a rural or peri-urban water and sanitation project. The "guide" is presented as a checklist with a brief text which also contains figures, flow charts, tables and other materials which graphically demonstrate the content, sequencing and interrelationships of the planning process for water supply planning. Sources are listed at the end.

I Planning

The document is based on planning for a village water supply based upon the cycle of planning methods to develop design criteria and standards to be implemented at the site and with the iteration of the planning cycle following data collection and evaluation.

Figure 1 is a schematic representation of the cycle of planning activities for water supply and sanitation. Identification refers to the choice of the village and the appropriate project. This document is directed to the planning of local water supply and sanitation projects with particular reference to the phases represented by choice of the village, design of the project, construction, operation and maintenance, and evaluation and monitoring. The phases represented by the macroplan and sector planning take place at the national level and are concerned with policy formulation, financing, resource allocation and national planning.

Planning takes place at several jurisdictional, geographical, and administrative levels. The site of the planning activity determines the specific components of the plan dealt with at that level. For example, the national planning agency will be involved with resource allocation and donor support; the region with the establishment of allocation priorities;

Figure 1.

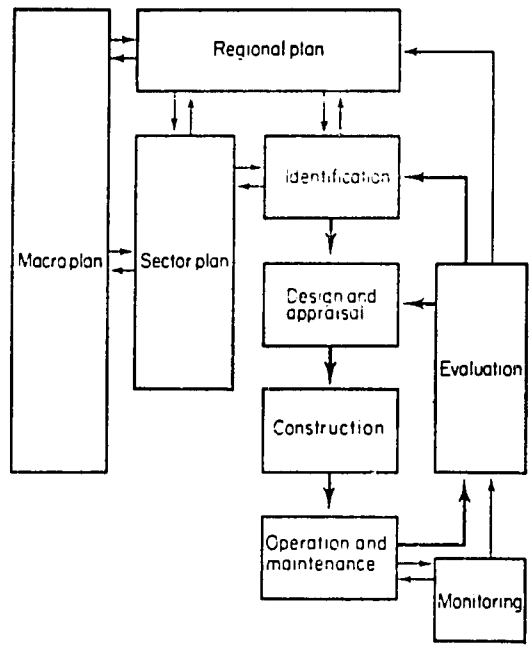


Figure 1 Schematic representation of planning activities

Source: 3

the village with project implementation; the village population may be involved in community participation and health education; while the family and individual must be considered in questions of preferences and human factors design. Table 1 provides a listing of the functions carried out at the various levels of a rural water program.

The components of the planning process involve different skills and reflect a variety of viewpoints which must be considered. For water supply program planning, the disciplinary components may be the sanitary engineer, the public health specialist (medical and environmental), the economist, the behavioral scientist (though rarer in practice), and the village population. Figure 2 illustrates the interrelations of these actions and decisions.

Water Supply and Sanitation Objectives

Planning is directed to the development of objectives, their translation into design criteria and standards, and their accomplishment in accordance with performance criteria of efficiency, adequacy, and other performance requirements. The basic benefits of an improved water supply include: (a) improvements in water quality, quantity, availability, and reliability; (b) savings in time and energy; (c) improvements in convenience and health; and (d) stimulation and facilitation of use of complementary inputs. Water supply is preceded and followed by complementary objectives that may determine the operation, utilization and effectiveness of the water. These complementary inputs include sanitation practices and facilities, community participation, training, operation and maintenance.

The water supply and sanitation objectives stated above are directed to designs of the water supply and supportive facilities with an objective of amenity, convenience and health improvement. It is prudent to accept the health improvement objective on the basis of observations, practice and historical evidence. Attempts at experimental justifi-

Table 1.

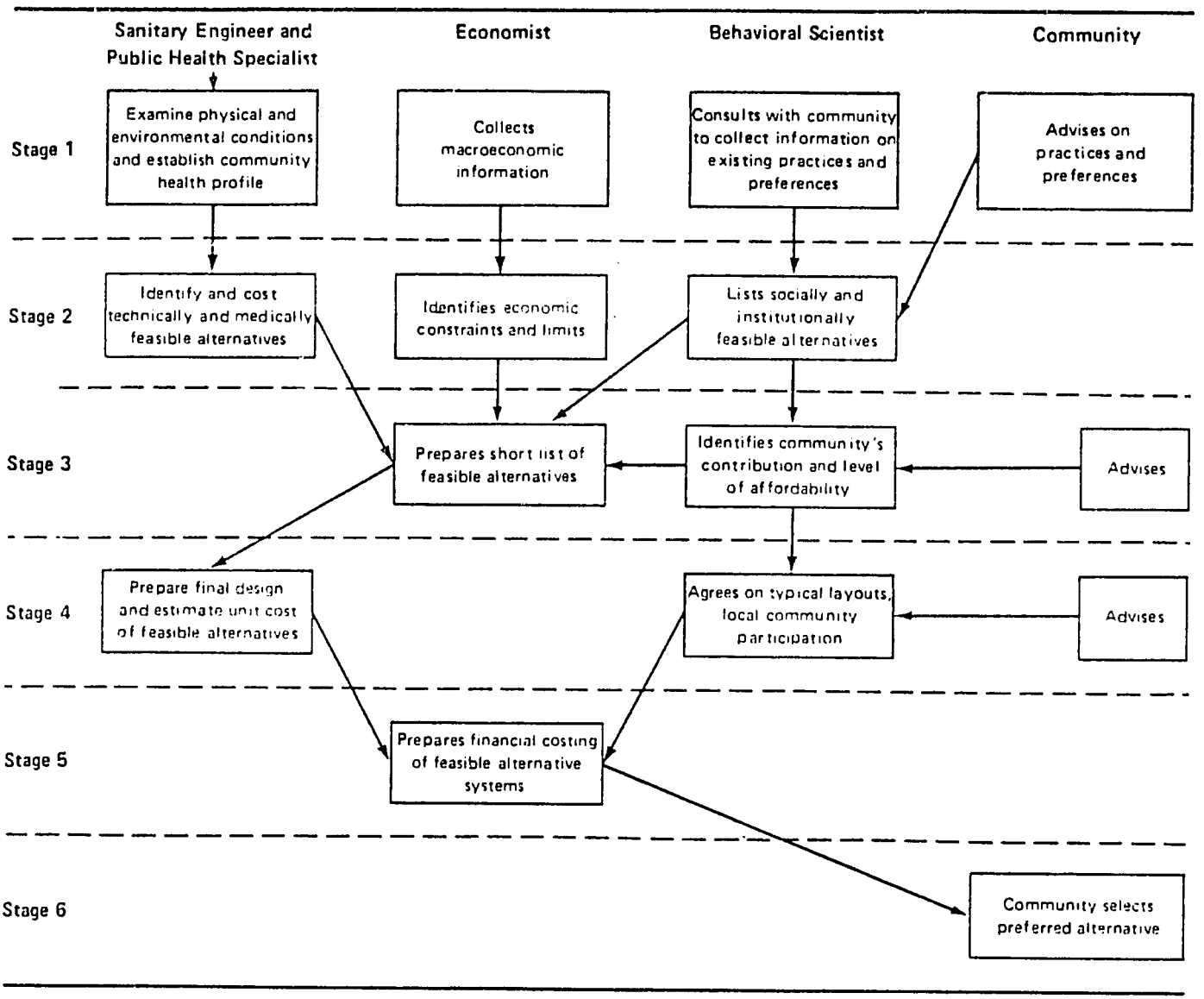
Tatle 11.3 Functions of various levels of a typical rural water programme

National	Provide a financing channel for national counterpart funds, international loans, national grants and local contributions Develop norms and policies (technical and administrative) Supervise execution of national plan Conduct long-range planning Coordinate construction efforts Supervise regional programmes Exercise overall financial control Provide technical and administrative assistance Provide training
Regional	Supervise programme execution Carry out design (in case of larger countries only) Supervise construction, operation and administration of projects Undertake community promotion and supervision of projects
Local	Administration of system Operation of system Maintenance of system Collection of water rates

Source: 2

Figure 2.

Figure 1–1. Recommended Structure of Feasibility Studies for Sanitation Program Planning



Source: 4

cation for a particular water supply are beyond the purview of planning and evaluation. Indeed, recent large-scale experiments to establish and measure the health objectives have been disappointing because of inherent methodological and experimental difficulties. For a given project, the justification of a project should rest on terms of entitlement to a basis water supply.

CHECKLIST FOR PLANNING

I. Problem Definition

a) National and regional perspectives

b) Community perspectives

II. Objectives

1. Health Objectives

a) decrease medical expenditures

b) lessen the debilitating effects of childhood infection (morbidity, decreased growth)

c) lessen possible consequences of diminished learning potential and development

d) increased coverage of populations with preventive health service.

2. Convenience and Other Objectives

a) improve the quality, quantity, availability and reliability of the water supply

b) decrease water carriage and promote the saving in time and energy for women

c) increasing the water supply to facilitate water use for bathing, laundry, food preparation, utensil washing and improved personal hygiene practices.

3. Improvements in Productivity

a) stimulate economic growth

b) improve village life

c) promote food and agricultural development.

4. Stimulate Community Organization

a) Provide base for other efforts

b) contribute to long range development of self-reliance.

III. Planning Information Requirements

1. Resources

a) site including climate, topography, geology (soil stability), hydrology (seasonal variations), flooding situation

b) materials and their transport including local availability of materials for environmental improvements

c) population including census (numbers and distribution), house mapping, house construction, income levels, educational levels, literacy, health status (morbidity, mortality, and profile of main diseases).

d) community profile including occupations, inventory of special technical and managerial skills, training resources, listing of available services and facilities (roads, power, communications, transportation, health posts)

e) environmental sanitation including state of the existing water supply, excreta disposal, solid waste handling, animal wastes, storm drainage and completion of an environmental sanitation survey.

2. Socio-cultural Factors

a) perceptions of the present situation, history of previous projects for environmental improvement

b) attitudes toward change, attitudes toward sharing of facilities, levels of modernity (exploration of socio-cultural variables will depend on the availability of trained surveyors)

c) patterns of water use including types and levels of service, facilities and preferences for their location

d) knowledge of personal hygiene practices including attitudes toward technology choices, religious and cultural beliefs, acceptance of hygienic practices.

3. Institutional and Decision-Making Factors

a) organizations involved in the planning process, including communities

b) national and/or regional organizations involved in policy, leadership and commitments

c) community organization including local cooperative or village betterment committees, patterns of community interaction, effectiveness of local and regional institutions in providing services for water, sewerage, sanitation, health and education

d) donor agencies (with emphasis on AID)

e) training infrastructure

f) manufacturing infrastructure including potential for local manufacture

g) institutional capacity for maintenance.

IV. Financing

1. History of previous projects and assessment of willingness to pay including reasons for payment or non-payment.

2. Ability to pay including experience with present water supply, record of payment, present rates and rate structure and records of use of the water supply.

3. Alternate payment schemes including payment in funds or in kind for planning, construction, operation, maintenance, and management.

4. Financial management including payments from users, from regional and national subsidies and international donors.

5. Availability of national and donor funds for capital investment and operation and maintenance.

V. Design Criteria for Water Supply and Sanitation Systems (Implementation Plan)

1. Design objectives including simplicity, acceptability to the recipients and self-help potential. Design objectives should favor the use of indigenous rather

than imported materials and equipment, favor ease of operation and maintenance and establish a balance between availability and low cost designs.

2. Design guidelines (for the achievement of objectives)

a) decision for the level (type, convenience and availability) of water supply and sanitation services to be provided to the community

b) decision for the engineering design which is optimal for the level of service chosen.

3. Level of service guidelines (for water system design)

a) daily amount of water per capita for the systems design

b) water supply delivery points including choices of house connections, piping into the yard, standposts

c) water quality considerations

4. Level of service (for excreta disposal)

a) concordance with personal habits and cultural patterns

b) affordability

c) hierarchy of technical designs including pit-privy, septic tank, aqua privy, sewerage system

d) household latrine and/or community latrine including institutional facilities at schools, markets, public building

5. Evaluation methods and criteria

PLANNING CRITIQUE SHEET

MAJOR PLANNING AREAS	BURUNDI	PARTICIPANTS' COUNTRY
1. OBJECTIVES . HEALTH . CONVENIENCE, SOCIAL . PRODUCTIVITY . COMMUNITY		
2. TYPES OF INFORMATION . RESOURCES . SOCIO-CULTURAL CONDITIONS . INSTITUTIONAL DECISION-MAKING FACTORS		
3. FINANCING . ABILITY TO PAY . HISTORY and WILLINGNESS . PAYMENT SCHEMES . FINANCIAL MANAGEMENT		
4. DESIGN CRITERIA . WATER SUPPLY SYSTEM . SANITATION SYSTEM		

MAJOR PLANNING AREAS	BURUNDI	ADVANTAGES and DISADVANTAGES
1. OBJECTIVES . HEALTH . CONVENIENCE, SOCIAL . PRODUCTIVITY . COMMUNITY	Providing health centers with water to improve health care delivery. Provide population with clean, convenient reliable water supply.	ADVANTAGE: COMMUNITY PARTICIPATION OBJECTIVES IN THE DECISION, OPERATION, AND MAINTENANCE OF THE WATER SUPPLY SYSTEMS.
2. TYPES OF INFORMATION . RESOURCES . SOCIO-CULTURAL CONDITIONS . INSTITUTIONAL DECISION-MAKING FACTORS	Past government reports were used and some sites were visited. Program was autonomous from central government but integrated with local governments.	ADVANTAGE: INSTITUTIONAL AND DECISION-MAKING FACTORS WELL SURVEYED. DISADVANTAGE: INFORMATION REQUIREMENTS NOT MET ESPECIALLY IN REGARD TO SOCIO-CULTURAL FACTORS SUCH AS ATTITUDES TOWARD CHANGE AND KNOWLEDGE OF PERSONNAL HYGIENE PRACTICES.
3. FINANCING . ABILITY TO PAY . HISTORY and WILLINGNESS . PAYMENT SCHEMES . FINANCIAL MANAGEMENT	Planned integration with other community development projects. Several donor funds available for materials. Water technicians were payed by local districts. Local community supplied labor.	ADVANTAGE: GOOD FINANCING PLANS TAKING INTO ACCOUNT ALSO THE PAYMENT OF OPERATION AND MAINTENANCE.
4. DESIGN CRITERIA . WATER SUPPLY SYSTEM . SANITATION SYSTEM	Spring capping is simple and inexpensive. Easy maintenance. Spring must have adequate flow, be situated near population and be presently in use by the population.	ADVANTAGE: AVAILABILITY, RELIABILITY, AND SIMPLICITY ARE INCLUDED IN THE DESIGN CRITERIA. DISADVANTAGE: LACK OF LAUNDRY AND BATHING FACILITIES. SANITATION PROGRAM NOT COORDINATED WITH THIS PROJECT

PLANNING CRITIQUE SHEET

PLANNING WORKSHEET

Identification of Problem and Possible Solutions

1. Major Planning Area (Circle one or more)
   - Objectives
     (Health, convenience, social, productivity, community)
   - Types of Information
     (Resources, socio-cultural conditions, institutional decision-making factors)
   - Financing
     (Ability to pay, history and willingness, payment schemes, financial management)
   - Design Criteria
     (Water supply system, sanitation system)

2. Describe the planning problem (potential or actually experienced).

3. What are the underlying causes of the problem?

4. Outline possible solutions; include idealistic and realistic approaches.

5. List any resources that could be called upon for assistance, e.g. national and international organizations (public or private), Key individuals. Briefly describe the type of assistance needed.

PLANNING CASE STUDY

CASE STUDY OF A UNICEF WATER SUPPLY PROJECT IN BURUNDI

Burundi is a country with ample water resources. The problem is that much of the population does not have access to safe water. The population is dispersed in rural areas throughout the hills of the country. Water for domestic use is collected from numerous small springs. The topography, limited financial resources and the absence of nucleated villages make large centralized water systems generally impractical, but does permit gravity systems that would not be feasible in flat terrain.

Over the past 20 years the Fond du Bien-Etre Indigene (FBI) and its successor, l'Association Internationale de Developement Rural (AIDR) capped 9293 springs of which 4300 have fallen into various states of disrepair and no longer provide a safe water supply to the villagers. In 1977 it was reported there were 136 dispensaries and health centers located throughout the country of which 48% were not supplied with water and some of the other centers only receive water intermittently.

The health centers and dispensaries are administered either by the Public Health Ministry or the Catholic and Protestant missions. They are usually part of a larger social complex consisting of schools, markets, and government offices.

Government Infrastructure

Administratively, Burundi is divided into 8 provinces, 17 districts (arondissements), and 80communes. Each commune is governed by a commune administrator of the Ministry of Interior.

In Burundi the Corporation for the Supply of Water and Electricity, a semi-autonomous corporation, is responsible for the water supply system of the two largest cities. With German technical assistance, the corporation is working on a renovation program of water supplies for secondary cities.

The second organization involved in water supply is the Department d'Hydrauliques Rurales et Electrification (DHRE) (Rural Water and Electricity Department) of the Ministere de Development Rural (Ministry of Rural Development). The Department is responsible for maintenance of existing rural water systems and construction of new systems, particularly the supply of water to new villages formed as a result of the government resettlement program. The Department is assisted by Belgian bilateral aid which provides two expatriate engineers (one in water supply and the other in electricity supply) and a modest budget for equipment and logistical support.

The World Bank, Fonds European du Developement and Belgian

Aid have provided assistance to DHRE for rural gravity and pumped water supply systems along with wells with handpumps in areas where no springs exist.

The Ministry of Interior also plays an important role in water development at a communal level. The commune administrator is responsible for local self-help projects such as spring capping.

Initial Field Study

With the cholera epidemic in Burundi in 1977, the Ministry of Health was increasingly concerned about the lack of adequate water supplies at health centers and dispensaries throughout the country. At the request of the Ministry, UNICEF in 1977 developed a plan to provide simple water systems to health centers. It became obvious that water developed for health centers could, if there were adequate water supply, provide additional collateral standposts for use by villagers and community centers. Gravity spring-fed distribution systems were recommended for the health centers. For the health centers and dispensaries which could not readily be served by springs, roof catchment systems were considered. Throughout most of the country there is adequate rainfall for this purpose. In some cases relocation of health centers was recommended.

During the field study, UNICEF saw also a need to protect the water supplies of the general population from fecal contamination. In the report, UNICEF included a plan to cap or recap 4300 springs.

In other areas of the country where springs do not exist, wells are used but not as part of this project. The average costs of simple water supply options are listed below.

TABLE 1. Costs of UNICEF Water Systems (in U.S. dollars)

Systems	Unit Cost	$/capita
Spring capping	200-400	2-10
Wells	11,000	50-100
Spring-fed distribution systems	35,000	50-200 (highly variable)
Cisters/roof catchment		
a. roof improvement	13,000	50-350
b. gutters and cistern only	314	3

Project Investment Planning

The total planned cost of the UNICEF project was estimated in 1977 at 4.2 million dollars and was allocated as follows:

Capping 4300 springs	$1,581,000
Providing water to health centers	
-40 new gravity spring-fed schemes (170 km. total)	1,516,000
-Repair 20 existing gravity schemes (84 km. total)	727,000
-25 rooftop catchment systems	314,000
Total	$4,165,000

To date 1.5 million dollars have been made available from three donor agencies: UNICEF, the Canadian International Development Agency, and the United Nations Development Fund (UNCDF). The Government of Burundi has provided 207 thousand dollars or 12.2% of the project funds. It is expected that UNICEF and GRB funding will continue at roughly the same levels for the remaining three years of the project. Assuming these levels and no additional donor funds, the net shortfall is roughly $1.5 million. In actuality some additional donor funding may be made available. The World Bank Kirimiro project may, for example, provide $200,000 and the Finnish International Development Agency (FID) a similar amount. AID has been requested to provide $500,000 during FY1982, which would enable the project to accelerate its rate of completion of spring captations and gravity systems.

The UNICEF project is also being coordinated with several other rural development projects funded by the World Bank, religious missions, the International Labor Organization, and Action Aid, a British charitable organization. In addition various local cooperatives provide materials and manpower for water improvement projects. UNICEF provides technical expertise and training in water supply improvement to most of these independent rural development projects.

In most cases the project also provides the imported materials, i.e. cement, reinforcement bars, plumbing fixtures, and pipe. The communities are responsible for providing the labor and local materials (sand, gravel, wood and clay). In the first year of the project, UNICEF pays the salary of the water supply technicians. Afterwards the local communes pay the salaries.

The project was planned to maximize local participation in the design, operation and maintenance of the water improvement systems. Through this effort it is hoped the villagers and local authorities will understand, appreciate and maintain an improved water supply.

Spring Capping

The spring capping program utilizes by far the fewest resources per capita served. It requires the shortest time period for completion of a system (3 to 4 weeks), and requires only basic technical skills, minimal maintenance and maximum user participation.

Although the feasibility study called for dispensary gravity flow systems as first priority, small community spring cappings, it soon became apparent, offered distinct advantages as initial project undertakings. First of all, the per unit cost is much less than that of a gravity scheme. When it became obvious that the promised Canadian donor funding of the project was going to amount to only a single grant of $361,000 and that the rest of the financial support of the project would have to come from UNICEF program funds, it was decided that the lower cost, more quickly realized spring capping approach would probably bear more fruit in the beginning than investment in only a few more costly gravity schemes. In fact, it has been possible with the meager funds available to keep the communal water spring technicians (fontaniers) supplied, supervised and occupied, to the extent of more than 650 springs spread across all eight provinces.

Secondly, these small spring cappings provide an avenue for local participation that the larger gravity schemes do not. For each capping the project must depend upon local officials of both the administration and the Party to help mobilize the people to provide materials, labor and long term maintenance. Because of Party discipline in enforcing the Saturday public work day and other aspects of the program, local cooperation is usually assured.

Once a request for spring capping has been made and approved by the communal administrator and the technical criteria have been met, the water supply technician surveys the site. The planned excavation is staked out and the standard materials necessary to complete the spring capping are requested from UNICEF.

Spring capping for water use on site involves building a simple water collection system (in appendix) with a pipe leading out with a continuous flow of water for use by villagers. In some cases, clothes washing areas are constructed below the spring.

To protect the spring, the collection structure should be located to force surface waters to pass through at least 3 meters of soil before reaching the ground water. Human habitations should not be located within 100-300 feet above the collection pipe. Special attention is given to latrines located in the vicinity of the spring and a diversion ditch should be dug above and around the collection pipe to divert potentially polluted surface runoff. Adequate drainage should be provided below the spring outlet so contaminated water does not collect. Active village participation is important in keeping these sites clean and safe.

Design Criteria for Spring Capping

UNICEF estimates capping 4300 springs will serve 10-20% of the population. In planning which springs should be capped or repaired, certain criteria must be fulfilled.

- The population must take water regularly from the particular spring and must have requested the capping;
- The spring should be situated near a center of social activity;
- The minimum flow (measured) must be at least 0.05 liters per second and must cover the needs of the population;
- The spring should run continuously through the dry season;
- Spring capping must be technically feasible.

Cost of Spring Capping Project

The cost of the capping and repairing of 43000 springs was estimated by UNICEF in 1977 and is listed below. The staff salary is the total for the 3.5 year project period.

Item	Cost	% Total
2 expatriate experts	$ 322,000	20.4
Local project personnel includes: 3 trainers, 8 community organizers, 93 water supply technicians	282,438	17.9
Transport	157,024	9.9
PVC piping and plastic sheeting and accessories	325,788	18.3
Steel pipe	10,291	0.7
Cement	422,753	26.7
Reinforcement bar	715	--
Tools	19,112	0.6
Miscellaneous	12,079	0.8
Adjustment for inflation and lost materials	74,513	4.7
TOTAL	$1,581,100	100%

Health Center Water Supply Systems

Because of lack of funding, the construction of water systems for health centers is just now getting underway and therefore is not discussed in this report. A description of these systems and the design criteria are given in the appendix.

IMPLEMENTATION

The implementation of the project is in four phases:

1) Recruitment and training of personnel;
2) Sensitizing the public to realizing their health and water supply needs;
3) Technical site surveys and design of water systems;
4) Construction and maintenance of the water supply improvements.

The UNICEF project commenced in 1978 with the arrival of Claude Masser, the project director, who was formerly with AIDR in Rwanda where over 5,000 springs have been capped with the same design to be used in Burundi. The project also hired a host country associate director.

Training

The selection and training of personnel became the first priority of the project. Three local trainers were hired to train the water supply technicians (fontaniers). Eventually one trained water supply technician will be placed in each of the 80 communes and one for every district (arondissement). The candidates for training were chosen by the local authorities on the basis of their perceived competence and respect by the population.

The training takes place in four-week seminars. The training period consists of one week of theory and three weeks of practice in which the principles of capping the spring, laying the pipe, making maximum use of the slope, and doing masonry work are taught in field situations. Some training in communications skills and group work is also included, but is minimal. The training minimizes the theoretical and emphasizes hands on, job specific skills. To date, eighty technicians have been trained, of whom 75 remain on the job. Thus there is one for almost every commune.

The project is also training community organizers (animatrices sociale) who in addition to the technical skills of the water supply technicians are given training in communication skills and public organizing. The project hopes to have one community organizer for each of the eight provinces in Burundi.

Participation of the Population

The UNICEF project is based on participation of the local leaders and general population in requesting development assistance, providing the labor for the spring improvement and maintaining the capped spring. Mobilization has its base in the felt need of most populaiton groups for fresh accessible water. With increased health education, a populaiton begins also to require a clean and safe water supply.

Many requests for spring improvement are made by the people to the communal administrator. Once a water supply technician (fontanier) becomes installed in an area, these requests multiply. After reviewing the request, the administrator canvases the local leaders to develop the objectives of the project. The responsibilities of the local villagers are determined in carrying out the work and supplying the local materials, i.e. sand, gravel, wood, and clay. The water supply technician then designs the spring improvement to meet the villagers' need and orders the cement and pipe from the national UNICEF project headquarters. The water supply technician coordinates the work of the villagers who have been mobilized by the project community organizer and commune authorities.

Mobilization efforts are coordinated at meetings held three times a year and attended by the communal administrator and all authorities (administrative and political party) from every level. At these meetings spring cappings are discussed, priorities determined and instructions are formulated and passed on to those responsible.

Political Party Involvement

The national political party, UPRONA, is vital to the popular mobilization at the local level. UPRONA is well organized at the communal and sub-communal level. The existing structure of the party facilitates organizing work teams for the project on a neighborhood level. The president of the party who is also the president of Burundi demonstrated his support for the project by personally inaugurating the first spring capped.

Supply and Transport

The normal source of commodities for the project has been Kenya. Kenya produces cement and PVC materials and fabricates steel pipes. The UNICEF office in Nairobi has been responsible for procurement and transport arrangements overland through Uganda and Rwanda. Commodities are warehoused in Bujumbura and transported to the field by a project truck. Commodity deliveries are based on monthly reports mailed by each community administrator. These reports simply state the number of springs completed during the previous month and material requirements for the next month. Based on these requests, an efficient delivery schedule is developed. The order forms used are extremely simple, written in the native language with pictures of the items to be ordered so that they can be filled out by someone having limited reading and writing skills. A sample order form is included in the appendix. Standard spring designs are used which helps minimize blatant commodity abuse. It would be evident if inadequate quantities of cement were used on the project and diverted for other purposes.

With the political unrest in Uganda, a major problem with the supply system has arisen between the source and Bujumbura. For a period of several months the project was without cement and the completion rate for springs was seriously affected. In 1980, a total of 480 springs were completed, while for the first six months of 1981, only 129. Eventually this drop in completion rate is likely to seriously effect the credibility of the project, the morale of the employees and general interest of the population. The project is investigating alternative sources of supply. One such alternative is trucking goods from Zimbabwe to the Zambian port on Lake Tanganyika, and from there by ship to Bujumbura, but this route is much longer.

EVALUATION

In order to evaluate the project, the benefits of the project must be determined. Unfortunately, many of the potential benefits are difficult to measure such as improved health or change in social behavior. Incidence of disease in a population is not solely related to water supply. There are several other factors also affecting health, including the cleanliness of the water vessels, personal hygiene, nutrition, and occupation. It is difficult, therefore, to relate such indirect evaluation criteria as disease incidence to the project.

In order to correlate improved water supply with health in Burundi, an epidemiological study would have to be conducted. These studies tend to be time consuming, costly, and in many cases inconclusive. A study of this magnitude would be beyond the scope of the project. It is therefore more useful to pick evaluation criteria which can be easily observed or measured. The evaluation criteria for the UNICEF project could include such areas as: convenience of the water supply; change in quantity of water used; quality of water supply; estimates of population affected; cost effectiveness of project; materials wasted or abused; willingness of government to take over leadership role in the project and commit financial resources; local populations' activities in organizing and continuing construction of improved water supply; improved health practices of the population affected by water supply project.

The project needs to develop systematic methods of self-evaluation carried out by the staff to evaluate these criteria.

In September 1981 a WASH field team evaluated the project for potential AID funding. The team formulated questions to ask of the participants in the project. The sources of information were divided into nine categories.

1. The Project Director: questions about project management, supplies, personnel, training.
2. Project Moniteurs (instructors): questions about local participation, the roles of the fontaniers,

maintenance, and some about social/behavioral outcomes.

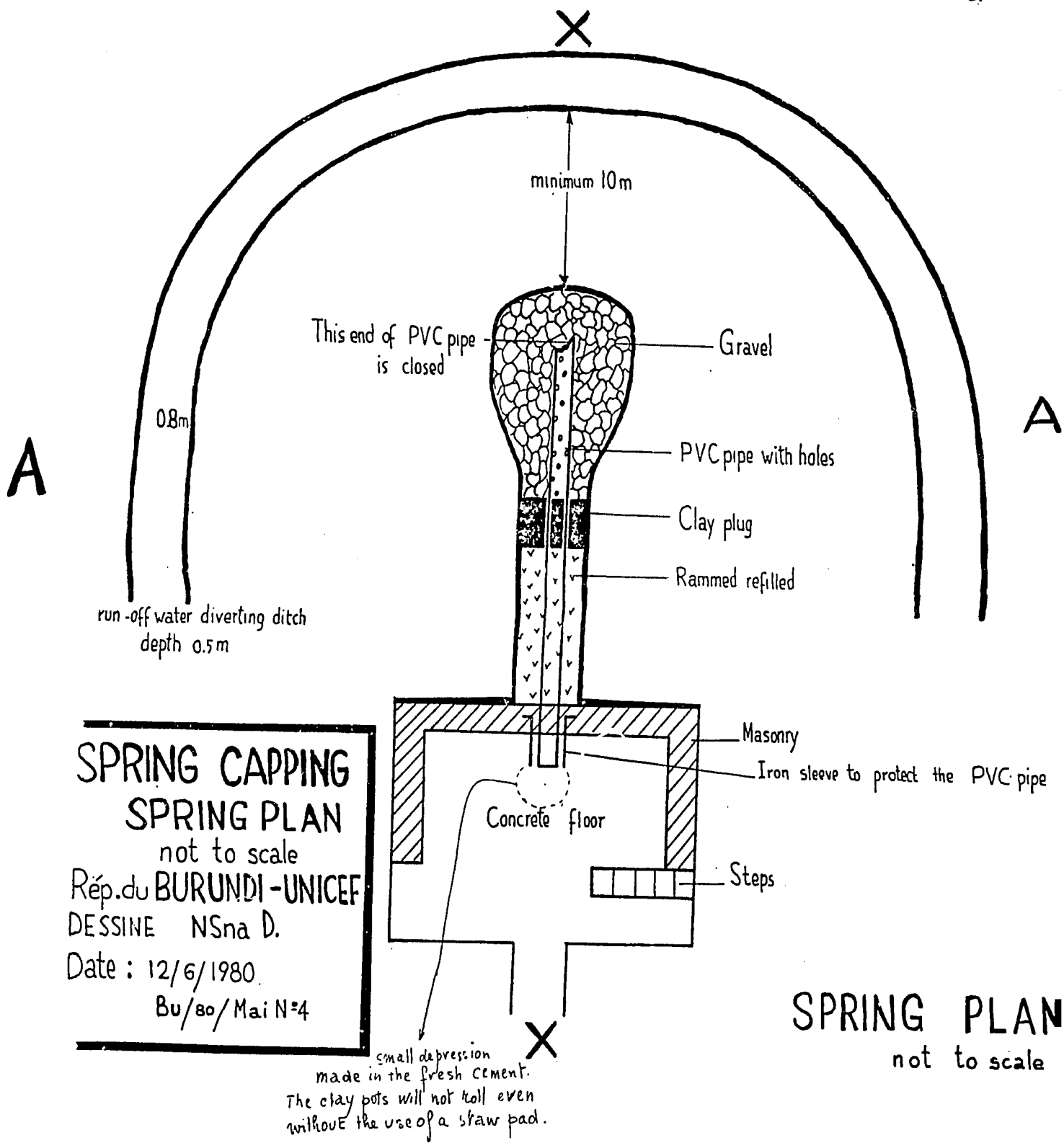
3. Fontaniers: questions about their roles, local participation, local materials, roles of local officials, and maintenance.
4. Local officials: questions about local participation, local materials, requests for water, water use, and sanitation related beliefs and behavior.
5. Ministry officials: project management questions.
6. Officials of other donors: questions on complementary activities, questions about local participation, overall questions on the Burundi water and sanitation sector.
7. Missionaries: questions about local participation and social/behavioral aspects.
8. Project documentation - all questions.
9. Relevant documentation from other projects provide complementary information.

Recommendation

The evaluation team found several areas where the UNICEF project could be expanded or improved.

1) Provide health education skills to community organizers (animatrices) applicable to water and sanitation.
2) Coordinate health education and sanitation programmes with the project.
3) Provide areas for laundry and bathing of the spring sites.
4) Develop management in rural water development for commune administrators.
5) Increase technical, communication and problem solving skills of water supply technicians.
6) Institutionalize the program in the Ministry of Rural Development.

UNICEF BURUNDI : SPRING CAPPING

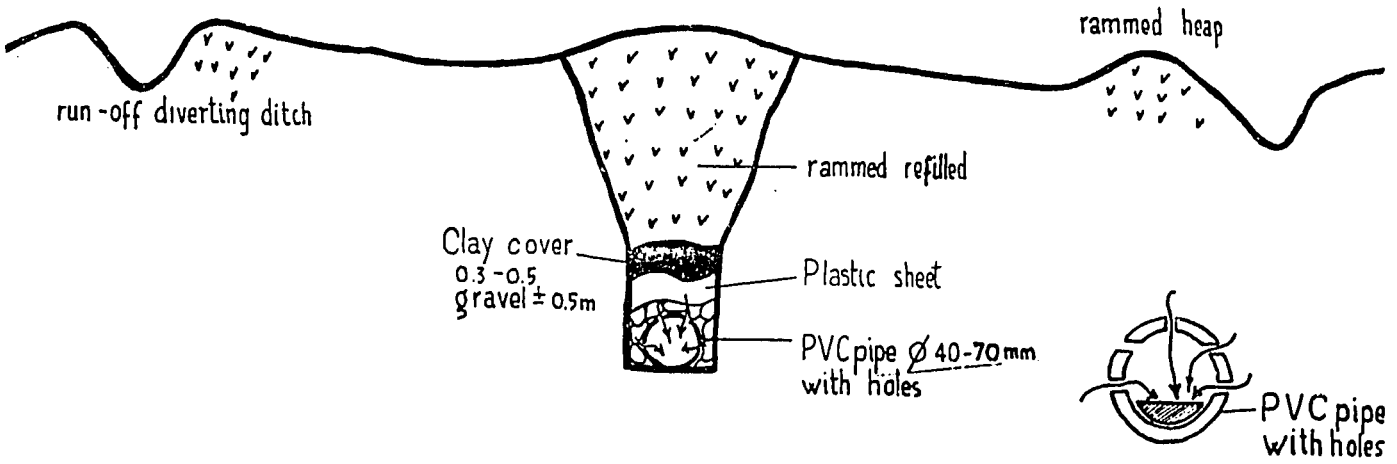


SPRING CAPPING
SPRING PLAN
not to scale
Rép.du BURUNDI-UNICEF
DESSINE NSna D.
Date : 12/6/1980
Bu/80/Mai N°4

SPRING PLAN
not to scale

SECTION A-A

not to scale



SECTION X-X

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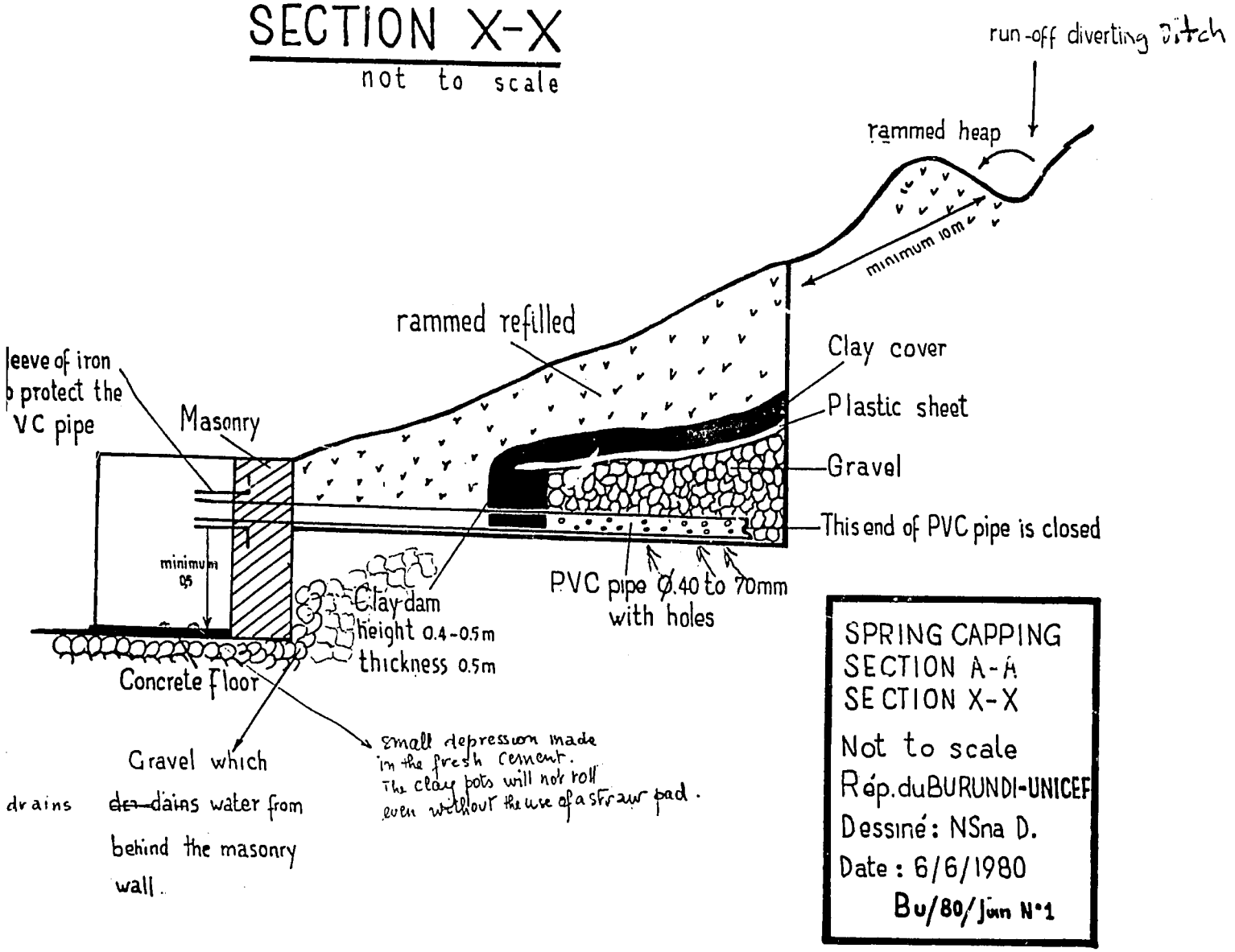

SPRING CAPPING
SECTION A-A
SECTION X-X

Not to scale

Rép. du BURUNDI-UNICEF

Dessiné: NSna D.

Date: 6/6/1980

Bu/80/Jun N°1

UNICEF - LETA Y'UBURUNDI

UNICEF - GOUVERNEMENT DU BURUNDI

Poroje yubaka amasoko ya rusengo mu gihugu hagati

Projet d'aménagement des sources et Alimentation en eau des Dispensai

Ruraux.

Nom du fontainier:

Izina ry'umukozi :

Province :

Provensi :

Commune :

Komine :

Equipement du fontainier

Ibikoresho vyo kubaka amasoko ya rusengo

OBJET	IBIKORESHO	DESSIN ISHUSHANYO	NOMBRE IGITIGIRE	DATE IBARIZO	SIGNATURE UMUKONO
Truelle	Umwikb				
Niveau	Inivo				
Mètre	Imetero				
Scie à métaux + lame	Umusumeno				
Pelle	Isipawa				
Pic	Isipiri				
Houe	Isuka				
Marteau	Inyundo				
Corde de niveau	Umugozi				

OBJETS	IBIKORESHO	DESSIN ISHUSHANYO	NOMBRE IGITIGIPI	DATE ITARIKI	SIGNATURE
Machette	Umupanga				
Bottes	Ibirato				
Barre à mine	Umutarimbo				

Signature du magasinier

Umukono w'uwashinzwe ivyo bikoresho

- Si le Fontainier cesse d'exercer ses fonctions, le matériel doit être remis à ses successeur en présence d'un témoin.

- Iyo umukozi ahejejo akazi kazarunga, ivyo bikoresho ahwiyo kuca abiha umusubirizi mûne bariho n'icabona.

Pour la remise

Pour la reprise

Témoin :

Nom :

Remarques:

Grade:

Spring-Fed Distribution System

The water for the spring-fed distribution system is collected as it emerges from the spring and diverted into a drainage canal which is half filled with gravel and covered with packed clay. At the bottom of the canal is a perforated PVC pipe. Spring water drains into the PVC pipe and is fed into a system of either PVC pipe or steel pipe which gravity feeds the water into storage cisterns From the cisterns the water is distributed by standposts, faucets which lead to the dispensary, or school fountains which can be turned on for students before and after classes. In a gravity system the only moving parts which are subject to wear are the faucets which will have to be replaced periodically. Criteria must be met before siting a spring-fed distribution system.

Criteria for Distribution System

- The health center must be located at an altitude lower than the spring so it can be gravity fed and forego the need for pumps;
- The spring should have an adequate annual flow to serve the needs of the users. The water demand must be calculated for each site.
- The spring must be within 5 kilometers of the center to be served, otherwise the capital cost of piping becomes prohibitive.

Design Study

The survey and design of these distribution systems are conducted by the central office or contracted engineer. During the UNICEF feasibility study 53 sites were visited and the cost of water supply systems were estimated. An illustrative example is provided of a proposed water system for Musenyi Dispensary and Catholic Mission. This will help show how water demand and costs can be estimated.

EXAMPLE 1

Musenyi Spring-Fed Distribution System
Date of Site Visit: 06/16/1977
Distance from Capital: 160 km

WATER NEEDS	No.	Unit demand m^3/unit	Daily Water Demand m^3/day
Patients	45	0.005/patient	0.225
Dispensary Beds	8	0.1/bed	0.8
Leprosy consultation one/week	43	0.005/patient	0.22
Family of Personnel	1	0.15/family	0.15
Mission Health Center			
-- Mother infant cons. 2/week	50	0.005/consultation	0.25
-- Prenatal consultation 2/week	40	0.005/consultation	0.20
--Nutrition consultation	30	0.005/consultation	0.15
-- Personnel: Nuns	4	0.15/person	0.60
-- Mission: monks, priests	14	0.15/person	2.1
-- Extension Agents	8	0.15/person	1.2
-- Primary school day students	500	0.005/student	2.5
-- Secondary school/ boarding students	300	0.1/student	30.0
-- Adult education	10	0.015/person	0.15
-- Cathicism	300	0.005/person	1.5
General Population	---	0.03/person	4
		TOTAL	44.97m^3/day

44.97 x 1.25 = 56.2 m^3 or 0.65 liters/sec.
The calculated demand is multiplied by a factor of 1.25 to allow for growth in the community.

Present Situation at Musenyi

The dispensary depends on water pumped from the mission. The mission pump is no longer in service. The pump was originally installed by FBI in 1964. The mission and dispensary are situated on top of a hill and the time needed to fetch water from the closest spring takes ½-hour.

Site Survey

When the pump was installed a survey for a gravity-fed system was done. There is another source on a hill located at an altitude 20 meters above the mission and distance from the mission of 4 km as the bird flys or 6 km by road. The hydraulic slope can be estimated at 20/4000 to 20/6000 = 0.005 to 0.0033. The total spring discharge was measured at 2.51 liters/sec in Quarzite. The spring water to be collected was estimated 0.8 liter/sec using 80 meter drainage canal. The water will arrive at the present mission reservoir or be distributed from one of the 3 m^3 cisterns to be constructed.

Estimated Cost of Water Supply System for Musenyi

	QUANTITY	UNIT PRICE $	TOTAL PRICE $
Survey & Design	6 km	506	$ 3,033
Transport (6 trips to capital)	1920 km	.56	1,079
Spring Water Collection			
-- Earth work	340 m^3	16.3	5,539
-- Collection Drain	80 m	20.2	1,618
-- Protection Ditch	120 m	5.6	674
Canalization			
-- Earth Work	3,000 m^3	6.9	20,562
-- PVC Pipe	6,000 m	5.1	30,337
Masonry			
-- Cistern 3 m^3	2	1404	2,805
-- Standpipes	3	290	843
-- River Crossing	1	562	562
		TOTAL	$67,393 or 11,2[illegible]

This example illustrates the importance of distance between the spring and the health center in determining the cost of the project. A second important factor in determining cost is the topography. This affects both the distance of piping and the amount of earth and rocks which must be displaced.

Thirteen sites were visited by Claude Masser in 1977. The costs for the spring fed systems ranged from $8,000 for a 0.6 km system, to $80,000 for a 7.5 kilometer system. The costs per kilometer were less variable, for the 13 sites, and ranged from $8,000/km to $14,000/km with the average for all the planned UNICEF projects of $8,900/km. For this reason distribution systems longer than 7 km are not encouraged.

Rain Catchment Systems

Health centers and dispensaries which cannot be served by gravity spring distribution systems because they are located on hilltops can be equipped with rain catchment systems. The water supply system consists of a tin roof, gutters, and a down-spout loading into a cistern. The cistern is covered to protect the water from insect breeding and pollution from animals. The cistern should also be able to be drained so it can be cleaned periodically. It is important that the cistern is large enough to store water into the dry season. The capacity of the cistern can be determined by the area of the roof, seasonal rainfall and the water demand.

The system is inexpensive if the roof is in an adequate state of repair and of sufficient area. If the dispensary needs to be reroofed the price increases greatly. The main criteria are:

- adequate tile or corrogated aluminum roofs of sufficient area to capture rainwater;
- adequate rainfall spread over most of the year.

There are 25 health centers and dispensaries which could use rain catchment systems. The average cost per meter squared of rain catchment is $89. At each center there is usually a minimum of 2 buildings (the dispensary and medical technician house). The minimum area of each roof is 77 m^2. The total cost for providing the 25 systems is estimated at:

$$2 \times 25 \times 77\ m^2 \times \$89/m^2 == \$342,000$$

IMPLEMENTATION SESSION

Implementation of Water Supply and Sanitation Projects

Design Criteria and Standards

These design criteria constitute the link between the broad decisions made during the planning stage and the specific actions of the implementation phase. Each of these stages (planning,design and implementation) constitute a decision area. The types of decisions and the sites of the decision (national, regional, local) differ as among these decision areas. However, there is a flow from area to area that influences and determines the subsequent decision.

As planning progresses to the implementation stage certain baseline considerations become important. These include stipulations for choices among goals, objectives and targets represented by:

a) Desired Benefits: (1) health improvement; (2) life quality and convenience benefit; (3) extension of sanitation services and utilization; (4) stimulation of economic growth; and (5) redistribution of income.

b) Desired Outcomes: (1) simplicity; (2) acceptability to the community; (3) stimulate self-help efforts; (4) ease of operation and maintenance; and (5) low-cost options.

c) Administrative Considerations: (1) training of operators; (2) community involvement.

d) Financial Assessment.

These design criteria are translated into design guidelines and standards which determine the construction of the water supply. The standards include:

1. the daily amount of water per capita for which the system is to be designed;
2. the location of water supply delivery points or stations with respect to users;
3. the safety of the water that is supplied;
4. the reliability of the system for meeting demands.

Community Participation

Human behavior plays an important role in the etiology and epidemiology of infectious diseases. However, any change in old habits will not be accepted readily; certainly not within a short period of time. This has led to the emphasis on awareness and self-reliance as key factors in health-related programs such as water supply and sanitation programs as important factors underlying change in behavior. These concepts themselves are parts of a wider concept of community participation.

Community participation can be defined as a process by which individuals and families assume responsibility for their own health and welfare and for those of their community, and develop the capacity to contribute to their own development and that of the community. A vital part of this process is health education which consists of planned attempts to change individual, group, and community behavior with the objectives of disease prevention and promotion of the health status in the community.

CHECKLIST FOR IMPLEMENTATION

I. Engineering Design

1. Water system

a) source including yield, protection from contamination, surface or groundwater source

b) pumping equipment including handpumps

c) treatment including type of treatment

d) storage and distribution equipment and facilities including storage tank, main and distribution system.

e) water points including number, type (standposts, house connections), drainage, meters, flow control devices

f) level of service including number and distribution of water points to individual standposts or handpumps, piped networks with standposts, house connections

g) provisions for system upgrading

2. Sanitation system

a) treatment technology providing for latrines, pour-flush toilets, double-vault composting toilets, aqua-privy, septic tanks, vault toilets and cartage, sewerage

b) soil conditions including soil permeability, groundwate level, rocks

c) household density including land space, proximity of water systems, gradients, urban/rural requirements

d) water requirements

e) construction requirements including costs, needs for complementary investments, self-help potential

f) physical environment including precipitation, ambient temperatures, land use patterns, flooding, water tables.

g) levels of sanitation services including individual or public latrines, septic tanks, water carriage system, sewerag systems,treatment

h) provisions for system upgrading.

3. Refuse collection and disposal

a) composition and quantity including source from domestic, commercial and industrial sources as well as special wastes (hospitals, construction, street cleaning, storm drains)

b) collection methods and equipment including collection points, transport, refuse dumps, transfer points, storage

c) treatment and disposal methods including dumps, sanitary landfill, incineration, composting

d) sanitation implication of treatment methods including air pollution, water pollution, odors, fly-breeding, rodents, fire.

II. Community Participation

1. Utilization of village committees for organization and orientation to objectives, reponsibilities and procedures, and mobilization of resources.

2. Survey of community attitudes beliefs and motivation assessment of the perception of needs, identification of village communication patterns.

3. Recruitment of participants, especially women, for training in systems operations, bill collecting, community promotion activities.

4. Involvement of community members in dialogue on design of systems and their operations and maintenance.

III. Human Resource and Career Development

1. Training project offered locally for village participants in community promotion, water system operation and maintenance health education.

2. Providing opportunities at the regional sites for training in supervision, technical operations and management.

3. Development of training manuals, teaching guides, consultation resources, visual aids to be made available to community workers in health education, community betterment projects and project management and operations.

4. Career development and personnel planning.

IV. User Education

1. Community programs for health education to village populations including target populations of village leaders, mothers, school children.

2. Utilization of manuals, guidelines, mass media and visual aids prepared at the national and regional levels.

3. School programs for education in sanitation-related subjects and in hygienic practices.

V. Project Management

1. Utilization of voluntary groups for project support including women's groups, youth groups and other community interest groups.

2. Establish information resource systems to be made available to governmental units and other participants including contractors.

3. Develop project plan for construction including scheduling, use of materials, transport arrangements and financial management.

4. Develop plan for provision and utilization of complementary inputs and for distribution of information to promote water use.

5. Develop working procedures for operation and management including financial management.

6. Develop plan and procedures for continuous monitoring of project activities as well as ultimate evaluation.

IMPLEMENTATION CRITIQUE SHEET

MAJOR IMPLEMENTATION AREAS	MALAWI	PARTICIPANTS' COUNTRY
1. ENGINEERING DESIGN . WATER SYSTEM . EXCRETA DISPOSAL SYSTEM . REFUSE COLLECTION and DISPOSAL		
2. COMMUNITY PARTICIPATION . COMMITTEES . ATTITUDES . RECRUITMENT		
3. HUMAN RESOURCES DEVELOPMENT . VILLAGE TRAINING . TECHNICAL TRAINING . TRAINING MATERIALS . PERSONNEL PLANNING		
4. USER EDUCATION . COMMUNITY . SCHOOLS . MATERIALS		
5. PROJECT MANAGEMENT . VOLUNTEER GROUPS . COMMUNICATION LINKS . CONSTRUCTION (MATERIALS, TRANSPORT, FINANCING) VILLAGE INFRASTRUCTURE		

MAJOR IMPLEMENTATION AREAS	MALAWI Description	ADVANTAGES and DISADVANTAGES
1. ENGINEERING DESIGN . WATER SYSTEM . EXCRETA DISPOSAL SYSTEM . REFUSE COLLECTION and DISPOSAL	Gravity Fed Distribution system with standposts. No water treatment except sedimentation and screens.	ADVANTAGE: GOOD ENGINEERING DESIGN, ESPECIALLY IN TERMS OF SIMPLICITY. DISADVANTAGE: EXCRETA DISPOSAL AND REFUSE COLLECTION AND DISPOSAL WERE NOT INCLUDED IN THE PROJECT.
2. COMMUNITY PARTICIPATION . COMMITTEES . ATTITUDES . RECRUITMENT	Chief and local Party leaders set up section committees to organize work. Villagers feel improved water availability of primary importance, not health.	ADVANTAGE: COMMUNITY PARTICIPATION WELL PLANNED TAKING INTO ACCOUNT THE FELT NEEDS. LOW COST AND EASE OF OPERATION OF THE SYSTEM.
3. HUMAN RESOURCES DEVELOPMENT . VILLAGE TRAINING . TECHNICAL TRAINING . TRAINING MATERIALS . PERSONNEL PLANNING	Technical officers and assistants given on job training with yearly refresher courses. Upgrading courses and training for promotion in civil service. Local watchman hired to keep intake pipes clean.	ADVANTAGE: PLANS FOR TRAINING OF PROJECT PERSONNEL. ALSO, INCLUDES JOB ADVANCEMENT POSSIBILITIES. DISADVANTAGE: NO TRAINING MANUALS AND OTHER TRAINING MATERIALS.
4. USER EDUCATION . COMMUNITY . SCHOOLS . MATERIALS		DISADVANTAGE: LACK OF HEALTH EDUCATION AS A PART OF THE PROJECT.
5. PROJECT MANAGEMENT . VOLUNTEER GROUPS . COMMUNICATION LINKS . CONSTRUCTION (MATERIALS, TRANSPORT, FINANCING) . VILLAGE INFRASTRUCTURE . OPERATION & MAINTENANCE	Villagers trained in maintenance of water system. Village committe provided labor and money to carry out minor repairs and maintenance, supervised by project assistant. Cement and some PVC pipe produced in Malawi. Donor support. No water charges.	ADVANTAGE: VILLAGERS MAINTAIN SYSTEM.

IMPLEMENTATION WORKSHI

Identification of Problem and Possible Solutions

1. Major Implementation Area (Circle one or more).

   - Engineering Design
     (Water system, excreta disposal system, refuse collection ar
     disposal)
   - Community Participation
     (Committees, attitudes, recruitment)
   - Human Resources Development
     (Village training, technical training, training materials,
     personnel plannint)
   - User Education
     (Community, schools, materials)
   - Project Management
     (Volunteer groups, communication links, construction,
     village infrastructure, operation and maintenance)

2. Describe the implementation problem (potential or actually experienced).

3. What are the underlying causes of the problem?

4. Outline possible solutions; include idealistic and realistic approaches.

5. List any resources that could be called on for assistance e.g. national and international organizations (public or private). Key individuals. Briefly describe the type of assistance needed.

IMPLEMENTATION CASE STUDY

CASE STUDY OF A RURAL WATER SUPPLY PROGRAMME IN MALAWI

Introduction

Malawi is a long, narrow, landlocked country with ample water resources. The average annual rainfall is 1000 mm, varying between 2450 mm in the mountains to 635 mm on the leeward side of the mountains. The rain falls during a 6-month rainy season which is followed by a 6-month dry season. Water is available during the dry season from natural storage provided by lakes, swamps, rivers, and high water tables.

The population is estimated at 6 million with over 90% of the population living in rural areas. The fertility and mortality rates are high in Malawi with 42% of the population under the age of 15.

Agriculture occupies 85% of the labor force. Malawi has few mineral resources but is self-sufficient in cement. Recently a small PVC pipe industry was developed which is of particular importance to water supply development.

Women bear the greatest burdens of village life in rearing children, domestic chores and agriculture. As drawers of water, women receive the greatest benefits of water supply projects and provide a major part of the self-help labor in such projects. The success of rural water supply will depend on their support.

Government Infrastructure

Malawi is characterized by a strong central government. National development is the responsibility of three divisions within the Office of the President: the Development Division, Economic Planning Division, and the Physical Planning Division. The country is divided into three regions and 24 districts which are administered by district commissioners.

Each district is served by an office of the various central ministries such as Agriculture and Natural Resources, Works and

Supplies, Health, and Community Development. Local development projects are coordinated by District Development Committees which include party officials, elected district counsellors, and officers for each development ministry. All development projects initiated in the districts are discussed by the District Development Committee and selected projects are forwarded to the appropriate ministry via the Development Division of the President's office.

Urban Water Supply

In the urban areas, it was estimated that in 1977, 69% of the population had access to a developed water supply. Urban systems are intended to be self-financing with metered water charges for private connections and flat monthly charges per family for water from standposts. Financing for the urban water supply projects has been provided by the Commonwealth Development Corporation, the UK Ministry of Overseas Development, the African Development Fund, and the International Development Association. Urban water supplies are either operated by municipal water boards or the Ministry of Works and Supplies.

Rural Water Supplies

The World Bank estimated in 1977 that 30% (1.4 million) of the rural population was served with water supplies. In 1977, there were 3700 bore holes drilled in rural areas and 300 bore holes with hand pumps are completed each year. Funds for this program are obtained from the Ministry of Agriculture and Natural Resources and the Christian Services Committee. Bore hole maintenance is also carried out by the Ministry of Agriculture and Natural Resources.

The Water Project Section (WPS) of the Ministry of Community Development and Social Welfare have developed a program, which is the focus of this report, of constructing gravity-fed water supplies. By January 1979, 22 projects had been completed serving 308,000 people (see Table 1). There are no house

connections and water is free. The communities are actively involved in maintaining the system.

A separate self-help project for construction of shallow wells with hand pumps has been developed by the water project section in the central region of the country where there is a shallow water table throughout the year. The program is in the early stages with a few hundred wells completed as of 1979. The ultimate goal is to construct 5000 wells in the regions, each serving 100 people. Cement and the hand pump are supplied by the central government and the villagers provide the labor and local materials. Maintenance is the responsibility of village committees who select a villager for training in repair and maintenance of the hand pump.

From Malawi's diversity of water projects it is evident that no single technology is appropriate in all areas of the country. Coordination of water supply programmes is of paramount importance in the efficient use of available resources.

In 1980, the water-related activities, which had been fragmented among government agencies, were integrated into a new Department of Lands Valuation and Water within the office of the President. It is expected the various programs will continue functioning as before but with a greater degree of centralized planning and coordination.

Objectives

The objectives of the rural water supply program are several The most important, the villagers feel, is the improved quantity, availability, and reliability of the water supply. The convenience of a piped water supply decreases water carriage and leads to savings oftime and energy. With the increased water supply the rural population can improve their personal hygiene and washing of laundry and utensils. The improved quality and quantity of water hopefully will improve the health status of the community, though this is not the primary objective of the program. The Ministry of Agriculture and Natural Resources puts

emphasis on water supplies for improved agricultural productivity by opening up new areas for settlement and land cultivation.

Project Beginning

A major water program is not always planned out from the beginning. Often-times it grows from a smaller project whose methods have proven successful. In Malawi the rural water supply program grew gradually within the limits of its own competence. It took more than a decade to develop a skilled cadre of technicians, establish confidence and trust among the population, and test practical aspects of the proposed program. This gradual growth has led to the success of the project.

In 1968 the Ministry of Community Development and Social Welfare designated sixteen villages in the Chingale area to be a development project. A ministry engineer was sent to assist the community in determining possible construction projects. The people of the area were receiving their water from shallow unprotected wells and during the dry season the women had to walk several miles to dig for water in a dry river bed.

The engineer met with a village committee of local leaders and visited a perennial stream above the village. It was apparent to the engineer that water could be piped by gravity from this stream. The village committee was skeptical at first but at a later meeting agreed that the people could provide the labor if the ministry supplied the pipe and materials to build the water system.

The engineer drew up a project design and schedule and USAID, who was funding the community development project, agreed to provide capital for the purchase of materials.

Community development assistants organized the villagers in the construction of the trench, laying the pipe, and backfilling. Twenty-five standposts were constructed along the 25 km of piping. The system supplied 3000 people with 25 liters per capita per day. The system still functions today and is maintained by the local population with assistance from the Ministry.

The Ministry of Community Development and Social Welfare was quick to realize the success and potential implication of such community self-help projects. The Ministry decided to try the same approach on a larger scale in the Chambe area.

The ministry engineer designed a system serving 30,000 people in 60 villages with 180 standposts. The water supply was gravity-fed via 95 km of PVC pipe from a river on the slopes of a mountain above the plain where the villages were located.

Five community development assistants were sent by the ministry to mobilize support from the population for the project. Leaders from Chambe were taken to visit the Chingale project and discussed with Chingale leaders how they carried out the work.

The leaders returned to these villages and discussed what they had seen with others in their local communities. Once interest in the communities was aroused, the chief called a public meeting at which time the engineer offered government support in supplying pipe and materials if the local population provided the labor. The government also received support on the project by OXFAM, a British organization.

Village committees were formed to carry out the main effort of digging trenches for the pipe. The project suffered from political discord during this period but was finally completed in 1970.

The visible success of these two projects motivated people in other villages to request from their leaders similar water improvements. Soon afterwards district development committees began asking the Ministry for development assistance.

From the larger Chambe project it became evident there were several weaknesses in the Ministry organization of the program. The community development assistants had theoretical training but not enough practical, technical, and labor management skills. The self-help labor required increased supervision by a field staff willing to get their hands dirty. Much of the work carried out by the villagers was of poor quality. Trenches were seldom dug straight or to the proper depth. The larger Chambe project also indicated that self-help projects were more effective for tasks which required unskilled labor than work which needed

skilled labor, such as masonry. The need arose for a properly trained building team paid out of project funds to carry out the more technical work.

Program Plan

The Ministry began to plan a more rational programme and created the Water Project Section (WPS) under the control of a senior water engineer and three community development assistants who had proven themselves on the two earlier projects. The project was authorized to recruit and train 20 field staff known as project assistants, and hire a construction team specializing in construction of water intakes and cement tanks.

Proposals for water supply projects may originate from one of three sources:

-- Local initiative through district development committees;
-- The Ministry of Agriculture and Natural Resources may identify areas of agricultural potential where water supplies limit development;
-- WPS identify potential projects from water resource surveys, maps, and other data.

Design Criteria

At the end of the dry season the senior water engineer and his staff tour the country when water resources are at their lowest. Information is sought on potential sources, terrain, demography, existing water supplies, and attitudes of the people and local authorities.

From the annual feasibility survey a short preliminary list of projects is prepared by the WPS. General guidelines for choosing projects are listed below:

-- Projects are located in focal areas to make efficient use of limited resources.
-- Areas of agricultural potential receive special consideration since lack of water is a serious constraint to the development of fertile lands.
-- The government favors those projects with a lower per capita cost.

-- The program concentrates on gravity systems due to advantages of cost and maintenance (other programs in the country deal with different water supply technologies).
-- The program concentrates initially on water sources that do not require treatment.
-- Motivation by local villagers and authorities significantly influences which projects are chosen.
-- Political considerations are also addressed in project selecti The government is sensitive to unbalanced geographical distribution of water projects.
-- The water supply project must be technically feasible and provide adequate supplies of water year round.

The senior water engineer develops the selected proposals estimating cost and staff requirements. He submits the proposals, according to routine civil service practices, to his superiors who review the project and pass the project with recommendations up through the system. This procedure can be time-consuming but tend to institutionalize the program and increase its life expectancy. Programs which operate autonomously become overly dependent on a select few jeopardizing the program's existence.

Donor Support

A donor agency may express an interest in funding a particula proposal or sometimes accidentally becomes involved. An example of this is the UNICEF involvement in funding a project in Mulanje.

UNICEF has proposed building a dairy near the Chambe water supply area. The Chambe water system was not large enough to supply water to the proposed dairy. WPS suggested that the dairy could receive water from the Mulanje project which was being designed but had not yet been funded. UNICEF agreed to help fund the project and subsequently the dairy proposal was dropped.

Minor projects are generally too small to attract donor interest; they are therefore grouped together into a sub-program and funded froma rolling fund maintained jointly by UNICEF and the Christian Service Committee.

Once agreement has been reached between the donor agency and the Malawi government, money is transferred to the Ministry of Finance which uses the money to apy for specific materials and operating costs of the WPS project.

Manpower Development

From 1968 to 1971 the water projects were staffed by community development assistants already employed by the Ministry. When the program began to expand, it was evident that a closer degree of supervision of water projects was needed with more and better trained staff.

WPS selected 20 project assistants in 1972 to help carry out the program. Project assistants are responsible for the day-to-day supervision of self-help labor, technical standards, and certain technical tasks. The candidates to enter training were chosed by their work history, interview and a written test. All candidates had to be 25 years of age and received at least 8 years of primary education.

The preliminary two-week training course is held at a camp-site at the headworks of an ongoing water project. The trainees are given practical instruction in digging trenches, laying pipes, masonry, and some site visits. At the end of the course successful candidates are appointed as project assistants, many candidates are deselected at this time.

The project assistants continue as trainees for two more years working on major water projects. During this period they develop technical, organizational and communication skills. After the two years they are appointed to different districts to live and work within the community developing water projects under minimal supervision. Once a year a refresher course is held to maintain staff spirit in the program and introduce new skills and relearn old ones. Project assistants can be promoted to increasingly higher ranks in the civil service by continuing on-the-job training and attending upgrading courses. Eventually they can be promoted to the highest ranks of the project staff.

Project Managers

Project managers are responsible to the WPS program director in all aspects of carrying out a major rural water project. Unfortunately, there is an extreme shortage of Malawian engineers. The government so far has recruited expatriate engineers to fill these positions.

The newly appointed project manager ideally spends about one month working with the project manager of another project to learn the characteristics of the program before taking on his management responsibilities.

Technical Officers

Technical officers manage a group of smaller water projects or work under a project manager on larger projects. They are trained on the job both in the field and at headquarters before they are given their field positions.

Technical officers are recruited from the Malawi Polytechnic. It is difficult to attract qualified applicants who want to work in rural areas. The Malawi Polytechnic is expanding their engineering courses and hopefully there will not be such a shortage of technicians and engineers in the future.

Gravity Water Supply Systems

The relatively large scale gravity water supply systems developed in rural Malawi employ very simple technology which can easily be maintained. The system consists of an intake of perforated steel pipe placed in a clean stream located in mountain forest reserves above the villages. The water is fed into screening and sedimentation tanks to remove vegetation and suspended particles. From there a main line supplies branched lines via branch concrete reservoirs. The system is designed for average flow with a capacity for overnight storage of water.

The population receives their water from standpipes. The system is designed to provide 27 liters/person per day for the anticipated population of the area. The original project provided

for one standpipe per 300 people. This was later changed to one standpipe per 160 people increasing water accessibility. The average cost per person for the projects completed to date is $4.68. A breakdown of costs by project is given in the appendix.

There is no provision at the standpipes for washing facilities. The villagers either wash their clothing at home with collected water or wash in one of the local polluted streams or stagnant pools. The provision of washing slabs at standpipes would reduce the community's exposure to water borne disease such as schistosomiasis. This would however increase the cost and per capita consumption of water and might require change in design capacities.

Materials and Transport

The larger pipes are made in-country of asbestos cement. The smaller PVC pipes are produced in Malawi. Unfortunately, Malawi as yet cannot produce enough PVC pipe to keep up with demand so some PVC pipe must be imported from Europe. Streel pipes are used where mechanical strength is necessary, i.e. intake pipe, crossing streams, or roads. Steel pipe is more costly, harder to transport and more difficult to work with. All materials are of standard sizes so they can be interchanged easily.

Project materials are delivered either to program headquarters or directly to the project site by contractors. Headquarters maintains a store of scarce items in case a project runs short.

Project assistants are loaned money to buy bicycles to get to and from worksites while technical officers have use of program motorcycles. The program also owns several trucks of various sizes to transport labor and materials.

Community Participation

Once the WPS has chosen an area to implement a water project local leaders call a general meeting to ask for public participation. The project manager explains the project, the materials the government will provide, and the responsibilities of the local population in carrying out the work. Local leaders are taken to visit similar projects in other communities and a film explaining

the program is shown to the public at various centers in the area.

The chief and local party leaders set up section committees to organize work groups and set schedules. It is important to realize it is the local leaders primary responsibility to mobiliz and supervise the local villagers; not the WPS personnel. This local responsibility is vital to the success of self-help project

The project manager, however, is in a favorable position to advise the committees on coordination of work which is taking place simultaneously on different branch lines.

After about two or three months of trench digging, worker participation begins to drop off due to harvest time or lack of enthusiasm. A large project may require 150 km of trench to be dug in six months. To remotivate the population to complete the work the area chief convokes the people to discuss the problem.

The major concrete work is contracted out to a local builder The builder is however closely supervised by the project staff. The excavation for the tanks is performed by the self-help labor.

Maintenance

Often-times in developing countries it is easier to build a water supply system than maintain it. This is perhaps one of the most important aspects of community involvement.

The Malawi projects use simple technologies with no pumps or sophisticated machinery to maintain. This does not mean the syste is maintenance free; soil around the pipes erodes away, water intakes become clogged, pipes brust and areas around standpipes can have poor drainage.

On each major rural water project a project assistant remain after construction to supervise the maintenance of the system. Village committees are responsible for providing the labor and supply money to pay for minor repairs. Villagers are trained to repair brust pipes and erosion damage. Spare washers for the water taps are stores locally with responsible villagers. A watchman is paid by the villagers to maintain and clean the intak pipes.

If the area around a tap is not maintained and becomes unsanitary the project assistant may turn off the tap until the work is completed. Because villagers invested their labor in building the system they feel a responsibility to maintain it.

Evaluation

A simple system of evaluation can provide rapid feedback as to the strengths and weaknesses of the program. With the reorganization in 1980 of the WPS into the Department of Lands Valuation and Water a new Training and Research Unit was created. The purpose of the unit will be to provide data and analysis for project monitoring and evaluation to address four components of the program: the economic, technical, health, and social.

Evaluation is not only important to improve a project but also to aid in national planning of resources and to provide information to donor agencies who have interest in funding rural water projects in Malawi. Donor agencies are skeptical of providing resources to projects which do not have adequate monitoring and evaluation. In 1980 USAID approved $6,000,000 to be used to strengthen the program. Some of this money will go towards developing simple monitoring and evaluation techniques.

The total benefits of the project are difficult to measure. Improved health is not the primary goal of the project, as far as the villagers are conderned. Improved water availability is of primary importance.

There does need to be, however, a closer cooperation between the rural water supply program, health education and improved sanitation. Once a population has mobilized to build a water system the community confidence and structure developed can be used to tackle other development projects such as improved sanitation and health care.

After: Glennie, C.E. The Rural Piped Water Programme in Malawi, MS Thesis, University of London

COMPLETED RURAL PIPED WATER PROJECTS IN MALAWI AT JANUARY 1979

PROJECT	DISTRICT/REGION		DESIGN POPULATION	LENGTH OF PIPING(KM)	NUMBER OF TAPS	CONSTRUCTION PERIOD	COST OF CONSTRUCTION	FUNDING AGENCY
1. CHINGALE	Zomba	S	5000	40	35	1968-9	K 6000	USAID
2. CHAMBE	Mulanje	S	30000	97	180	1969-70	64000	OXFAM
3. MIGOWI	Mulanje	S	6000	24	45	1969-71	12000	USAID
4. CHILINGA	Mulanje	S	2000	10	14	1971-2	4000	CSC
5. NG'ONGA	Rumphi	N	2000	18	20	1971-2	6000	CSC
6. MUHUJU	Rumphi	N	1000	19	21	1972-3	7000	USAID
7. CHINKWEZULE	Kasupe	S	700	2	7	1973-4	1000	CSC
8. IGHEMBE	Karonga	N	4000	18	36	1973-4	7000	CSC
9. MULANJE WEST	Mulanje	S	75000	238	460	1972-5	170000	UNICEF
10. LUZI	Mzimba/Rumphi	N	8000	60	42	1974-5	24000	CSC/UNICEF
11. CHINUNKHA	Chitipa	N	4000	26	51	1974-5	12000	"
12. CHILUMBA	Karonga	N	4000	18	29	1974-5	8000	"
13. CHILOBWE	Ntcheu	C	1200	6	12	1974-5	2000	"
14. PHALOMBE	Mulanje	S	90000	491	578	1973-7	500000	DANIDA
15. DEDZA	Dedza	C	1400	8	10	1975-6	5000	CSC/UNICEF
16. MCHINJI	Mchinji	C	20000	137	116	1974-6	52000	"
17. CHAGWA	Kasupe	S	7000	80	95	1975-6	15000	"
18. KALITSIRO	Ntcheu	C	1000	6	9	1976-7	3000	"
19. LIFANI	Zomba/Kasupe	S	20000	101	140	1975-7	72000	"
20. HEWE	Rumphi	N	8000	42	42	1975-7	30000	"
21. NKHAMANGA	Rumphi	N	12000	76	120	1976-8	134000	CSC
22. LIZULU	Ntcheu	C	6000	24	25	1976-8	20000	CSC/UNICEF
	TOTALS		308300	1541	2087		K1154600	

Table 1

Average cost per person = $4.68

CURRENT RURAL PIPED WATER PROJECTS IN MALAWI AT JANUARY 1979

	PROJECT	DISTRICT/REGION		DESIGN POPULATION	LENGTH OF PIPING(KM)	NUMBER OF TAPS	CONSTRUCTION PERIOD	COST OF CONSTRUCTION	FUNDING AGENCY
23.	NTONDA	Ntcheu	C	25000	121	140	1977-9	K 106000	CSC/UNICEF
24.	LINGAMASA	Mangochi	S	12000	43	48	1977-9	40000	"
25.	NAMITAMBO	Chiradzulu/ Mulanje	S	50000	257	350	1976-80	480000	DANIDA
26.	SOMBANI	Mulanje	S	40000	185	300	1977-80	240000	ICCO
27.	ZOMBA (DOMASI)	Zomba	S	100000	451	700	1977-80	520000	CEBEMO
28.	LUWAZI	Mzimba	N	8000	80	54	1978-9	79400	CIDA
29.	MULANJE SOUTH	Mulanje	S	45000	293	394	1979-81	150000	"
30.	KARONGA	Karonga	N	30000	196	250	1979-81	180000	"
			TOTALS	310000	1626	2236		K1944400	

Average cost per user = $7.84

Average cost per standpipe = $15,332.41

NEW RURAL PIPED WATER PROJECTS COMMENCING 1979

	PROJECT	DISTRICT/REGION		DESIGN POPULATION	CONSTRUCTION PERIOD	ESTIMATED COST OF CONSTRUCTION	FUNDING AGENCY
31.	KAWINGA	Machinga	S	60000	1979-82	K 711300	DANIDA
32.	NTHALIRE	Chitipa	N	3000	1979-80	50000	CIDA
33.	DOMBOLE	Ntcheu	C	16000	1979-81	85000	"
34.	MWANZA VALLEY	Chikwawa	S	20000	1979-81	120000	"
35.	LIVULEZI	Ntcheu	C	10000	1979-81	75000	"
			TOTALS	109000		K 1041300	

Projected cost per user = $11.94

EVALUATION SESSION

Evaluation of Water Supply and Sanitation Projects

Project evaluation (i.e., the measurement of accomplishment of the implementation) requires a clear definition of project objectives and perceived benefits as well as the identification of direct and complementary inputs and outputs. Therefore, evaluation follows from the explicit criteria and standards for design and operation of the project. The methods for evaluation are difficult but are directed to: (2) measurement of impacts and effects on a designated target population; and (b) the establishment of monitoring and data management systems through which the project outputs are recorded and analyzed.

It may be useful to make a checklist of the variables that are applicable to a monitoring and evaluation system. It is also useful to reinforce the notion that these variables are measured as discrete items, but are further required to be linked in order to express the project impact of a water supply and sanitation project. An example of a linkage between health, economic and environmental variables is shown in Figure 3. These include:

(a) environmental indicators: water quality, water consumption and utilization, household sanitation, waste disposal, housing quality, crowding and personal hygiene;

(b) social indicators: level of living, demography;

(c) health indicators: mortality, morbidity, health facilities, availability and utilization;

(d) economic indicators: income, expenditures, consumption, primary sector productivity and time allocation;

(e) cultural indicators: attitudes, beliefs, health knowledge.

The decisions of consequence in planning water supply systems involve resource allocation, choice of sites for water supply installations, establishments of tariffs, financia feasibility criteria and economic analysis which precede the choice and establishment of design criteria and standards for

Figure 3.

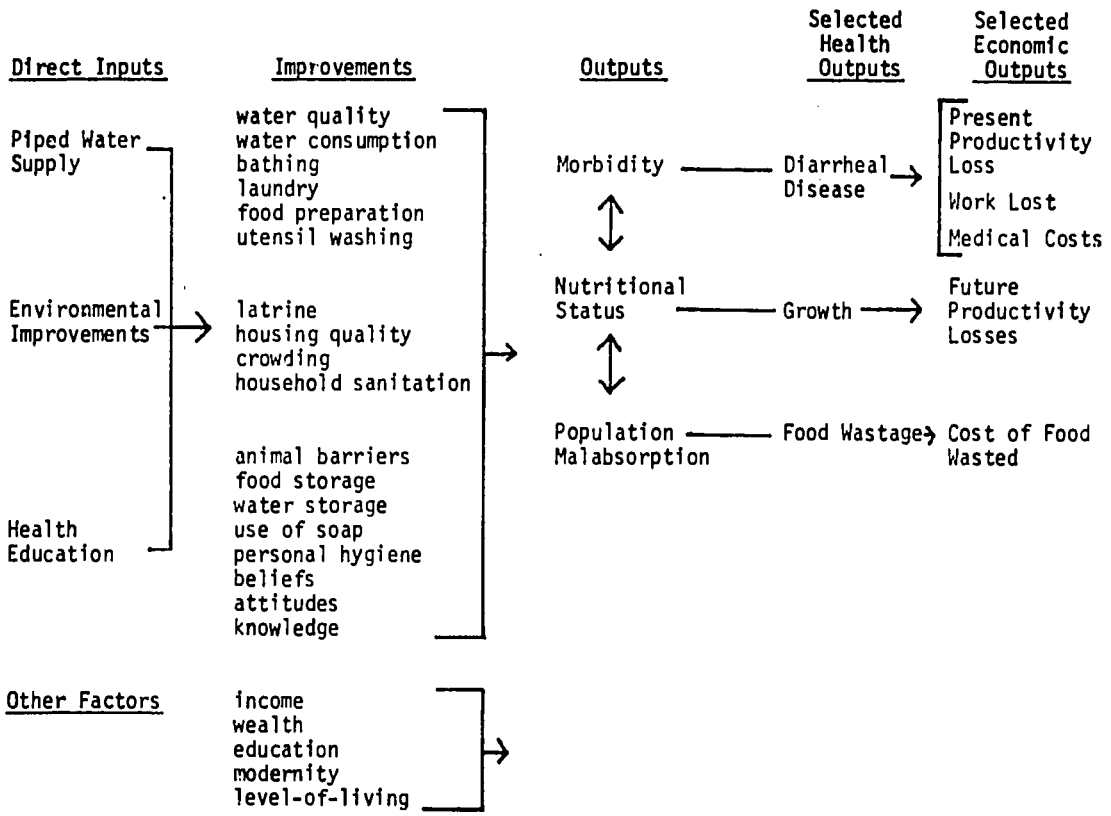

FIG. 1. Conceptual Scheme for Linkage Between Environmental Improvement, Health and Economic Change.

Source: 9

implementation of specific projects. Evaluation for decision-making at this level is even more complex than for the project level.

The essential purposes of evaluation of these planning and decision strategies are:

1. to determine the extent to which a policy meets objectives;

2. to detect important problems (cultural, economic, environmental) at an early stage;

3. to make the best use of available opportunities

4. to determine modification and adjustments to the plan.

CHECKLIST FOR EVALUATION

I. Water System Surveillance, Monitoring and Evaluation

1. Surveillance and monitoring points

   a) tap

   b) water transport containers (from tap to house)

   c) house water storage containers

   d) other points in the treatment and distribution system

2. Monitoring of outputs

   a) quantity of water (lcd), water pressures in the system

   b) system reliability including down time and insufficient flows

   c) water quality in terms of microbiological and chemical standards

   d) records of water use for purposes consistent with water supply objectives

   e) surveys of opinions or convenience and perceptions of availability

II. Effectiveness of Planning Strategies

1. National and regional plans

   a) resource allocation

   b) payment options

   c) balance of low cost/availability options

   d) technology choices

III. Effectiveness of Implementation Strategies

1. Community and individual water utilization

   a) ownership of the water supply

   b) percentage of community households reached by the supply

   c) access to the water supply

   d) equity of the rate (fee structure)

   e) patterns of individual and family water utilization

   f) stimulation of complementary uses of water (with special reference to health and personal hygiene)

2. Project support activities

   a) health education

   b) community participation

   c) information and community relations

2. Project support activities

a) health education

b) community participation

c) information and community relations

3. Project management

a) availability of required resources in sufficient quantities

b) effectiveness of the management and supervision of the supply

c) availability of trained persons

d) operation and maintenance including availability of spare parts, down-time, water quality and consumer satisfaction

4. Measurement of benefits (difficult and not feasible with limited evaluation resources)

a) social benefits

b) health benefits from diminishing morbidity from water-connected diseases

c) secondary benefits including decreased medical expenses, reduced expenses, reduced time lost from work, increased productivity, improved nutrition

IV. Evaluation of Sanitation Systems

1. Sanitation technology

a) chosen in respect to rural or urban application

b) appropriate for physical, climatic, land use, water table, and soil conditions

c) construction meets criteria for cost, operating cost, ease of construction

2. Social acceptability

a) tradition and culture

b) compatible with the requirements of the physical environment

c) educational projects for health information

d) projects to stimulate change in personal hygiene practices

e) maintenance of the facility

3. Management and financial factors

EVALUATION WORKSHEET

AUDIENCE	WHAT QUESTIONS?	SOURCE	METHOD	WHEN	BY WHOM

EVALUATION

(DISCUSSION and EXAMPLE)

AUDIENCE	WHAT QUESTIONS?	SOURCE	METHOD	WHEN	BY WHOM
(DISCUSSION) Who wants answers?	What are the questions each audience is asking? What to they need to find out?	Who can you go to, or Where can you go to find answers?	What method or instrument can you use to measure the source of information?	When should you measure?	Who should take the measure, to answer the questions?
Funding Agencies Government Ministries and/or regions Technical Training Schools etc.	How many wells are dug? How many people are using them? What is the cost? How effectively did those trained do their job? NOTE: Questions should be asked that can be answered immediately and definitely. (Avoid impact on health)	See technology in place. Check operations Project records The community -attitude -maintenance - use On site technicians Comm. organizers Health officer Progress of contractor	Observation Survey Interviews Questionnaire Regular reports etc.	Before and after project? During? At one point? At regular intervals? NOTE: Need both monitoring and assessment (formative and summative evaluation)	Outside consultants Community representatives Health Officer Ministry officials, etc.
(EXAMPLE) A.I.D.	How many people are served and at what cost?	Project records Water installation	Review of records. Observation of sited	-At project completion -Before project: twice, in dry & wet season. -After project: twice, in dry & wet season.	Outside consultants. e.g. WASH NOTE: if audienc were different, then evaluation would be different.

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APPENDIX

ABSTRACTS

CARRUTHERS, ID. "Impact and Economics of Community Water Supply, A Study of Rural Water Investment in Kenya". Wyz College, University of London, Ashford, Kent, 1973.

This study documents the experience and discusses the problems related to rural water development in Kenya from an economic perspective. Provided are several findings and recommendations:

- Rural water development is seen by Kenyan authorities as an important component of national development. Five percent of public sector development expenditures will be allocated to water supply.

- The main constraints providing clean water supply for all by the year 2000 are shortages of engineers and financing.

- The potential health and environmental impacts from this investment are great but at present the realized benefits are insignificant. This is because of neglect of complementary programs in health, education, sanitation, agricultural production, and marketing.

- Self-help activity is critical to rural development. It requires firm central government direction to use available resources efficiently.

- Rural water supplies should be regarded as a basic social service. Communal water distribution points should be free and private connections should have rates set according to regional income levels.

- Operation and maintenance of water systems need additional resources, upgraded procedures and improved regional organization.

- Selection and design criteria can no longer be regarded as a major problem in rural water development.

GF White, DJ Bradley, and AU White. DRAWERS OF WATER: DOMESTIC WATER USE IN EAST AFRICA. Chicago, University of Chicago Press, 1972.

The authors studied water use at 35 sites throughout Uganda, Tanzania and Kenya. The sites range from rural subsistance farming areas to slums and luxury dwellings in urban areas. Examined are costs, benefits, and social aspects of water use.

East Africa tends to have a dispersed pattern of settlement in rural areas as opposed to the nucleated villages found in West Africa. This factor tends to increase the cost of providing water in rural East Africa. This and other varying environmental and social conditions make it difficult to extrapolate the cost of providing water to different populations.

In the areas studied where water is carried from a source or standpipe, water use per capita ranged from 4 to 20 liters per day depending on the availability. Where water is piped to the house with only one tap and no indoor waste disposal, water use averages 30 to 40 liters per day. In households with more than one tap and indoor waste disposal, water use ranged from 25 to more than 600 liters daily.

The study found that the price of water piped into the dwelling had only a moderate effect upon daily consumption. Domestic water demand did not fluctuate greatly during the year except where the water is being used for gardening or when there are shortages of supply.

The authors predict there is a point at which increased quantities of water provide little or no added health benefit. This point probably lies between 20 to 80 liters per person. Further research is needed to determine this point more precisely in order to compare social costs and benefits of further water development.

Development of water supply requires some precautions. It is not uncommon for improvements in some aspects of water supply to create

additional health problems. Also, as water use increases there becomes a greater need for a more extensive waste disposal system.

Finally it is stressed that the users of the water source should help design, construct and operate the water scheme. This is important in making sure a water system fits the population's needs. Otherwise, a system is neglected and falls into disrepair.

DWORKIN, D (1980) Kenya Rural Water Supply: Programs, Progress, Prospects, US Agency for International Development, Project Impact Evaluation No. 5. 19 pp. + appendices 16 pp.

The Government of Kenya is committed to a long-term goal of universal water supply in the ocuntry. The investments to the water sector have been substantial, butthe same is not always true in regards to the results. The evaluation of Kenyan rural water supply systems was carried out in 1979 in order to find out the reasons for past failures. The primary cause for the existing problems was found to consist of two main principles: the size of the projects and the method of supplying water; i.e. the objective to deliver piped water to individual metered connections in dispersed communities. To the underlying reasons, why this type of an approach does not always work well in Kenya, belong:

- shortage of Kenyan engineers;
- high capital costs;
- high proportion of expatriates with short-term tenure among the technical personnel;
- inadequate operational and maintenance funding;
- lack of appropriate organizational structure in the water sector.

Also the following aspects are in favor of small system sizes as opposed to large ones:

- the size increases design complexity;
- surveying and pipe installations must be carried out more carefully to provide even gradients in case of large systems;
- if the number of persons using the system is large, more attention is required to ensure water safety;
- large systems have to be designed to be more dependable, since a single failure may cut the access to water for all the people in the community;
- if a system needs large amounts of water, it restricts the use of wells as a source and leads to the use of surface water, where there is a greater potential for fecal contamination.

It is recommended that in the future the technological level of water supplies should match the operational and maintenance support available. Also, the system reliability should be given a high priority. For example, it can be increased by constructing several single wells and handpumps to serve a community. In addition, more attention and support should be given to the Harambee self-help programs in terms of improving the design and providing the materials for construction.

VAN DER KNOEG, JD, CA Van Wisk-Sijbestia. 1980. Community Participation in the Rural Well Construction Programme of Guinea-Bissau. Aqua No. 9/10, pp. 21-23

The article presents an example of the successful integration of a community participation component into a rural drinking water supply program. The process is guided by male and female promoters who have been recruited from the areas they serve. Because of the gerontocratic system in the country, they are chosen to be older, well-respected members of the community.

Several months before the actual project is started in a village, the promoters carry out a socio-economic and cultural field survey. This way, they get an idea of existing problems and of possible solutions to these problems, and will be prepared to discusss about the alternatives with the community. The technical team, who at this stage is responsible for the collection of hydrological and geophysical data, is also attending these preliminary meetings. Only after the final decision, which is made by the community alone, a formal project agreement is made.

During the construction phase the village committee is responsible for providing the labor (voluntary and/or paid). It also forms the liaison with the water agency coordinating the program. Two voluntary caretakers (a male and a female) from the community are trained to take care of the daily operation and maintenance tasks. More complicated repairs and preventive maintenance are provided by the water agency.

The promoters are responsible for environmental health education and in order to stimulate discussion they are encouraged to use posters, local photographs, and role playing. In additon, the female caretaker is responsible for preserving hygienic conditions around the well by preventing pollution by people and cattle. The program evaluation is continuous; i.e. before, during, and after the construction joint meetings are held between the promotion team and the community. As to the success of the program, it is stated that the consultation and education of the communities has led to a better acceptance of those water supplies that were built under this participatory program.

Gachukia, E. 1979. WOMEN'S SELF-HELP EFFORTS FOR WATER SUPPLY IN KENYA: UNICEF, Assignment Children:45/46:167-174.

The spirit of cooperation - Harambee - among the women in Kenya is not new, since the tradition of mutal help has already led to the creation of over 5,000 women's associations. The UNICEF/N60 Water for Health Programme - Harambee Ya Wanawake Kwa Aiya - started in 1977 and the objective was to boost community water projects already initiated by women.

To increase the probability that permanent health and economic benefits would occur, the projects were widely conceived so that they would embrace all aspects of basic services, including water, health and hygiene, nutrition, sanitation, and education in these and other related fields. The results showed that a little assistance in a project was a tremendous motivation for the women to undertake and achieve more improvements in their living conditions.

For example, in Olosho-Olbor valley after the provision of clean water, the community was willing to construct latrines, a clinic, and a market garden. The Ministry of Health provided a full-time nurse to the area for immunziation and health education. In addition, two local women were trained as village workers. As a result the scabies, common among children, started to disappear and a significant immunziation coverage was made within a period of only one year.

In addition, in many areas the construction of rainwater collection tanks has made it possible to reopen the health centers that had been closed due to the lack of water. As a consequence health education, family planning, and immunziation programs have been implemented.

MN Karinki. "Sewerage Development in Kenya", Presented at a Seminar on Water Supply and Water Pollution Control in Kenya held in Nairobi, Kenya under the auspices of the Environmental Training and Management in Africa Project of the University of North Carolina, July 20-August 7, 1981.

Three basic methods of sewerage disposal are considered appropriate in Kenya: the pit latrine; septic tank; and piped sewage leading to sewage treatment works. The pit latrine is the primary method of sewage disposal in the rural areas. Some of the more affluent rural households are changing from pit latrines to septic tanks with soakaway pits. In urban areas, the Ministry of Water has continued to integrate the use of septic tanks and sewer systems. Low density urban areas will continue to use septic tanks, while the more densely populated areas will be serviced by sewerage systems.

The design criteria for all sewerage projects in Kenya are based on a WHO study entitled "Report No. 9 - Selection and Design Criteria for Sewerage Projects". The following criteria apply to the design of sewerage systems in Kenya.

1) Separate sewers for sewage and storm water

2) The use of sewage stabilization ponds as far as possible before considering alternative methods (i.e. trickling filters, oxidation ditches, etc.).

3) Three types of stabilization pond systems will be considered: (i) aerated + facultative + maturation; (ii) anaerobic + facultative + maturation; (iii) facultative + maturation.

4) When land is not available for ponds, the next alternative to consider is the oxidation ditch.

5) The design of an oxidation ditch system should incorporate a maturation pond system to reduce the level of bacteria in the effluent.

6) The last alternative to be considered is the trickling filter which is inexpensive to run, but has maintenance problems.

Many industries in Kenya insist on obtaining direct connection to public sewerage systems. As a result, it is

standard procedure in MOWD to require an industrial survey to determine the characteristics of the wastewater which will be entering the sewage treatment works, before a connection is made.

There are presently 36 sewerage projects in various stages of planning, design and construction in Kenya. In addition, there are 60 other towns that are to have piped water systems as part of a 5-year development plan development plan (1979-83), and corresponding sewerage projects will be developed.

World Bank. "Water Supply and Waste Disposal", Poverty and Basic Needs Series,Washington, D.C.: World Bank, September 1980.

The World Bank is committed to the control of diseases related to water and sanitation. Loans by the Bank for water supply and waste disposal projects are expected to increase from an annual average of just over $300 million between 1974 and 1978 to more than $700 million between 1979 and 1983. The Bank estimates that the total investment needed to provide adequate water and sanitation for all in the coming decade will require $30 billion a year. The overall investment is projected to meet only 40% of this level of funding. As a result, the Bank calculates that in 1990, with the increase in world population, the same number of people will be without adequate sanitation or water as in 1975 (1.5 billion people).

The current policy of the Bank in providing assistance in water supply and waste disposal is not changed. Some sectors of the Bank's activities will be reemphasized and reinforced during the Drinking Water and Sanitation Decade. These recommendations are presented:

- Careful attention must be given to the proper balance among water supply, waste disposal and hygiene education.
- The Bank has a responsibility to inform member countries of results of research in appropriate technology and help them consider the alternatives for meeting the demands of the population.
- The Bank should expand its assistance to borrowing countries in sector planning and project preparation.
- The Bank should encourage development of institutions withing the borrowing country that can reach large numbers of beneficiaries effectively. Better ways are needed of recovering costs of water and sanitation projects from rural beneficiaries and minimizing the burden on the government treasury.

- The Bank should give more attention to the training of personnel in developing countries for improvement of water supply and sanitation. In addition to technical and commercial personnel, training should also be provided for promoters, health and extension workers.

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He has worked in the field in Zaire, Senegal, The Gambia, Mali, Cameroon, Chad, and Central African Republic and has done in addition consulting work in Ghana, Nigeria, Togo, Burundi, Iran, India and Bangladesh. From 1972-75 he was field director of an experimental regional health education project in Central Africa. On the basis of his experiences he has authored or coauthored more than fifteen articles and one book.

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He holds a Master degree in geography under Dr. Gilbert White from the University of Colorado and has lived over seven years in Africa in Tanzania, Kenya and Sierra Leone working for the Peace Corps and P.V.O. He has consulted on water and sanitation projects in Malawi, Liberia, Oman, Lesotho, Swaziland, Botswana and Kenya. He has initiated a variety of training programs including village based training in Sierra Leone and Liberia and a model water/sanitation pre-service training program for Peace Corps Volunteers in collaboration with the U.S. Indian Health Service and the Center for Disease Control.

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Chief, Division of Community Water Supply and Sanitation Office of Health he has over 25 years experience in civil, environmental, and public health engineering, education, and management. Prior to joining AID in June 1980, he was a partner in an international consulting engineering practice. From 1962 to 1975, he was a professor in the School of Public Health at the University of North Carolina where he directed several international programs. Earlier, he taught at V.P.I., managed projects for consulting engineering firms, and served as an officer in the U.S. Army Corps of Engineers. He has worked in over 30 countries and has been a consultant or advisor to AID, WHO, the World Bank, PAHO, UNEP, UNICEF, UNESCO, NAS, EPA, OIH, IUCN, et al. He has written over 100 publications including 10 books.

CONTINUING EDUCATION PROGRAM
PRIMARY HEALTH CARE/AFRICA
November 15-20, 1981
Lome, Togo

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LESSON PLAN - PLENARY SESSION

ACTIVITIES/NOTES	COMMENTS
I. Introduction and Overview R.B. Isely	Time: 20 minutes.
A. The presence of this program within a PHC workshop and the length of time devoted to it exemplifies the increased focus and importance placed on Water and Sanitation needs in Africa.	
B. We are privileged to have a number of experts in the areas that must be represented and coordinated in all Water and Sanitation projects. (Introduce instructors, giving credentials and experience).	Mention areas of expertise for each instructor.
C. You, working as a Health Officer, may find yourself contributing to any or all of these areas when you are involved in Water and Sanitation projects. It is therefore important to know something about each area, and, more critically, to be aware of the criteria for success in each area. (Mention the roles that Health Officers may have played-or might play-in the projects).	
D. Therefore, in planning the program, we wanted to ensure that whatever information on Water and Sanitation you took away from this program was of use to you in your own situation.	Have participants turn to objectives in their booklets, read with you.

ACTIVITIES / NOTES	COMMENTS
E. Here are our objectives: These objectives are in the booklet of materials that have been handed out to each of you. If you turn to the first page you will see a Table of Contents. Note that the first page is background information on the workshop leaders, followed by the objectives and the agenda. We have included all the papers that will be presented in the various sessions of the program, and all the worksheets you will need are also provided in the booklet.	Read from the booklet. Explai the rationale for the objecti briefly.
F. We have an Agenda for the next 1 ½ days. Turn to page 4 in the booklet. Note that we have a Plenary Session, 3 different group sessions, and a closing session. The program is arranged this way so that the leaders can make presentations-to provide information-and then, in smaller groups, we can capitalize on your knowledge and experience. We have much to learn from each other and smaller groups will allow more give and take discussion among all the participants and the leaders.	Have the participants turn to the next page and review as y speak.
G. [Describe each presentation in Plenary Session] The smaller group sessions are organized around what we perceive to be the 3 phases of Water and Sanitation projects: planning, implementation and evaluation. In each session we will go over the procedures and the decisions necessary for that	Emphasize the flow - reason f the sequence of the talks.

ACTIVITIES/NOTES	COMMENTS
phase -then we will apply these to case studies, projects actually going on in Africa- and finally apply them to your own situations. Whatever group you happen to find yourself in, you will have a different leader (one of us) for each phase. In this way, we hope to give you a slightly different emphasis, based on our different areas of expertise, each time you rotate. We hope this will contribute to the broad background you need when you are involved with Water and Sanitation projects.	
H. The closing session will bring us all back together again. Participants from each group will serve as a panel to summarize what has been learned from the group discussions. We will try to identify patterns and trends in your different situations, and point out the most practical approaches we have heard in the sessions.	
II. First speaker: Mr. F. Eugene McJunkin, "A.I.D. Commitment to Water and Sanitation"	Time: 20 minutes
III. Speaker: Dr. Abby Bloom,"A.I.D. Water and Sanitation Policy"	Time: 15 minutes
IV. Speaker: Dr. David Sanders, "Relationship of Water and Sanitation Programs to PHC"	Time: 20 minutes
V. Speaker: Mr. Craig Hafner, "Field Report - African Projects"	Time: 15 minutes
VI. Film - "The Malawi Project" Introduction by Mr. Craig Hafner	Time: 25 minutes

ACTIVITIES/NOTES	COMMENTS
VII. Speaker: Dr. Daniel Okun, "Technical Issues for African Projects"	Time: 15 minutes
VIII. Summary. Point out the highlights of each talk, the value of each. These presentations provide a framework for the upcoming sessions where participants will play an active role in determining how to plan, implement and evaluate Water and Sanitation projects. Organize participants into 3 groups, and tell each group where to report after the break.	Time: 5 minutes
BREAK	11:15 - 11:30 a.m.

LESSON PLAN: GROUP SESSION ON PLANNING

ACTIVITIES/NOTES	COMMENTS
I. STATE PURPOSE OF GROUP SESSIONS As Dr. Isely pointed out in the opening remarks, we have become smaller groups so we can more easily exchange information, learn from each other. This program can only be successful if it relates to the experiences, problems and situations you have encountered, so we depend upon you to contribute these in our discussions. - All of us are aware that theory -new information- such as the type presented this morning, is only useful when we can apply it. The "how to" information for our own situations is what is needed. We want to try to dig some of that out in these group sessions. We want to hear different viewpoints, different approaches. We need to use each other as resources, encouragers, guides. - We need high participation here. This is a place where we can be supportive of each other. We can be open to all suggestions and consider all the issues before we make judgments. We may come away with new ideas, new approaches if we can maintain this outlook. - Finally, keep in mind that participating does not just mean initiating ideas. You will help our discussions if you can clarify a point, or point out certain relationships, or question our line of thinking.	Time: 5 minutes

ACTIVITIES/NOTES	COMMENTS
- We hope that any value (learning) you gain from our program is as much a result of your colleagues as it is of the leaders.	
* SELECTION OF GROUP REPRESENTATIVE At the end of the planning session, you must select one among you to represent group on closing session panel. To describe the work the group did -the issues you dealt with- the problems and the solutions you identified. Keep this in mind.	
II. DISCUSS THE PROCESS OF PLANNING	Time: 10 minutes
- The flow chart in the booklet depicts a process - one conceptual approach that is useful to begin thinking about the phases - could take many different forms.	Have the participants look at the flow chart in their bookl
- What characterizes each box? (Discuss) Macro plan Regional plan Sector plan Project Identification, including standards and criteria.	
* All the above take place in the PLANNING phase.	
(Discuss) Design and Appraisal Construction Operation and Maintenance	
* All the above are considered to be the IMPLEMENTATION phase.	
(Discuss) Evaluation Monitoring	
* All the above are the EVALUATION phase.	

ACTIVITIES/NOTES	COMMENTS
- Note the constant overlap - the arrows moving back and forth. The process is dynamic - adjustments in the procedures and steps are constantly necessary.	Point out that supporting information for the flow chart is in appendix of the booklet.
III. INTRODUCE THE CHECKLIST FOR PLANNING	Time: 25 minutes
- Turn to it in the booklet.	
- Point out major categories.	
- Allow participants time to read the checklist.	
- Discuss the checklist. "Are there any planning areas we overlooked?" "Are there some areas you consider more important than others?"	Use these and other questions to start discussion.
"Could the checklist, as now written, serve as a guide for your projects?" "How would you change it to be more useful?"	Put suggested changes, additions on the blackboard or the flip-chart.
IV. DIVIDE INTO SMALL GROUPS (3 groups of 5) to do next activities	
* NOTE: this is optional for leaders.	
V. READ THE BURUNDI CASE STUDY	Time: 20 minutes (30 minutes if using small groups)
Use the planning checklist as reference. Make notes of the PROBLEMS you find in the study on the PLANNING CRITIQUE SHEET in your booklet.	
The PROBLEMS can be jotted down as you read the study, in the major planning areas we just discussed. The PLANNING CRITIQUE SHEET is organized this way.	

ACTIVITIES/NOTES	COMMENTS
You also have a column for jotting down any problems you recognize for <u>your country</u>. This will help you prepare for our last group activity, where you describe the problems you anticipate or have experiences in planning for your own situation. * If using small groups: When you have finished reading and making notes, discuss the problems you identified and compile them into one group report. Make sure the whole group agrees on the final list of problems for the case study.	
VI. PRESENT GROUP REPORTS Each group will present its report to full group, allowing questions/discussion as each completes presentation. After the first group has presented, ask other groups to present <u>only</u> those issues/problems that the first group did not cover (or to argue why they think the problem the first group presented should <u>not</u> be on the list, etc.) * If not using small groups: conduct large group discussion, letting individuals identify problems they found.	Time: <u>20 minutes</u>
VII. ASK PARTICIPANTS IF THEY FOUND SIMILAR PROBLEMS IN OWN COUNTRY. Point out that this discussion will help them think out next activity, where they begin to analyze planning problems in their own country.	
VIII. BREAK - LUNCH	1:00 - 2:00

ACTIVITIES/NOTES	COMMENTS
IX. PARTICIPANTS PREPARE THEIR OWN PROBLEMS	Time: 30 minutes
Use the worksheet in the booklet. Give the option to work in pairs if they want to (because of the lack of experience, etc.)	
X. SELECT PARTICIPANTS TO PRESENT PROBLEMS	Time: 30 minutes
Ask for group critique. "Who has similar problem?" "Which proposed solution is most practical? Why?" "Is this a high priority problem?" "Could it be delayed or ignored?" "What are the consequences - long and short-term?"	Use these and other questions to get group discussion.
XI. HAVE GROUP SELECT GROUP REPRESENTATIVE	Time: 10 minutes
Let them decide any way they want. Give examples: volunteers, secret ballot, a committee to appoint, etc. Leader might consider leaving the room at this point, announcing he will return for their decision in 10 minutes.	

LESSON PLAN: GROUP SESSION ON IMPLEMENTATION

ACTIVITIES/NOTES	COMMENTS
I. Overview of SESSION	Time: 10 minutes
. The steps we go thru in this group are similar to ones in Planning Session Checklist for Implementation A new case study to review Identify problems in study Develop our own problems and solutions Have group critique our work.	
. You have stayed together as a group, but rotated to a new leader. Consider me a new source of information. I approach water and sanitation from a different area of expertise. Hopefully, you will be able to get the views from each of us and use them to further refine your own perspective.	
. Brief me on the outcomes of your session in planning. What were the main areas that appear to give problems?	This may be of help to the group representative who wil serve on the panel in CLOSIN SESSION.
. I know you chose a group representative for the closing panel. That person will need to observe closely and take notes during the session. If any of the rest of us can help, let me know.	
II. Introduce the CHECKLIST FOR IMPLEMENTATION	Time: 25 minutes
. Turn to it in booklet . Allow participants time to read checklist . Discuss the checklist "Are there any areas we overlooked?" "Are there some areas you consider more important than others?"	Use these and other question to start discussion.

ACTIVITIES/NOTES	COMMENTS
"Do you see the overlap between planning and implementation? Do you agree with where we drew the line?" "How could you use the check-list for your projects? Would it require changes?"	Put suggested changes, additions on blackboard or flipchart.
III. Discuss TRAINING ASPECTS	Time: 25 minutes (May use less time here - can add it on to discussion of case study and participants problems.)
. Training appears to be one of the critical issues in the implementation phase.	
. [As Craig Hafner pointed out, in opening session] so many training programs are not relevant to jobs that need to be done. There is no needs assessment to determine what jobs should be, no task analysis to find out tasks that should be performed, no job description. Instead, there are existing training institutes that teach a traditional curriculum, whether or not it is relevant to project need.	
. How can you solve this kind of problem? [In terms of liaisons, needs assessment, etc. and who would do all of this]	
. We must begin to recognize the importance of first - identifying the needs of the project (for staff), and identifying specific job positions and specific tasks these people must perform. THEN (and only then) building the training objectives around these tasks, so that all the training is geared, in a practical fashing, toward their job duties and responsibilities. Could this be done in your countries? Could you still use existing programs?	Might want to describe simple circular flow chart, to show steps of training in systems approach: Identify needs → Analyse problem → Write task list → What jobs are needed? What are the problems? / Is training needed? For whom? Can existing training be improved? / Describe the tasks performed for each job - in behavorial manner.

ACTIVITIES/NOTES

- In general, who must be trained?
  [Community, technicians, health personnel, etc.]

  How would you accomplish such a training program?
  Describe a staffing pattern - sites - budget.
  Where would you find skilled trainers?

IV. Divide into small groups (3 group of 5) to do next activities.

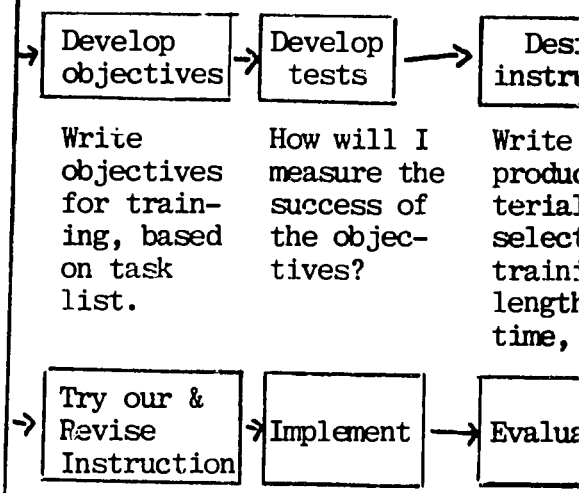
*NOTE: this is optional for leaders.

V. READ THE MALAWI CASE STUDY

Use the implementation checklist as reference. Make notes of the PROBLEMS you find in the study on the IMPLEMENTATION CRITIQUE SHEET in your booklet.

The PROBLEMS can be jotted down as you read the study, in the MAJOR IMPLEMENTATION AREAS we

COMMENTS



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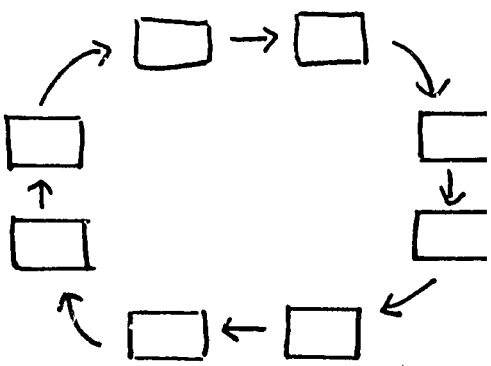

Time: 20 minutes
(30 minutes if using small groups.)

ACTIVITIES/NOTES	COMMENTS
just discussed. The CRITIQUE SHEET is organized this way. You also have a column for jotting down any problems you recognize for <u>your country</u>. This will help you prepare for the last group activity - where you describe problems you anticipate or have experienced in implementing your own project.	
. (If using SMALL GROUPS) When you have finished reading and making notes, discuss the problems you identified and compile then into one group report. Make sure the whole group agrees on the final list of problems for the case study.	
You have 30 minutes to do this.	
VI. PRESENT GROUP REPORTS	Time: <u>20 minutes</u>
Each group will present its report to full group - allowing questions/discussion as each completes presentation. After first group has presented, ask other groups topresent <u>only</u> those issues/problems that first group did not cover (or to argue why they think problem first group presented should <u>not</u> be on the list, etc.)	
* If not using small groups, conduct large group discussion, letting individuals identify problems they found.	
VII. ASK PARTICIPANTS IF THEY FOUND SIMILAR PROBLEMS IN OWN COUNTRY.	Time: <u>10 minutes</u>
. Point out that this discussion will help them think out next activity - where they begin to analyze implementation problems in own country.	
. Remind group representative to spend time (in evening) preparing talk for panel discussion tomorrow.	

ACTIVITIES/NOTES	COMMENTS
VIII. END OF DAY Tomorrow - one more hour in implementation phase to identify your own problems andsolutions.	5:30 p.m.

NEXT DAY (2nd day)

IX. PARTICIPANTS prepare own problems Use worksheet in booklet. Give option to work in pairs if want to (because of lack of experience, etc.)	Time: 30 minutes
X. Select participants to present problems. Ask for group critique. "Who has similar problem?" "Which proposed solution is most practical? Why?" "Is this a high priority problem? Could it be delayed or ignored? What are the consequences - long and short-term?" "How would our group representative summarize this session?"	Time: 40 minutes
XI. BREAK	10:15 - 10:30 a.m.

NEXT DAY (2nd day)

LESSON PLAN: GROUP SESSION ON EVALUATION

ACTIVITIES/NOTES	COMMENTS
I. Overview of Evaluation Session This session will be different that the preceding two. We will review a checklist for evaluation. But instead of looking at a new case study and identifying problems, we will use the 2 we have already read - BURUNDI and MALAWI - and try to come up with an evaluation scheme for each of them. You noticed there is not much information in the case studies about evaluation. This is very often a neglected area.	Time: 5-10 minutes
. STATE IMPORTANCE OF EVALUATION - Justifies future endeavors (Funding agencies want to know our track record). - Enables us to improve our approach next time. - Identifies problems and, often, the means to correct them. - Tells us where we are - our progress toward our goals. - Provides cost-effectiveness data.	Discussion - Get participants to add to this list, or come up with all the points.
. You have rotated again, and have a new leader. My field of expertise is different from the other leaders, I expect you to draw on my views to form you own perspective. Use me as a source of information with a view toward your own responsabilities in the Water and Sanitation area.	
. Who is the group representative? You will be on the panel shortly. If the group can be of any assistance to you, in preparing your remarks during this section, let us know.	

ACTIVITIES/NOTES	COMMENTS
II. INTRODUCE THE CHECKLIST FOR EVALUATION . Turn to it in booklet . Point out MAJOR categories . Allow participants time to read checklist. . Discuss the checklist "Are there areas to evaluate Which we overlooked?" "Are there some considered more important than others?" "Are there some areas which defy measurement?" [Point out that impact of Water and Sanitation on health is such an area - too many variables, long-term.]	Time: 15-20 minutes
III. Discuss Approaches to EVALUATION . The checklist only pointed out the areas to assess. It did not provide guidelines on approaches to evaluation. . Basically, evaluation is trying to determine: 1. Did the program accomplish its objectives? 2. Were the program objectives the right ones? Realistic? 3. What other things happened as a result of the program? . Give example of 3 points e.g. 1. Were all wells capped that we had planned - in the time designated and to an acceptable level of quality? 2. Was this the right thing to do - most cost-efficient? Affect the greatest numbers's of people? Right locations? Did time deadlines/constraints undermine community involvement?	Time: 25 minutes

ACTIVITIES/NOTES	COMMENTS
3. Did something else happen - did community establish stable organization? Were new jobs created? Or did we create too high expectations? Lose community support? Destroy village economy?	
. Ask group to provide more examples of above.	
. We evaluate these things in <u>formative</u> and <u>summative</u> evaluations. <u>Formative</u> means while the project is going on. This is actually <u>monitoring</u> the progress-measuring what is happening on a regular basis. <u>Summative</u> means after the project is completed. This is the assessment of what has been accomplished.	
. In this session we will work with the basic scheme for evaluation. It is an analysis that covers: WHO wants to know something from your evaluation. This is the identification of your target audience. WHAT QUESTIONS do they want answered? WHERE will you find such data? HOW will you measure the data you find? WHEN will you look for the data? How often? and WHOSE RESPONSIBILITY will it be to do all this? You, or someone else?	
This is the first step in planning on evaluation. After you have these answers, you can follow A.I.D. guidelines for constructing the type of study and the sample size.	

ACTIVITIES/NOTES	COMMENTS
But these questions are the heart of evaluation, and we will focus on them this morning.	
. In the booklet, turn to Evaluation Critique Sheet.	
LEADERS-NOTE: (Use the discussion points and example on following page to explain the EVALUATION CRITIQUE SHEET to participants.)	
IV. DIVIDE INTO SMALL GROUPS (3 groups of 5) to do next activities.	
V. Develop EVALUATION SCHEME for BURUNDI or MALAWI	Time: 20 minutes
. Small group should fill in sheets for one case study - developing as many questions, etc. as possible. Try to be through!	May want to assign one parti ular case study to each grou or let them choose. Circulate to each group, to sure they are working effect
VI. PRESENT GROUP EVALUATION SCHEMES	Time: 20 minutes
Each group can present its recommendations. Encourage discuttion -note differences, similarities in group reports. Are these schemes similar to what participants would develop in own country?	Might want to appoint secret to write on board (fill in c as groups make reports.
BREAK - DIRECTLY TO CLOSING SESSION	12:00

EVALUATION

(DISCUSSION and EXAMPLE)

AUDIENCE	WHAT QUESTIONS?	SOURCE	METHOD	WHEN	BY WHOM
(DISCUSSION) Who wants answers?	What are the questions each audience is asking? What to they need to find out?	Who can you go to, or Where can you go to find answers?	What method or instrument can you use to measure the source of information?	When should you measure?	Who should take the measure, to answer the questions?
Funding Agencies Government Ministries and/or regions Technical Training Schools etc.	How many wells are dug? How many people are using them? What is the cost? How effectively did those trained do their job? NOTE: Questions should be asked that can be answered immediately and definitely. (Avoid impact on health)	See technology in place. Check operations Project records The community -attitude -maintenance - use On site technicians Comm. organizers Health officer Progress of contractor	Observation Survey Interviews Questionnaire Regular reports etc.	Before and after project? During? At one point? At regular intervals? NOTE: Need both monitoring and assessment (formative and summative evaluation)	Outside consultants Community representatives Health Officer Ministry officials, etc.
(EXAMPLE) A.I.D.	How many people are served and at what cost?	Project records Water installation	Review of records. Observation of sited	-At project completion -Before project: twice, in dry & wet season. -After project: twice, in dry & wet season.	Outside consultants. e.g. WASH NOTE: if audience were different, then evaluation would be different.

CLOSING SESSION

ACTIVITIES/NOTES	COMMENTS
I. Introduction of Panel - B. Isely . Ask these questions: - What were the significant problems seen in last 1½ days? What phases? Did you see patterns, trends? - What types of solutions were proposed? Any particularly innovative approaches? - Do you have a clear idea of how, generally, the people in your group view Water and Sanitation projects? (Essential? Impossible? As part of larger project? Separate undertaking? etc.)	Time: 25 minutes (approximately 8 minutes per question, if ask each of 3 questions to panel)
II. Introduction of Reactors - B.Isely Sanders McJunkin . Sanders can summarize and relate back to PHC. . McJunkin can comment on their views as theyrelate to A.I.D. policy and current activities. Can point out the value of this type of information in continuing to shape A.I.D. efforts in Water and Sanitation projects.	Time: 15 minutes
III. CLOSING REMARKS - B. Isely . Restate objectives of workshop. (in booklet) . Only way we could see to accomplish these was in a combination format: - we provided some information - you provided some information - we used all the information to apply to real situations-yours. We hope these sessions have given you the chance to analyze your own issues.	Time: 10 minutes

ACTIVITIES/NOTES	COMMENTS
. We hope you go awaywith a few other things too - an increased awareness of the importance ofwater and sanitation projects. - a deeper commitment to such projects, and a fuller perspective of all facets. - the knowledge that there are valuable sources of help for such projects [such as WASH, etc.]	Ray: These are ideas you can elaborate on.
. We hope the workshop booklet will become a reference material for you, as you become involved in such projects.	
. We want current information on all Water and Sanitation projects. Please see one of us during the week if you have either operational or planned activity. And continue to stay in touch with us.	
IV. PARTICIPANTS FILL OUT QUESTIONNAIRE (back of booklet).	Time: 10 minutes

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August 1979

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SAFE WATER –

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ESSENTIAL TO HEALTH

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SAFE WATER – ESSENTIAL TO HEALTH

by
Dr Eric R. Ram*

INTRODUCTION

On a visit to Southern Sudan earlier this year, I met several women, with children slung on their backs, walking along a winding path, carrying earthern pitchers on their heads. This sight became a commonplace one for me after a few days in the country. The women of Southern Sudan commonly walk up to five or ten kilometers to fetch water, then trek back the same distance with it to their homes. This is in addition to their other tasks of washing, cooking and caring for their children and husbands, and cultivating the land to grow food. For many, this series of tasks is the story of each day of their lives. And Sudan is no exception in the developing world where the collection of water is, primarily, the task of women. Especially in years of insufficient rain, women must undergo extreme hardship in order to fetch water from remote places. Since much time and energy is spent in collecting water, little time is left for other family activities, including health care.

The importance of safe drinking water and sanitation in the control of such diseases as diarrhoeas, typhoid and paratyphoid fever, shigelloses, salmonelloses, cholera, infectious hepatitis, amoebiasis and giardiarsis has been well established. However, according to a recent global survey conducted by the World

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UNICEF photo by P.E. Mandl

In the developing world, the collection of water is, primarily, the task of women, who must often undergo extreme hardship to fetch water from remote places.

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Health Organization (WHO), 78 per cent of the world's rural population is without reasonable access to a safe and adequate water supply. In absolute numbers, this means that 1230 million people, excluding the population of the People's Republic of China, are without adequate water supply. Of these, more than 700 million are children; and this is of particular note in 1979 – the International Year of the Child. These numbers are growing faster than safe water supplies are being installed. Only 38 per cent of the population in developing countries have access to safe drinking water.

The urgency of the need to do something about the situation has been well expressed by the United Nations' declaration of an International Water Supply and Sanitation Decade (1981-1990), whose motto is "Fresh Water for All by 1990". The importance of water in the context of health services was also emphasized during the 1978 WHO/UNICEF International Conference on Primary Health Care, held in Alma-Ata, USSR.

WATER – A BASIC NEED

Safe, adequate and accessible supplies o water, together with sanitation, are recognize as basic health needs and essential compo nents of primary health care. Many of th diseases affecting underserved population especially the rural poor and slum dweller could be greatly reduced by meeting thes basic health needs. Plentiful supplies of clea water help to decrease mortality and morbi dity, in particular in infants and children, a well as making life easier for women.

A survey on the relation between water suppl disposal of excreta, and health has been con ducted through twenty-eight studies in variou parts of the world. It suggests that a significan relation does exist between an adequate, saf and convenient source of water and the inc dence of waterborne and water-related dis eases. The studies provide empirical evidenc that the closer a family lives to protected wate the lower will be the incidence of diarrhoe The ease with which reasonably good wat can be obtained by users seems to be the ke

Water is an essential element for many areas of development.
UNHCR photo

factor. Several studies have stressed that simply providing safe drinking water, or only providing facilities for disposing of excreta, without the other half of the solution, will be unlikely to lead to an improvement in health.

Water is an essential element for many areas of development. At the 1978 Alma-Ata Conference on Primary Health Care, it was said that water for household use is as important as water for domestic anirnals, farm irrigation,

Table 1

DISEASES RELATED TO DEFICIENCIES IN WATER SUPPLY OR SANITATION

Group	Diseases	Route Leaving Man (a)	Route Entering Man (a)	Relevant Measures
WATERBORNE DISEASES				
Water acts as a passive vehicle for the infecting agent. The contamination of the water occurs through poor sanitation.	Cholera	F	O	Improve quality. Aim for maximum microbiological quality of water. Improve sanitation.
	Typhoid	F,U	O	
	Leptospirosis	U,F	P,O	
	Giardiasis	F	O	
	Amoebiasis	F	O	
	Infectious hepatitis	F	O	
WATER-WASHED DISEASES				
Inadequate quantity of water and poor personal hygiene create conditions favourable for their spread. The intestinal infections in this group also relate to lack of proper human waste disposal.	Scabies	C	C	Improve quantity. Provide a greater volume of water, facilitate access, and encourage its use. Improve sanitation, personal hygiene.
	Skin sepsis	C	C	
	Yaws	C	C	
	Leprosy	N(?)	?	
	Lice & typhus	B	B	
	Trachoma	C	C	
	Conjunctivitis	C	C	
	Bacillary dysentry	F	O	
	Salmonellosis	F	O	
	Enterovirus diarrhoea	F	O	
	Paratyphoid fever	F	O	
	Ascariasis	F	O	
	Whipworm (Enterobius)	F	O	
WATER-BASED DISEASES				
A necessary part of the life cycle of the infecting agent takes place in an aquatic animal. Some are also affected by waste disposal. Infections spread other than by contact with or ingestion of water have been excluded.	Urinary schistosomiasis	U	P	Reduce contact with infested water. Protect water source. Improve sanitation.
	Rectal schistosomiasis	F	P	
	Dracunculosis (Guinea worm)	C	O	
WATER-RELATED VECTORS				
Infections are spread by insects that breed in water or bite near it. Adequate piped supplies may remove people from the biting areas or enable them to dispense with water storage jars where the insects breed. Unaffected by waste disposal.	Yellow fever	B	B mosquito	Clear vegetation. Avoid need to visit source. Provide reliable supply. Get rid of stagnant water.
	Dengue + dengue hemorrhagic fever	B	B »	
	West-Nile & Rift Valley Fever	B	B »	
	Arbovirus encephalitides	B	B »	
	Bancroftion filariasis	B	B »	
	Malaria (b)	B	B »	
	Onchocerciasis (b)	B	B (Simulium Fly)	
	Sleeping sickness (b)	B	B (Tsetse fly)	
FECAL DISPOSAL DISEASES				
A group of water-based type infections likely to be acquired only by eating uncooked fish or other large aquatic organisms.	Clonorchiasis	F	Fish	Proper disposal of fecal materials. Eat well-cooked fish.
	Diphyllobothriasis	F	Fish	
	Fasciolopsiasis	F	Edible plant	
	Paragonimiasis	F,S	Crayfish	

(a) F = feces; O = oral; U = urine; P = percutaneous; C = cutaneous; B = bite; N = nose; S = sputum
(b) These are usually related to natural standing or flowing surface water.

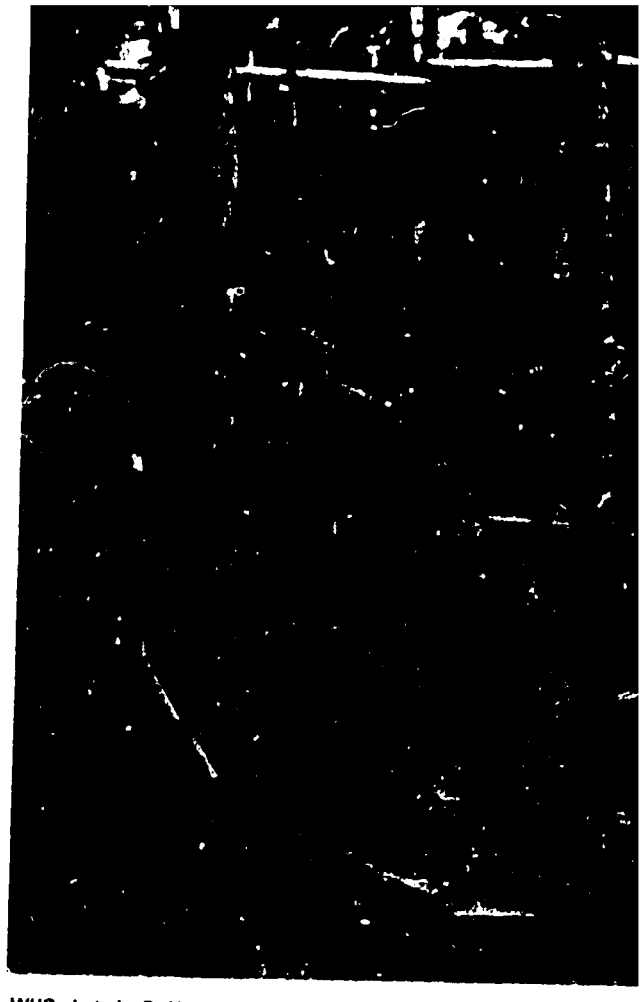
Source : World Bank Research Publication: **Village Water Supply — Economics and Policy in the Developing World,** 1976, p. 32 (Adapted.)

energy and industry. It follows that programmes and activities to supply water and sanitation should be considered within the framework of total development efforts.

WATER-RELATED DISEASES

The first consequence of lack of water is disease. WHO estimates that as many as 80 per cent of all diseases in the world are associated with water. Table 1 shows that this association can take one of several forms. Some relevant disease-prevention measures related to water are suggested in the last column of the table.

An astonishing number of people suffer from water-associated diseases at any one time: in round figures, there are 400 million with gastroenteritis, 160 million with malaria, 30 million with river blindness, 200 million with schistosomiasis. Diarrhoeal diseases, especially among infants, constitute a major cause of acute morbidity and mortality throughout the developing world. Skin and eye infections are also a major cause of ill health in the water-washed category and are reduced by increasing the **quantity** and availability of the water supply, almost irrespective of its quality. Therefore, a ground rule can be postulated: that in all low-income



WHO photo by P. Almasy

Increasing the quantity and availability of wa supply for personal hygiene has important heal benefits.

Community "water boards" or health committees choose a caretaker to be trained and supervised maintenance of wells, care of a pump and disinfection of the well.

UNICEF photo by Matheson

regions, efforts should be directed to bringing abundant year-round quantities of water close to where people live. Conventional wisdom would add that **all** water supplies, with the possible exception of underground water sources, should be treated to improve quality; such treatment will pay additional dividends in improved health.

COMMUNITY INVOLVEMENT IN WATER DEVELOPMENT

Too often, engineers and technicians go to villages to install water facilities such as hand pumps, expecting the villagers to use them immediately and for long periods of time. If this does not happen, it is concluded that the villagers are ignorant and have no motivation to use clean, safe water. However, the truth of the matter is that villagers have seldom been consulted on the subject of water needs, and seldom prepared in the use and maintenance of facilities.

Conversely, it has been seen time and again that, with proper consultation and guidance from community leaders, people can be motivated to help in the construction, operation and maintenance of water facilities for their villages. Experiences show that when villages have formed locally elected "water boards" or have given responsibility for water development to existing community health committees, that the day-to-day operation, management and maintenance run smoothly and well. The villagers, of course, require technical advice and assistance from the district or state government. Local "water boards" or health committees help collect funds for the maintenance of wells, choose a caretaker to be trained and supervised in the care of a pump, arrange for disinfection of wells and educate the people in the proper use and maintenance of a water system.

To ensure that the community does participate in the development of water for their village, it is important that they be involved from the planning stage onwards so that they see the development as their own programme. In this way, the community's involvement deepens and, in the implementation stage, they can and will claim responsibility.

The positive role of community participation in water development can be illustrated by events in Malawi. Here, participation of local people was the key to success in bringing piped water to over 150,000 villagers in water-scarce areas, at a cost of about US$3 per head. The villagers dug all the trenches, laid the pipes (supplied by the government and aid agencies) and constructed concrete aprons and soak-away pits. Small-scale demonstrations were initially used, leading to large public meetings where there was a chance to discuss all aspects of the new system. As the project evolved, the concept of a "barefoot engineer" was introduced; three-week training courses were conducted under tents for men who had been carefully selected by the community and charged with responsibility for the local system.

Another example of the importance of community participation in the installation and operation of a water supply system comes from the Philippines. There, the International Institute for Rural Reconstruction (IIRR) identified the hydraulic ram pump as a possible solution to the water supply problem of upland villages in the Cavite region. A questionnaire, designed to gauge the villagers' acceptance of the proposed system and their commitment to paying for and maintaining it, was administered in three villages. The third, Batas, accepted the project along with all the attendant responsibilities, after it had been thoroughly explained at a village assembly. Installation was accomplished with village labour and the hydraulic ram now provides a continuous supply of water to the village. The total cost to Batas of the system, which provides 5760 gallons per day to the population of 1250, was US$ 400. Since its installation, the community's enthusiasm for the project – what the IIRR team calls the "technical, social and economic appropriateness of the system" – have greatly contributed to its success, and the simplicity and economy of the technology have allowed the community to modify the system to suit their own needs without IIRR input.

NEED FOR AN EFFECTIVE MAINTENANCE SYSTEM

Experience shows that when water-system equipment such as hand pumps, tanks, filters and cisterns have been provided, there is often neglect in arranging for their operation and maintenance. Even the simplest of components require timely routine maintenance to prevent breakdown or malfunctioning and to preserve the investment. A non-functioning water supply system is of benefit to no one. It is

impossible to estimate the numbers of wells, pumps and water systems standing idle for lack of preventive maintenance. The ultimate responsibility for the continuous functioning and maintenance of equipment or a system lies with the community, at a local level, backed by a national programme.

A good example of this comes from the State of Tamil Nadu, in India, where a three-tier maintenance system was recently introduced. Since 1971, the State of Tamil Nadu has installed about 15,000 deep-well hand pumps and about an equal number of shallow-well hand pumps, serving over 16,000 villages in the rural areas of the State. The three-tier system is intended to ensure maintenance of these wells and pumps, and is embodied in the following service personnel:

1) Caretaker at Village Level

An interested and enthusiastic volunteer, who usually lives close to the hand pump, is chosen from among the villagers. He may be a farmer, shopkeeper, artisan or social worker. He is given a two-day orientation course on the importance of drinking water supply and on the mechanism, operation and servicing of hand pumps. He is trained to attend to minor repairs and is supplied with basic tools. He is also given pre-stamped and addressed postcards in the local language. When a breakdown occurs, the caretaker tries to fix it. If he can not do so, he specifies the type of repairs needed on two postcards, one of which he posts to the block-level "fitter" and the other to the Tamil Nadu District Water Supply and Drainage Board mobile team. So far, 1620 caretakers have been trained in Tamil Nadu State.

2) "Fitter" at the Block Level

One "fitter" for every 100 hand pumps is appointed at block level. He is under the supervision of the Block Development Officer. Upon receipt of a request from a caretaker, the fitter proceeds to the village and attends to repairs, if the problem is located in the "top end" of the mechanism.

3) Mobile Team at the District Level

In case of need for major repair, it is the mobile team at the district level which proceeds to the village upon receipt of the postcard. There is one such team for every 1000 hand pumps and, hence, this often involves a delay of a week more. To reduce this wait, the Tamil Na Government is now recommending one su team for every 500 hand pumps. Any expens incurred in the repairs are shared by t government and the local "gram panchaya (village councils).

The effort made to set up an effective mainte ance system in one village (Erandoli) in t Miraj Integrated Health Services Project Maharashtra State, India, is noteworthy. T villagers fitted a small motor to the pump in t bored well to pump water to a small waterhe tank, made out of a cement barrel. They assig ed the task of maintenance to a local m who lived nearby and ran a bicycle repair sho The village paid him 30 rupees (US$5) a mon for the job. He turned the motor on until t tank was full and looked after its maintenanc Because they paid him a fee, however sma the villagers valued the service more.

FINANCING COMMUNITY WATER DEVELOPMENT PROGRAMMES

In order that the maximum number of peop can benefit, it is necessary to find low-co solutions and to establish sound long-rang financing for water development project Revolving funds certainly offer one excelle method of financing because of their flexibili and adaptability to local needs and condition To start with, the funds need to be establishe at national, regional and local levels to provid capital for the construction and developme of the community water source. The loc people can contribute in terms of money, ma terial or labour and can decide on the suitab period of development and return of loans. Th loans are recovered by having the benefite community repay the fund. As the payment come in, they are available to finance othe community water development efforts.

Recent studies in Latin America indicate tha repayment schemes tend to promote effectiv organization at the local level. Communitie soon get used to community financing of servi ces received and one of the major benefits see is increased community involvement.

According to a WHO and World Bank estimate US$140,000 million would be needed to pro vide "clean water for all by 1990". Where wi all this money come from? It will require th joint effort of government at national, state an

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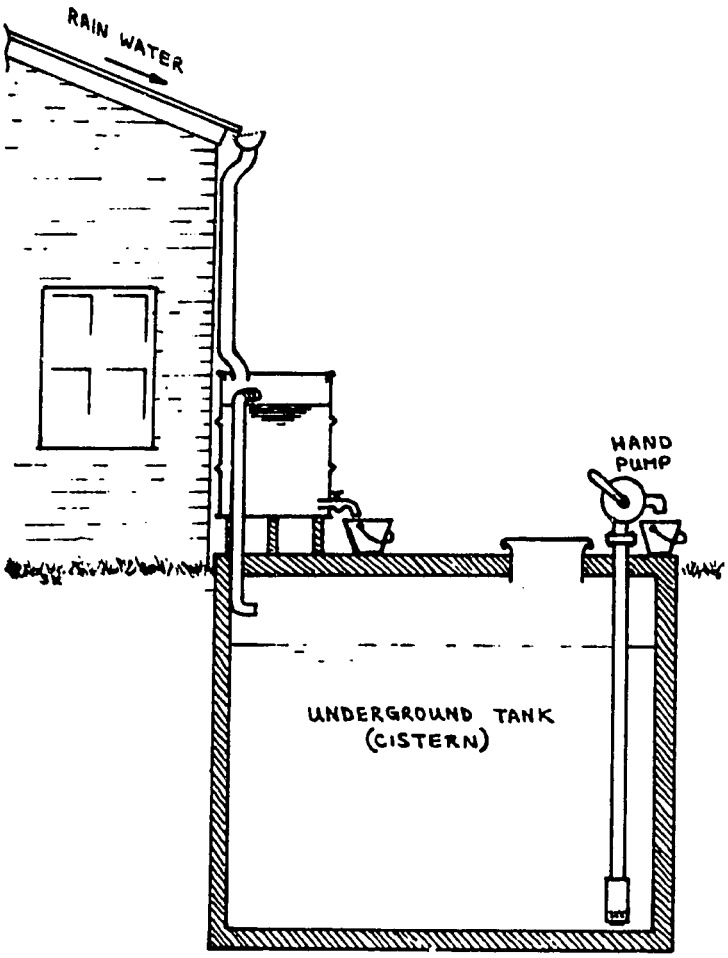


Figure 1 (by Stuart J. Kingma)
Domestic collection and storage of rainwater.

local levels, and of non-governmental agencies and church organizations; it will also require the communities' own contributions. It is not simply a question of money, however. It also means setting a new priority – water – and the willing determination to meet the target. The Alma-Ata Declaration (see CONTACT No 47, October 1978) speaks of the need to involve the community in primary health care as a whole and certainly, such involvement is essential if the Water Decade targets are to be met.

SOURCES OF WATER

The first step in designing a water system is to choose a suitable source or combination of sources of water. The source must be capable of supplying enough water for the community. If not, another source or perhaps several sources will be required. Some of these sources are listed below, and ways to tap them for human consumption and use are suggested.

1) Rainwater (See Figure 1)

In certain parts of the world, such as the countries of the Mediterranean littoral, rainwater catchments and reservoirs have been constructed and used for thousands of years. In some cases, the catchment basin is on the ground and in other cases, the run-off from roofs is collected. Reasonably pure rainwater can be collected from housetops made of tiles, slates, galvanized iron, aluminium or asbestos sheeting, but not of thatch or lead. The roof guttering should slope evenly towards the downpipe. If collected correctly and properly stored, this water is not contaminated, provided also that the collection is carried out during periods of regular rainfall. Dirt, dead leaves and bird droppings will accumulate on the roof during dry seasons. It is best to let these be washed off by the first few rains, with collection and storage beginning when roof and gutters are clean. A wire mesh should be placed over the top of the downpipe to prevent it from becoming clogged with leaves. It may be convenient to locate a storage barrel beside the house for domestic use of water and to run the overflow to an underground tank or cistern where it can be stored until needed in the dry season.

One can estimate how much rainwater can be collected, based on the roof area and the yearly rainfall, in the following way:

One millimeter (mm) of rainfall on one square meter of roof will give 0.8 liters of water, allowing for evaporation. So, if the roof measures 5m X 8m, and the average annual rainfall is 750 mm, then the amount of rainwater which can be collected in a year is equal to

$$5 \times 8 \times 750 \times 0.8 = 24{,}000 \text{ liters per year.}$$

If this could all be stored, it would provide for that family during the next year

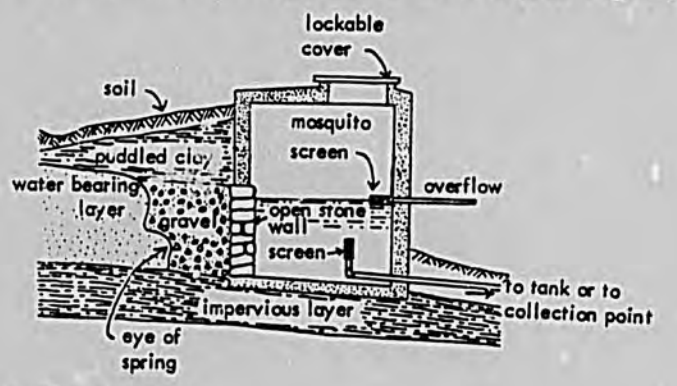
$$\frac{24{,}000}{365} = 66 \text{ liters on average per day}$$

2) Springs

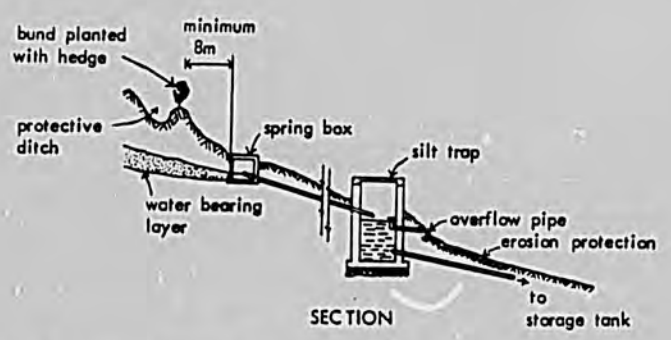
Springs are found mainly in mountainous or hilly terrain. Spring water usually flows from a deep "water-bearing layer" of sand or gravel, and comes to the surface because changes in the configuration of clay or rock strata forces it upward. The local people usually know of most springs in their area. Spring water can generally be used without prior treatment if the springs are properly protected by bricks, concrete or masonry constructions so that the water flows directly into a pipe without ever being open to pollution from outside. It is usually possible to arrange for the storage

reservoir or tank to be at a level lower than the spring, and the transfer pipe operates by simple gravity power.

To protect a spring, one should dig back into the hillside to the water-bearing layer to where the water flows from the "eye" of the spring. A collection chamber, sometimes referred to as a "spring box", should be built here (see Fig. 2).



a. A spring box.



b. Protected spring connected to a silt trap.

Figure 2 (after Sandy Cairncross and Richard Feachem)

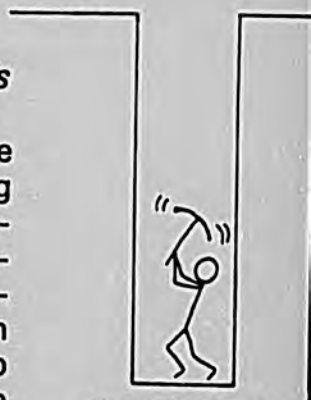
Before the back of the box is built, loose stones should be piled against the eye of the spring. This will serve to make a foundation for the spring box, and to prevent the spring water from washing soil away from the eye. The box should be covered with a concrete slab so that it is protected from outside pollutants. The slab should be removable or contain a "manhole" so that it is possible to get inside to clean it when necessary. When the spring box is complete, the space behind and around it should be filled with soil. Care in construction is necessary to prevent surface water from running down the hillside and into the box. At the bottom, level with the eye, the space should be filled with gravel or sand at least as coarse as the water-bearing layer. To make sure that the running water does not stagnate near the spring, an overflow pipe or gutter can be built leading to a point 5 - 10 meters away.

3) Wells

In areas where groundwater is readily availa at moderate depth, digging or drilling wells time-tested, simple and relatively inexpens method of providing a good water supply the community. Various means can be used construct wells:

a. *Hand-dug Wells*

In many parts of the world, hand-dug wells serve as a major source of drinking water. Their diameter and depth vary from place to place. Experience shows that it is difficult for two men to dig a well if its diamete less than 1.2 meters.



Hand-dug well

With the exception of wells sunk into cons lidated rock, an inner lining of perman materials such as brick, stone, mason reinforced concrete, etc., is to be reco mended. The lining serves several purpos It provides protection during constructi against caving and collapse; it retains t walls after completion, thus prolonging t life of the well; it acts as a seal to prevent p luted surface water from entering the wel isolates and protects the aquifer (the und ground stratum of flowing water) from pol tion; and it acts as a foundation and supp for the well top and any pump or oth mechanism which may be fitted on comp tion. Masonry, stone and brickwork a

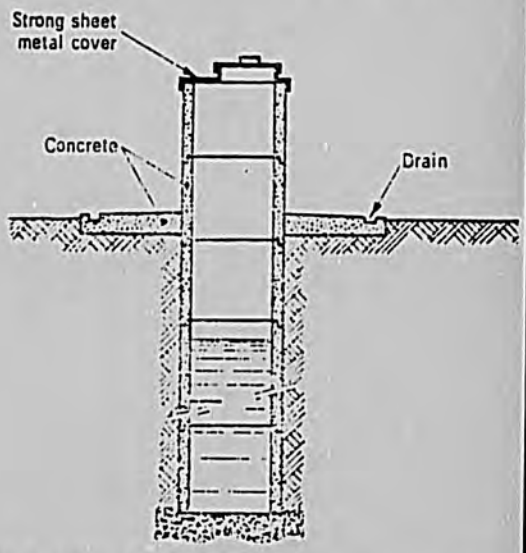


Figure 3 (after S. Rajagopalan and M.A. Shiffman)

Hand-dug well with cement lining.

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UNICEF photo by Matheson

In many parts of the world, hand-dug wells serve as a major source of drinking water.

widely used in many countries and can be very satisfactory if conditions are right. Where materials are available but no skilled masons, it is necessary to train people in the construction and lining of wells. Where cement and sand are available, it is relatively easy to train unskilled workers to pour concrete into place, under supervision. Steel and timber are not recommended as lining materials (see Figure 3).

Whenever a well is dug, a raised parapet should be constructed around its outer rim to protect the well from the inflow of outside dirty water. The wall should be high enough to prevent children and animals from falling into the well.

Such a hand-dug well usually has an open top and is likely to become polluted. It is necessary, therefore, to disinfect the well regularly, particularly if the bucket-and-rope system is employed to retrieve the water. Methods of well disinfection are described later in this paper.

It is also possible to improve existing wells by putting a reinforced concrete apron over them and fixing a hand pump with which to draw water (see Figure 4). Provision for a lockable manhole should be made in the concrete slab to allow chlorination of the water in the well.

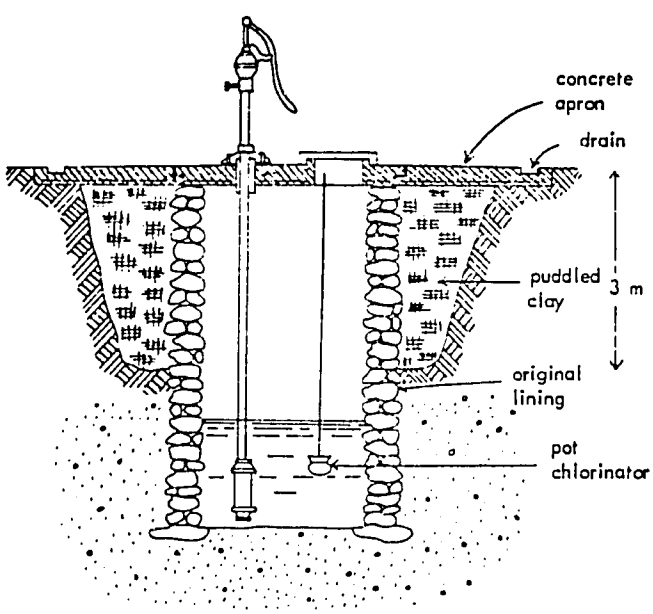
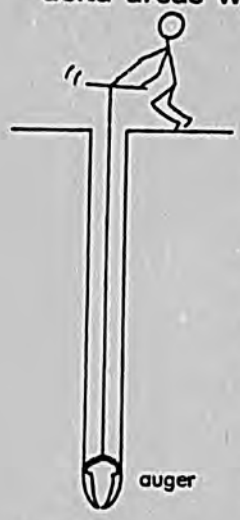


Figure 4 (after E.G. Wagner and J.N. Lanoix)
Improving an existing well.

b. *Bored Wells*

It is possible to use a boring technique in soft soils, sand and limestone, particularly in delta areas where this type of soil is most common. (This method is not feasible where underground formation is hard, such as rock or stone.) Such wells can be bored by hand, using such tools as earth borers, hand augers, spiral augers and rock chisels. A small hole of about 30–50 cm deep and of sufficient diameter to allow the introduction of the borer, is first dug in the ground with an ordinary pick or crowbar. From then on, boring proceeds to the desired depth.



Bored tube well

The shape of the internal spiral in the head of the boring instrument allows the loosened soil or gravel to rise upwards. From time to time, the borer is raised out of the hole, together with the soil extracted. Once the boring is completed and the water-bearing stratum deeply penetrated, small-size pipes with screen or strainers attached are lowered into the hole, a pump is installed and the well is completed by the construction of an adequate platform and a barrier to contaminating surface water.

c. *Driven Wells*

A driven well is made by pushing a pointed strainer, called a "well point", into the ground. A well point is a specially made steel tube with a point at the lower end and holes, or slits, in the sides through which water can filter.

A well point is driven into the ground, using a simple mechanism for hitting the top of the pipe with a heavy weight. As each length of pipe goes down, additional lengths of steel pipe are fixed to the top. The top end of the pipe is protected from damage while driving with a steel end cap or wooden block.

Driven tube well

Most well points are between 30 and 50 mm in diameter. The pumps used with this type of well have a mechanism known as a pu cylinder which is inserted down the well. proper functioning of the pump, the cylin should not be more than 5 meters above well point (see Figure 5).

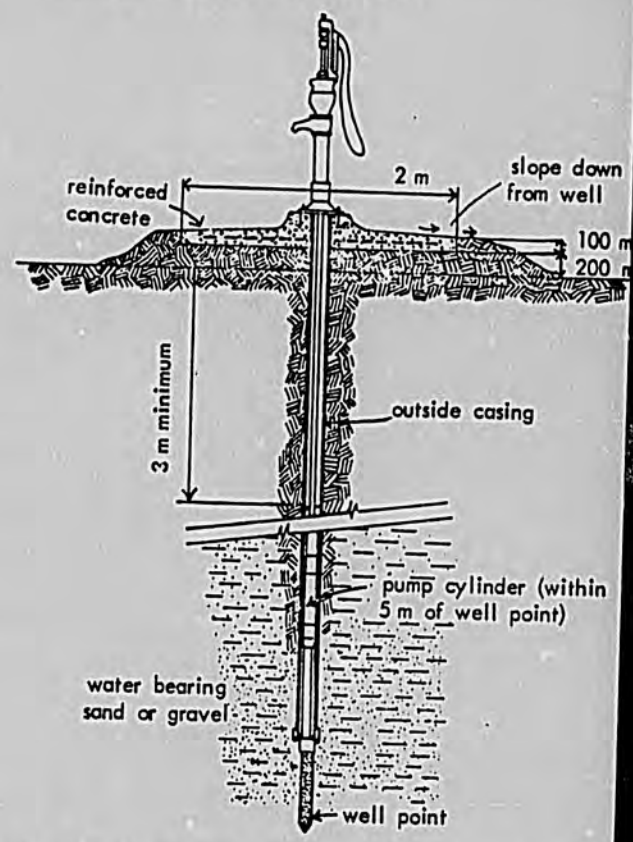
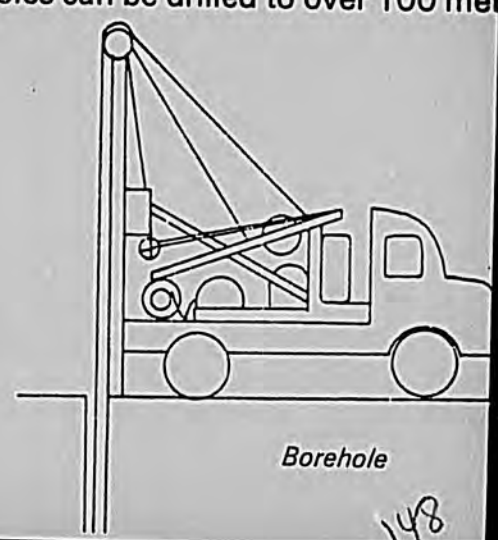


Figure 5 (after Sandy Cairncross and Richard Feache
A tube well with a driven well point.

d. *Drilled Wells*

Drilled wells are constructed with the hel machines especially designed and manuf tured for this purpose. These machines called drilling rigs, and they are generall two types: the "cable tool" or percuss type, and the rotary. They are mounted o truck. Drilling wells is specialized wo requiring training and experience. In so countries, it is possible to hire a drilling from a private contractor or the governme Boreholes can be drilled to over 100 met



Borehole

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UNICEF photo by Tom Martin

Pakistan

UNICEF photo by Matheson

Malawi

Various types of wells and pumps which can be constructed to provide a good water supply for the use of the community.

deep, even through rock. However, there can be no guarantee that water will be found. It is important, therefore, to choose very carefully exactly where a borehole should be drilled, with the help of experienced and trained people, together with information gleaned by hydrogeological surveys. If the water level in a borehole is over 60 meters down, it is difficult or even impossible to pump it up by hand and powered pumps are needed.

e. *Hand Pumps*

For most communities using wells of the three types described under a., b. and c. above, the use of hand pumps is the most appropriate way to efficiently get their water. A hand pump is easy to install. Most work by moving a piston up and down in a cylinder. In certain types, the cylinder is at the bottom of the well, and the piston is connected to the surface by a steel pump rod. There are very sturdy, relatively low-price pumps available of this type and which are capable of drawing water up to 25 - 30 meters upwards. Another type is called a "suction pump" and has a cylinder at the top of the well. This type is suitable only for shallow wells of up to 7 meters in depth. For each of these types, upkeep is simple and inexpensive.

The most important thing about a pump is its maintenance. (See section entitled "Need for

WHO photo (IYC) by P. Almasy

Latin America

an effective maintenance system" including the description of the three-tier maintenance system adopted by the State of Tamil Nadu, earlier in this paper.)

f. *Hydraulic Ram Pumps* (See Figure 6)

When a supply of water is required at a level which is considerably higher than that of a

International Institute for Rural Reconstruction

Hydraulic ram

spring or other source, the hydraulic ram is one of the simplest and cheapest devices for pumping it upwards. Its economy and simplicity consist in its requiring no engine and hence no electricity or manual power. The hydraulic ram makes the water pump itself. Two factors are necessary for this:

- The hydraulic ram must be situated well below the water source. Its raising power derives from the momentum of the w ter stream falling from the source to ram and moving through it.
- The source must produce a supply water in considerable excess of amount needed since the hydraulic r pumps only a small percentage of water flowing through it.

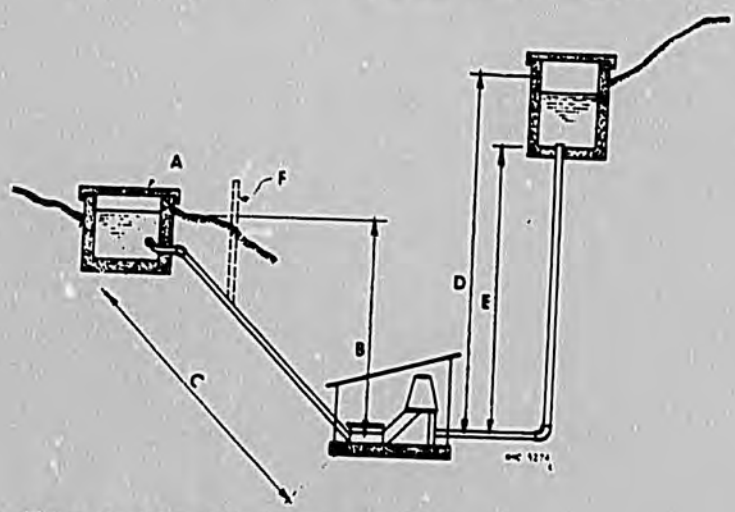

Figure 6 (after E.G. Wagner and J.N. Lanoix)

Hydraulic ram

A = Supply—litres/minute
B = Difference in elevation between ram and supply-power head
C = Length of drive pipe
D = Difference in elevation between ram and highest point to which water is to be elevated—pumping head
E = Total length of supply pipe
F = Stand-pipe, necessary in case of exceedingly long drive pipe

The water is conducted to the ram throu a drive-pipe, laid at a gradient of about 1 10 to 1 in 7, according to the volume water pumped. The pressure of water obtained serves to work the ram.

The ram itself functions with two worki parts which are an adaptation of the wa hammer principle. A combination of v ves of suitable dimensions are placed wi in a small cistern and fitted with an chamber. The alternate opening and sh ting off of the water supply by the va and the consequent release and checki of the water pressure forces a certain p tion of the water upwards.

The higher the desired height of t supply, the smaller is the amount of wa delivered. Between 7 and 14 times much water is required to work the ra than will be raised. A small amount of w ter with plenty of fall will pump as mu water as a greater quantity with a sm fall.

The hydraulic ram pump requires ve little maintenance. Rubbish must be cle red away from the strainer in the intak and the rubber valves must be replac when they wear out. When the wa source is a spring, the ram can continue function continuously and a great deal water is pumped over a 24-hour peri

The ram does not work under water a should, therefore, be fitted above flo levels. It must be firmly bolted down o concrete foundation and a drain provid for carrying waste water away from t escape valve. It should be located as ne as possible to both the source and t delivery point, while still maintaining t lowest possible elevation. It should be w tertight, with the strainer at the top to ke rubbish particles out of the water.

Since only a small percentage of the wat flowing through the ram is pumped, t

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surplus can be used for other purposes such as crop irrigation.

PURIFICATION OF WATER

The major health benefits of plentiful water supply will not be obtained if the water contains pathogenic organisms. Such organisms are responsible for many water-borne diseases and must be destroyed. Rainwater, highland stream water, springwater and some groundwater is generally good and little or no treatment is required for it. But surface water, that is, water from lowland rivers, unprotected shallow wells and some underground sources may be contaminated and should, therefore, be purified.

Various forms of treatment are available to improve water quality and safety for human consumption. Some of the simpler methods of water purification which can easily be adapted to rural conditions are discussed here.

1) Storage and Sedimentation
(See Figure 7)

The simplest method of treatment is storage in a covered tank. Water quality can also be improved in a large tank by sedimentation, the process by which silt and other solid materials sink slowly to the bottom of the tank. During storage, there is substantial reduction of bacteria, especially pathogens; this will not happen of course if organic matter has fallen into the tank (e.g., leaves, frogs, etc.). It should be remembered that sedimentation does not remove all of the harmful organisms from polluted water, although, if water can be stored for at least two days, it will be free of bilharzia-causing schistosome larvae. Sedimentation does help to make silty water clearer. It will produce completely clean water only if a specially designed tank is used and chemicals are added to the water to help the process. Sedimentation naturally is more effective in combination with slow sand filtration and chlorination.

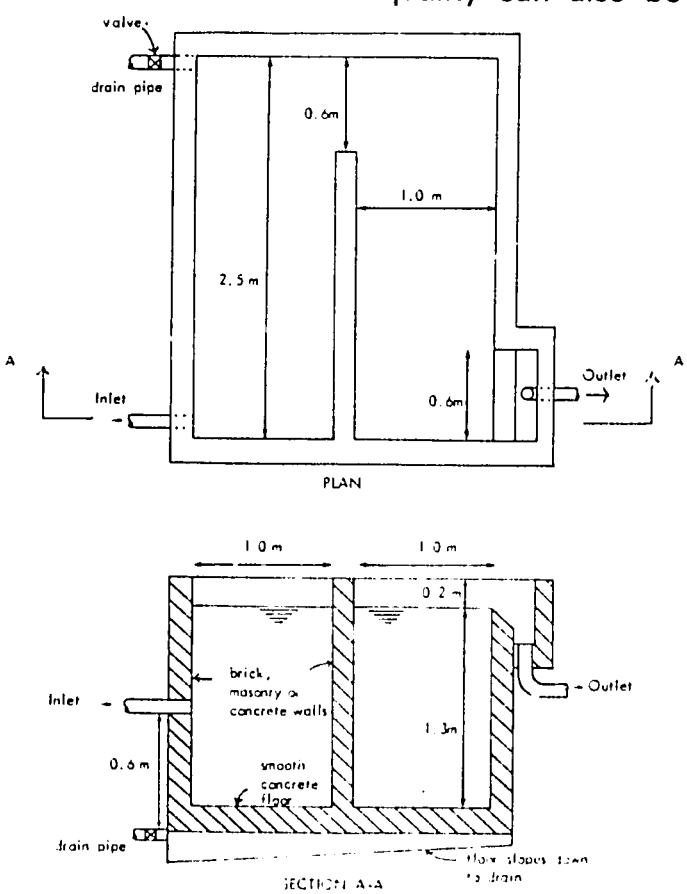

Figure 7 (after Sandy Cairncross and Richard Feachem)

A simple sedimentation tank for flows up to 2000 liters/hour.

In any storage tank, the inlet should be above the top water level, while the outlet should be about 10 cm above the bottom of the tank, and they should be arranged on opposite sides of the tank. Sedimentation tanks need to be cleaned out regularly and, therefore, require a drainpipe. Cleaning the tank is much easier if it has a floor which slopes to the drain point.

2) Filtration

Some types of water filters, if correctly operated, can remove up to 99 per cent of bacteria. Slow sand filtration, for example, is an excellent method of water treatment for rural water supplies. It can give good results with a minimum of operational and maintenance skill. Although sand is the most convenient material for filtering water, other materials, such as burnt rice husks, may be used. Whatever material is used, the particles should be fairly uniform in size, preferably between 0.3 mm to 1.0 in diameter.

a. *Slow Sand Filter* (See Figure 8)

A slow sand filter consists, basically, of a large tank, containing a bed of sand. The water filters down through the sand to a set of drains which take it to an outlet chamber. The filter does not work by a simple straining process alone. The sand grains in the top layers of the bed become coated with a sticky deposit in which bacteria and microscopic plants multiply. These form a very fine straining mat in the top few millimeters, as well as killing most other micro-organisms which do pass through.

A tank with walls which rise about 2.5 meters

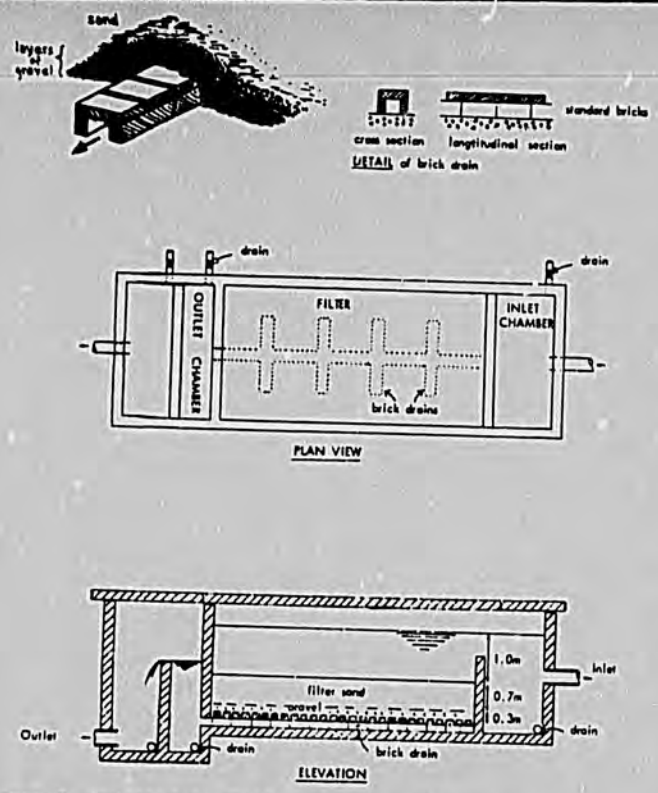

Figure 8 (adapted by CMC; after Sandy Cairncross and Richard Feachem)
Slow sand filter.

above its floor and a base at least 3 square meters in size (for example, one meter wide and 3 meters long) will have a filtration capacity of 400 liters per hour. Increasing the size of the tank in its floor area (not in height) in increments of 3 square meters will increase its output by increments of 400 liters per hour.

The sand should be at least 70 cm deep and at least 1 meter of water should be maintained above the sand to provide filtration pressure. Between the sand bed and the drains, there should be 3 or 4 layers of clean gravel, each 7-8 cm thick. The gravel particles in each layer should be of uniform size, with the particle size twice as large as in the layer above. Thus, the first layer on the floor of the filtration tank, also covering the drains, should contain particles of about 25 mm in diameter. The next layer might be about 10 mm diameter, the next about 5 mm, and the next 2 mm in diameter. On top of this, the sand is poured, making the entire filtration depth approximately one meter.

The drains beneath the gravel may be made of bricks, laid together without cement, making an arched tunnel. A small tank of only one meter width need have only a single drain down the middle leading to the exit into the outlet chamber. For larger tanks, branches can be added to the drain so that the drains are never more than one meter from each other or from the walls. The outlet chamber is construc-

ted with a partition wall which reaches a hei a little above the top of the sand in the filtra tank; this ensures that the sand will rem covered with water even if inflow is stopp As filtration proceeds, water flows over partition in the outlet chamber and is availa for the outlet pipe.

Ideally, an inlet chamber is also built to al particles in the incoming water to settle not contaminate the sand. All four section the unit should have floor-level drains cleaning purposes. The entire unit should course, have a secure cement cover provi with manhole covers for access. A small w screen-protected air vent is also necessar the cover is airtight. A float-valve regulator be installed to maintain the water level in filtration tank.

If the water being treated is reasonably clea slow sand filter may function for weeks or e months without cleaning. When necessa however, the slow sand filter can be cleaned raking off the top 20 mm of sand from the s face of the sand bed and discarding it. T layer should be replaced by new clean sa The old sand can be washed, flushed copiou with water and re-used.

b. *Household Sand Filter* (See Figure 9)

A household sand filter is easy to build and remove most of the silt, cysts, ova, schis some larvae and large organisms but not bacteria from water. A 200-liter steel dr with a removable lid should be thoroug cleaned out and disinfected with bleachi powder. A hole should be made in the side the drum near the bottom, and a tap fitted to The drum should also have two holes in t side, near the top, for an inlet and an overflo The overflow hole should be 5 cm above t

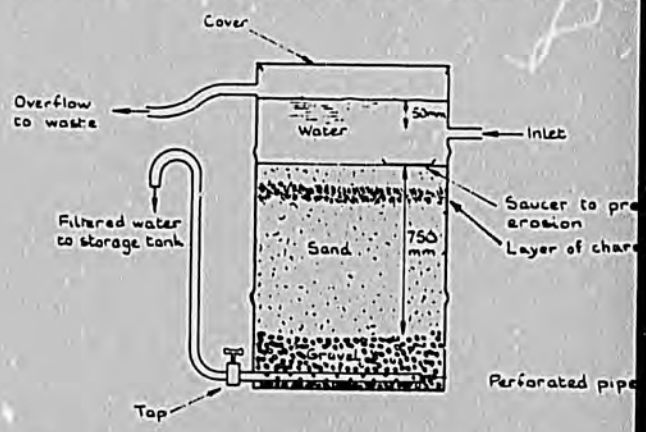

Figure 9 (after Sandy Cairncross and Richard Feachem
A household sand filter; capacity: 1 liter/min.

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inlet and should be connected to a short length of pipe, covered over by a mesh to keep out mosquitoes. Next, a layer of small stones, about the size of peas, should be placed at the bottom of the drum, to a depth of about 5 cm above the outlet hole, and the drum filled to within 10 cm of the top with fine clean sand. Sand particles of 0.2 to 0.5 mm size are preferable, but particles of up to 1 mm size can be used. Before use, the filter should be filled with a stong chlorine solution and left to stand for 12 hours, then flushed by running water. The taste of chlorine will remain for a few days, but will eventually disappear.

A saucer can be placed on the surface of the sand below the inlet; this will prevent the erosion of a hollow in the top of the sand from the incoming water. The outlet pipe from the tap at the bottom should be brought in a loop on the outside up to the level of the top of the sand. The cover of the drum should be tightly in place to prevent contamination of the water. A second drum or storage tank can be mounted below the filter and a tap fitted at its bottom. If the filtered water has an unpleasant taste, adding a layer of charcoal near the top of the sand may remove it.

During operation, the outflow tap should be open only a little, to allow a filtration rate of one liter per minute. The flow of water at the inlet should be continuous, just enough to keep the filter full, with slight overflow. The filter should be cleaned when the flow dwindles, normally after a few months. This can be done by draining out the water and scraping off a very thin layer, about 10 mm thick, of the sand surface. The new surface should then be lightly raked or scratched to leave it loose. After several such cleanings, the sand bed must be topped up to its original level with clean sand. If charcoal is also being used, it can be replaced at the same time.

3) **Disinfection**

The disinfection of drinking water to avert waterborne disease in situations where water supplies can not be adequately protected is important. The following simple methods of disinfection are available:

a. *Boiling Water*

Most dangerous germs are destroyed when water is boiled. To be effective, however, boiling must continue for at least 10 minutes, after which the water must be cooled as rapidly as possible and then protected from any fresh contamination. This method of disinfection is very expensive because of the large quantities of fuel continuously required for it. It is particularly limited in areas where firewood is difficult to obtain. It can, therefore, be used only for small quantities of water. Since boiled water does not contain any dissolved gas, its taste is altered; it is possible to aerate it and make it more palatable.

b. *Chlorination*

Among the chemical methods available for disinfection of water for large-scale use, chlorination has been found to be the most effective method. It Kills pathogenic organisms and most other bacteria, but does not completely sterilize the water (which, however, is not necessary for drinking). Chlorine is a very active agent and reacts quickly with a variety of organic and inorganic matter that may be present in water. For this reason, enough chlorine must be added to water to leave extra free chlorine for bactericidal purposes after these reactions have taken place. The amount of chlorine needed is known as the "chlorine demand" of the water. Sufficient chlorine should be added so that a chlorine residual of about 0.5 parts per million (0.5 mg/liter) is left after 30 minutes' contact. The amount of chlorine necessary to disinfect water varies from one water supply to another and from season to season.

In its natural form, chlorine is a gas and can be used either in this or in liquid form in most urban water supply systems. However, for rural water supply systems, a chlorine solution can be made from bleaching powder. Bleaching powder, or chlorinated lime, is a white powder which contains about 38 per cent of available chlorine when freshly made. This compound is generally available in 100 lbs (45 kg) drums. On exposure to air, light and moisture, it rapidly loses its chlorine content and, therefore, should be stored in a dark, cool, dry place, in a closed container resistant to corrosion. Another type of powder available is high-test hypochlorite, which contains about 70 per cent available chlorine. Some trade names for this powder are "HTH", "Perchloron" and "Pittchlor". These products are generally available in packages of 5 lbs (2-3 kg) and in cans of up to 100 lbs (45 kg).

Chlorine can also be secured in tablet forms

which are sold on the market. Some commercial tablets available are "Halazone", "Chlor-dechlor" and "Hydrochlorzone". Directions for their use are usually given on the package. They are quite good for disinfecting small quantities of water, but are very costly.

To make one liter of about one per cent stock chlorine solution, one liter of water should be added to either 40 grams (2½ tablesponnfuls) of bleaching powder; to 15 grams (one tablespoonful) of high-test hypochlorite; or to 250 ml (one cup) of liquid bleach. To chlorinate water, 3 drops of this one per cent solution should be added to each liter of water; or 30 ml of the solution to 120 liters of water. If the water is clean but coloured like very weak tea, the amount of solution would need to be doubled. After dosing, the water should be thoroughly mixed and left to stand for 30 minutes before being used.

c. *Disinfection of Open Wells*

Most bored and drilled wells do not require disinfection. However, open wells do, and a simple method of disinfecting them is described briefly here. The most effective and cheapest method of disinfection is by using bleaching powder. To do this, one needs firstly to know how much water is in t well (volume). This can be estimated by me uring the depth of the water (height meters) and the well diameter (in mete The average of several readings of the abo measurements should be taken since we are not usually of uniform dimensions. T following formula may then be used establish the approximate volume of wa in a well:

$$\text{Volume of water (liters)} = \frac{3.14 \times d^2 \times h}{4} \times 1000 \text{ lit}$$

(Note: one cubic meter = 1000 liters of wat
d = well diameter in meters
h = height of water in meters).

The appropriate amount of chlorine mu then be added to the well. The table in A pendix A or the chart in Appendix B can used to determine how much bleachi powder is needed for a particular volume water.

In order to use the chart in Appendix which was developed by the Integrat Health Services Programme in Miraj, Mah rashtra State, India, and used by the ru health workers there, a knowledge of t average depth of water and the diameter

A village health worker demonstrates well disinfection.

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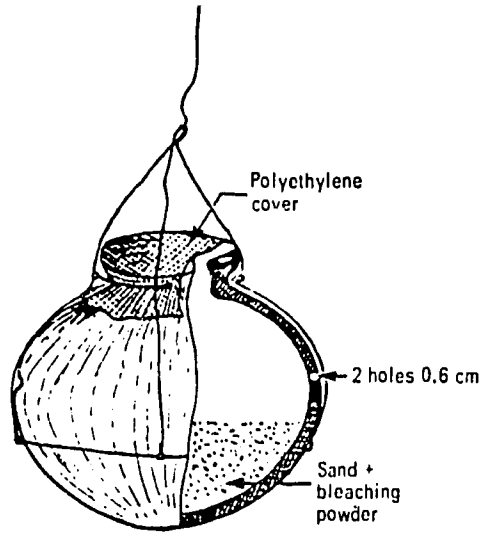
the well is all that is required. The correct amount of bleaching powder needed is given on the basis of these statistics, previous calculations on the volume of water having been made and built into this chart.* This method is, therefore, very simple and saves much time. It indicates the amount of bleaching powder needed for rudimentary disinfection. With experience and slight adjustments, a better degree of disinfection can be obtained.

After the amount of bleaching powder required for disinfecting the well has been calculated, the powder should be placed in a bucket and a thin paste made by adding water. Then, more water should be added until the bucket is nearly three-fourths full. It should be well stirred and allowed to settle for 5 – 10 minutes. The solution is then transferred to another bucket and the lime or chalk at the bottom is discarded. The lime should not be poured into the well as it increases the hardness of the well water. The bucket, tied to a rope, and containing the chlorine solution, is lowered some distance below the water surface and the well water is agitated by moving the bucket up and down quite vigorously. This should be done several times so that the chlorine solution mixes thoroughly with the inside well water. The water should not be used until 30 minutes have elapsed after this procedure is completed.

d. *Pot Chlorination*

Other simple and effective methods of well disinfection, using non-mechanical appliances suited to small rural water supplies and wells, have been devised. Among these, pot chlorination has proven to be quite effective.

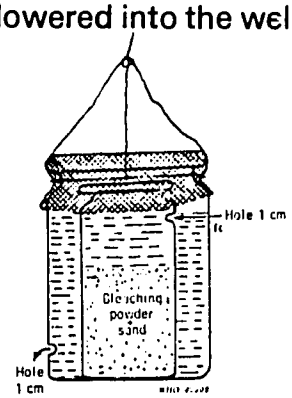
i. Single pot chlorinator (see Figure 10): A simple earthern pot is filled with a moistened mixture of 1.5 kg of bleaching powder and 3 kg of coarse sand (1.5 mm size particles). The pot is suspended in the well about one meter below the low-water level. The pot should have a 12–15 liter capacity, with two 6 mm diameter holes on opposite sides, about half-way down the pot. The mouth of the pot should be covered with polyethylene and should be lowered into the well by means of a rope and suspended away from the points at which water is withdrawn. This method can disinfect wells with withdrawal rates of 1200 liters per day, for about one week.



A Pot type

Figure 10 (after S. Rajagopalan and M.A. Shiffman) *Single pot chlorinator.*

ii Double pot chlorinator (see Figure 11): This method, which has been devised by the National Environmental Engineering Institute of Nagpur, in India, is an improvement on the single pot method. It consists of 2 cylindrical pots, one placed inside the other. The inner cylindrical pot is about 16 cm in diameter and 28 cm high and is filled with a moist mixture of one kg of bleaching powder and 2 kg of coarse sand particles of approximately 2 mm in diameter, to a level of about 3 cm below a hole (one cm in diameter) in the top portion of the pot. The pot should then be placed inside an outer cylindrical pot (25 cm in diameter and 30 cm high). The outer pot should have a hole (one cm in diameter) about 4 cm above the bottom. The mouth of the outer pot is covered with polyethylene sheet and the whole assembly is lowered into the well by means



C Double jar type

Figure 11 (after S. Rajagopalan and M.A. Shiffman) *Double pot chlorinator.*

*The measurements in the chart are given in feet but may be easily converted into meters (1 meter = 3.281 feet).

of a rope, to about one meter below the water level. This can chlorinate wells containing about 4500 liters of water, with a daily withdrawal rate of 350–450liters, for 2–3 weeks.

iii Coconut shell chlorinator (see Figure 12): In Malaysia, coconut shells are used as containers in what is called the "Pahang Continuous Chlorinator". A big coconut shell, with the husk removed and the kernel scraped out, is cut into two parts. A plastic bag containing a mixture of about 2 kg of bleaching powder and clean sand in equal portions is placed inside the lower part of the shell and the mouth of the bag is closed with a rubber band. The 2 coconut halves are then fastened together by rubber bands passed through staples at 3 peripheral points. Three holes of 0.5 cm in diameter are burnt through the container body with a red-hot rod, just below the centre, and 2 holes of 0.8 cm diameter are punched in the middle of the plastic bag, enabling the disinfectant to pass out through the shell into the body of the water to be disinfected. The shell chlorinator is hung by 3 raffia cords, passed through 3 staples about 30cm below the water level. This device can disinfect wells with a daily withdrawal rate of about 90 liters, for about 3 weeks.

iv. Test for Presence of Chlorine:
The chlorine demand of water varies considerably from one time to another, due to dissolved substances which are present in the water. Therefore, it is important to check whether the amount of bleaching powder put in is producing the desired bactericidal effect. This can be done by

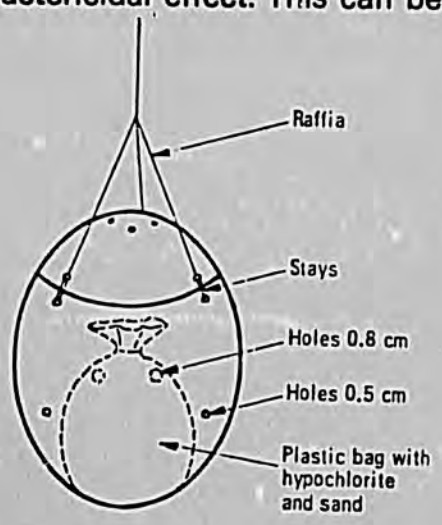


Figure 12 (after S. Rajagopalan and M.A. Shiffman)
Coconut shell chlorinator.

using one of the two following chlor demand tests. The **orthotolidine te** can be carried out 30 minutes after bl ching powder solution has been added water. Commercially produced equ ment for carrying out this test is simple operate, compact and easily transp table. One ml of orthotolidine reage when added to 100 ml of water, gives yellow colour which indicates the pre ence of residual chlorine. Yellow colo tion is matched against colour discs, su plied with the equipment, which indica sufficient levels of residual chlorine. If t test shows that the residual chlorine less than 0.5 p.p.m. (mg/liter) after 3 minutes, then the amount of bleachi powder used should be increased.

The **starch-iodine test** is a simple o which was used long before the comme cial method described above came in being. It can be used to get an approxi ate idea of the presence of chlorine in t water, when orthotolidine is not availab It requires visual judgement on the part the tester. Two bottles are needed – o for the starch solution (e.g., rice wat and the other for potassium iodine cry tals. A test tube is also needed. Thirty mi utes after disinfecting the well, som water is drawn off to half fill the test tub A tiny pinch of potassium-iodine cryst is added and the tube is shaken for abo 3–4 minutes, until the crystals are w dissolved. Three to four drops of star solution are then added. If the soluti turns a faint violet colour, this indicat an overdose of chlorine, and no colo means not enough chlorine is present

SUMMARY

The health benefits of clean, safe water ha been referred to throughout this paper. Wa as a basic health need, water-related diseas the importance of community involvement water development and the necessity of effe tive water maintenance systems, have all be touched upon here. An overview of some of t practical means of obtaining safe, clean wa supplies, available to rural populations, follo ed. Perhaps it would be fitting, in conclusio to cite just one striking example of how pro sion of safe, clean water can benefit peopl health. In Malawi, water is brought down pipes, by gravity flow, from the Mulanje Mou

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UNICEF photo by Black

The village tap.

tains to over 400 village taps, in an area of 100 square miles (160 km^2). During a 1974 cholera outbreak, an average of 20 persons per village (among villages which averaged 350 residents each) were attacked by the disease. In the villages with tap water, however, no more than one case per village was reported and, in each instance, the person concerned had visited another village where safe, clean water was not available on tap.

Malawi has used a water system appropriate to its geographic and topographic situation. In other countries, systems appropriate to their needs and resources will need to be found. Since 80–90 per cent of people in developing countries live in rural areas, our efforts must be geared towards these areas. Methods of tapping water sources and purifying them should be neither sophisticated nor expensive. A few examples of appropriate methods have been provided here. Details can be drawn from manuals which exist in great quantity. What is most important is that we include water as an integral part of our health and development programmes.

"Clean water for all by 1990" – it sounds like a tall order. And, in fact, technically it **is** a gigantic task. To provide safe drinking water to about 2 billion people will involve elaborate planning, implementation procedures, the setting up of new priorities in which water moves to the top of the list, political will, involvement of communities, joint efforts on the part of government, non-governmental organizations, churches and the people and, of course, pooling of resources. It is estimated that investment at the rate of US$3000–4000 million a year, over 10 years, would be required to provide solutions to the problem of inadequate water supplies for the world's peoples.

If anyone thinks that this is a large sum for the global community to raise, however, let them remember that the developed nations spend

over US$100,000 million per year on alcoholic beverages alone and that the world's governments together spend US$300,000 million per year on arms. Thus, diverting only 3 per cent of the bill for alcoholic drinks, or cutting back the expenditure on the instruments of death and destruction by a mere one per cent, could provide the funds for clean water for all by 1990.

In the final analysis, all the money, resources, planning and action on the part of governments and other agencies must come to nought if **people** do not participate in, and t responsibility for, the task of providing s clean water for themselves and their commu ties. Thus, the question of how such full part pation can be obtained is perhaps the one most urgent need of an answer, or answ Where answers have been found – in the fo of successful community participation in wa development programmes – these deserve closest attention and study from all involve the effort to provide "Fresh Water for All 1990".

AMOUNTS OF CHEMICALS NEED TO DISINFECT WATER FOR DRINKING

Water (m3)	Bleaching powder (25-35%) (g)	High strengh calcium hypochlorite (70%) (g)	Liquid bleach (5% sodium hypochlorite) (ml)
1	2.3	1	14
1.2	3	1.2	17
1.5	3.5	1.5	21
2	5	2	28
2.5	6	2.5	35
3	7	3	42
4	9	4	56
5	12	5	70
6	14	6	84
7	16	7	98
8	19	8	110
10	23	10	140
12	28	12	170
15	35	15	210
20	50	20	280
30	70	30	420
40	90	40	560
50	120	50	700
60	140	60	840
70	160	70	980
80	190	80	1100
100	230	100	1400
120	280	120	1700
150	350	150	2100
200	470	200	2800
250	580	250	3500
300	700	300	4200
400	940	400	5600
500	1170	500	7000

Appendix A

Use one of the chemicals listed in the table and choose the amount according to the quantity of water in the distribution tank, cistern or well.

Appendix B

Amount of Bleaching Powder (33%) Required for Disinfecting Wells
(grams)

Diameters of Wells in Feet — Diam. in Ft.	Depth of water in feet: 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1	0.2	0.3	0.5	0.6	0.8	0.9	1.0	1.2	1.4	1.5	1.7	1.8	2.0	2.1	2.3	2.4	2.6	2.7	2.9	3.0	3.2	3.3	3.5	3.6	3.8	3.9	4.1	4.2	4.3	4.5
2	1	1.5	2	2.5	3	4	4.5	5	6	6.5	7	7.5	8	9	9.5	10	10.5	11	12	12.5	13	13.5	14	14.5	15	15.5	16	17	18	18.5
3	2	3	5	6	7	8	9	11	13	14	15	16	18	19	21	22	23	24	26	27	29	30	32	33	34	35	37	38	39	41
4	3	5	8	10	13	14	16	19	22	24	27	29	32	34	37	38	42	43	46	48	51	53	56	58	61	62	66	67	69	72
5	5	8	13	15	20	23	25	30	35	38	43	46	50	53	58	63	68	71	73	75	80	83	88	91	95	98	103	105	108	113
6	6	11	16	22	27	32	38	43	49	54	59	65	70	76	81	86	92	97	103	108	113	119	124	130	135	140	146	151	157	162
7	7	15	22	29	37	44	51	59	66	74	81	88	96	103	110	118	125	132	140	147	154	161	169	176	184	191	198	205	213	220
8	10	19	29	38	48	58	67	77	87	96	106	116	125	135	145	154	164	174	183	193	203	212	223	230	240	250	259	269	278	288
9	12	24	36	49	61	73	85	97	109	122	134	146	158	179	182	192	207	219	231	243	255	267	279	291	303	316	328	340	352	365
10	15	30	45	60	75	90	105	120	135	150	165	180	195	210	225	240	255	270	285	300	315	330	345	360	375	390	405	420	435	450
11	18	36	54	72	90	108	126	144	162	182	200	218	236	254	272	290	308	326	344	363	381	399	417	435	453	471	490	508	526	545
12	22	43	65	86	108	129	151	172	194	215	237	258	280	301	323	344	366	387	410	432	453	475	496	518	539	561	583	604	626	647
13	25	50	76	101	126	152	177	202	228	253	278	304	329	354	380	405	430	456	481	507	532	557	583	608	633	658	684	709	735	760
14	29	59	88	118	147	177	206	236	265	294	323	353	382	412	441	470	500	529	559	588	617	646	676	705	735	764	794	823	853	882
15	34	68	101	135	169	204	238	273	307	342	376	411	445	480	514	549	584	618	653	675	710	744	779	813	848	882	917	951	985	1020
16	38	77	115	154	194	231	270	308	347	386	423	462	500	539	578	616	655	693	732	770	808	847	885	924	962	1000	1039	1077	1116	1154
17	43	86	130	173	216	260	303	347	390	434	478	521	565	608	651	695	738	781	823	867	911	954	997	1044	1084	1128	1171	1215	1258	1302
18	49	98	146	195	244	341	390	439	488	537	586	635	684	733	782	831	880	928	978	1026	1075	1124	1172	1221	1270	1319	1367	1416	1464	1513
19	54	108	162	216	270	324	379	433	487	541	595	649	703	758	812	867	921	975	1029	1083	1138	1192	1247	1300	1355	1409	1463	1517	1571	1626
20	60	120	180	240	300	360	420	480	540	600	720	780	840	900	950	1010	1060	1120	1180	1240	1300	1360	1420	1480	1540	1600	1660	1720	1780	1840
21	66	132	198	264	330	396	463	529	595	661	727	793	859	926	992	1058	1124	1190	1256	1322	1389	1455	1521	1587	1653	1719	1785	1852	1918	1984
22	73	145	218	290	363	435	507	580	652	725	797	869	942	1014	1087	1159	1232	1304	1377	1449	1522	1594	1667	1739	1812	1884	1957	2029	2102	2174
23	79	158	238	317	396	476	555	634	714	793	872	952	1031	1110	1190	1269	1348	1428	1507	1586	1666	1745	1824	1904	1983	2062	2142	2221	2300	2380
24	86	172	259	345	431	517	603	689	776	862	848	1037	1124	1210	1296	1382	1468	1555	1641	1727	1814	1900	1986	2072	2159	2245	2332	2418	2505	2590
25	94	188	281	375	469	563	657	751	844	938	1032	1125	1219	1313	1406	1500	1593	1687	1781	1874	1968	2061	2155	2248	2342	2435	2529	2622	2716	2810
26	101	202	304	405	506	607	708	809	911	1012	1113	1215	1316	1417	1519	1620	1721	1822	1923	2024	2125	2226	2327	2429	2530	2631	2733	2834	2935	3036
27	109	218	320	437	546	656	765	874	984	1039	1202	1312	1421	1530	1640	1749	1859	1968	2077	2186	2296	2405	2515	2624	2734	2844	2953	3063	3173	3282
28	118	235	353	470	588	706	824	942	1059	1177	1295	1413	1531	1649	1766	1884	2001	2119	2237	2355	2473	2519	2708	2816	2933	3051	3165	3287	3404	3522
29	126	252	378	504	630	757	883	1009	1135	1261	1387	1514	1640	1766	1892	2018	2144	2271	2397	2523	2649	2771	2901	3028	3154	3280	3406	3532	3658	3784
30	135	270	405	540	675	810	949	1080	1215	1350	1485	1620	1755	1890	2025	2160	2295	2430	2565	2700	2835	2970	3105	3240	3375	3510	3645	3780	3915	4050

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PUBLICATIONS ON WATER AND SANITATION

Low-Cost Technology, Options for Sanitation - A State-of-the-Art Review and Annotated Bibliography by Witold Rybczynski, Chongrak Polprasert and Michael McGarry. IDRC-103 e, 1978. 184 pages.
This review and annotated bibliography is a joint publication of the International Development Research Center (IDRC) and the World Bank. A variety of published and unpublished articles and documents dealing with conventional as well as alternative approaches to technical aspects of collection, treatment, reuse and disposal of human wastes, with a special emphasis on developing countries, are compiled in this book.

For additional information, write to :
International Development Research Center
Post Box 8500
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Rural Water Supply and Sanitation in Less-Developed Countries - A Selected Annotated Bibliography by Anne U. White and Chris Sevious. IDRC-028e, 1974. 82 pages.
The introduction to this book contains a clear overview of the diverse and complex problem of rural water supply. It offers an analysis of questions of safe water and health, costs and expected benefits, and appropriate technology and training. The material reviewed in the bibliography is organized under the headings: "General", "Technology" and "Health and Diseases". Unpublished documents containing useful data or evaluations have also been included. A final section lists other annotated bibliographies bearing directly on rural water supply and sanitation.

For additional information, write to:
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Water, Health and Development - An Interdisciplinary Evaluation by Richard Feachers et al. Tri-Med Books Ltd, 1978. Illustrated. 286 pages. Price: £3.25 + 25p postage and packing.
This book is written by a group of nine authors representing the engineering, economics, social anthropology, microbiology and medical statistics disciplines. It is largely based on an evaluation of village water supply in Lesotho which the team conducted over an 18-month period. Their findings are presented in Part I. In Part II, these findings are used as the basis for a general discussion on aspects of planning and design of rural water programmes in developing countries.

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If not, how many copies do you require? .....

In the following list, please check all the categories that apply to your own work.

1. **Church Offices**
- ☐ Regional councils of churches
- ☐ National councils of churches
- ☐ Local ecumenical councils
- ☐ National denominational offices
- ☐ Local church or diocesan offices

2. **Church and other non-governmental organizations (Voluntary agencies)**
- ☐ Church-related
- ☐ Non-sectarian
- ☐ International office
- ☐ National headquarters
- ☐ Regional or local office
- ☐ Programme or project office
- ☐ Field work

  Type of agency:
  - ☐ Health care service
  - ☐ Development work
  - ☐ Coordination
  - ☐ Relief or disaster service

3. **Governmental Agencies**
- ☐ Ministry or secretariat for health
- ☐ Other ministry. Specify:

3. **Governmental agencies** (continued)
- ☐ National office
- ☐ Regional or provincial office
- ☐ Local or district office
- ☐ Institutional or hospital staff

4. **Intergovernmental or UN agency**

  Specify agency: .....

  .....
- ☐ International headquarters
- ☐ Regional office
- ☐ National office
- ☐ Field office

5. **Health education or training programme**
- ☐ Medical schools, libraries
- ☐ Nursing schools, libraries
- ☐ Health auxiliary training centres
- ☐ Other categories of training. Specify :

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  .....
- ☐ Documentation centres

6. **Others**
- ☐ Private practitioners
- ☐ Interested individuals
- ☐ Other .....

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