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LOWER COST METHODS OF WATER AND WASTE TREATMENT IN LESS DEVELOPED COUNTRIES

SECOND ANNUAL REPORT

Submitted to

Office of Health
Agency for International Development
Department of State
Washington, D.C. 70523

Prepared by

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Regents Professor and Director
Bureau of Water and Environmental Resources Research
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From

The University of Oklahoma
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Norman, Oklahoma 73069

May 31, 1975

REPORT SUMMARY

A. 1. Project Title: LOWER COST METHODS OF WATER AND WASTE TREATMENT IN LESS DEVELOPED COUNTRIES

Contract Number: AID/CM/TA-C-73-13

2 Principal Investigator: Regents Professor George W. Reid

Contractor: The University of Oklahoma
Office of Research Administration
1000 Asp Avenue, Room 314
Norman, Oklahoma 73069

3. Contract Period: From 3/1/73 to 12/31/75

4. Period Covered by Report: 6/1/74 to 5/31/75

5. Total AID Funding of Contract to Date: $269,000

6. Total Expenditures and Obligations through Previous Contract Year: $59,400

7. Total Expenditures and Obligations for Current Year: $135,000

8. Estimated Expenditures for Next Contract Year: $74,600

B. Summary of Accomplishments and Utilization

In relation to the research objectives, the following accomplishments have been made during the report period and life of the project:

1 Prediction Model --- its process and resource matrices are complete, and field evaluation under way.

2 Data format complete, and undergoing field testing.

3 Two levels of field test kits complete and undergoing tests.

4 Contractual studies for processes and at sites constituting a global network have been initiated, work identified and contracts concluded. Processes include:

a. Water: (1) Slow sand filtration
(2) Alternatives to chlorination

(3) Rapid sand filters; valve less, dynamic, multimedia, multideck settlers
(4) Containment filters, coconut, rice, etc.

b. Sewage: (1) Lagoons, oxidation ponds
(2) Night soil
(3) Algae and fish production
(4) Estuarial disposal
(5) Aerated Lagoons

5. Contractual studies for states of the art, cost and demand validations, survey of innovative practices and historic studies are well underway.

6. Initial plans for documentation (5) and global workshops are completed.

In summary, the project foundation is well established, and the state of art papers and project process contracts are well underway. Provisions for initial model tests and dissemination through a global conference have been made, in addition to a substantial amount of cooperative and complementary effort from PAHO/WHO/IRC/WB and others forthcoming.

CONTENTS

ANNUAL RESEARCH REPORT (1975)

A. Introduction and Background

Research on the present contract has been in progress for 27 months and an additional seven (7) months (not including any extension) remain on the present contract. The basic rationale of the project was to see if it would be possible to forecast which of the many available water and waste water treatment processes could be looked at from the frame of reference of maximum compatibility of in-country resources.

For many years developing countries have been using developed countries' technology without modification, sometimes to their detriment. That is, treatment devices used were simply not compatible with in-country manpower and natural resources. Each failure of an imported high technology resulted in wasting local resources. Not only are public funds normally invested in such development but the non-effective uses of such funds in a particular country could also deprive it of other public services, and in some instances, a failure could result in the default on loans to develop water resources.

The project to date has developed a methodology for comparing processes and resources directed towards the most compatible in-country process selection. Fourteen (14) in-depth process studies are now under contract, at a network of nine (9) global LDC sites, utilizing five (5) different water treatment studies and six (6) waste water disposal studies. (See Table 1) These are directed primarily at demonstrating the value of unique and adaptive technological transfers. The processes are representative of the most likely candidates. As originally proposed, site contracts are appropriately divided among Latin America, Africa, the Middle East (including North Africa) and the Far East. In addition to these activities validation of the application of the user's model, the historic studies of the use of water and sewage in developed countries, and the testing of the analytical support kit are being conducted. Concurrent with these are the state of the art documentation and an innovative technology survey

of unpublished information on processes in developing countries. For dissemination, a technical workshop, publications, and global conferences are planned.

Throughout the life of the project, contact has been made with as many international agencies and organizations as possible. Widespread interest has developed in the project and its expected work products. Much cooperation and some collaboration (WHO primarily) with agencies such as UNEP, World Bank, etc., has been established. Most of this activity will intensify as the project moves into its dissemination phase.

B. Statement of Project Objectives as Stated in the Contract

The contract was to develop a system of matrices dealing with processes and in-country resources, that could be brought together in such a fashion as to identify processes that would be optimal in terms of resource conservation in LDCs. Specifically, it would be technology appropriate to the ability of a country to supply the resources to build and operate it. Once the matrices were developed, in-depth studies at global sites representative of appropriate water and sewage treatment processes was to be made to see 1) if the conceptional approach was sound and 2) to ascertain overall performance of 4-5 processes each. After the methodology was developed and tested in the field and the unique and adaptive processes studied in depth, the final order of business would be to its documentation then to find what is necessary to bring them to the useful attention of those involved in this activity.

Although the contractual objectives have not been modified, the scope and purpose of the project have, of course, lead to a better definition of the objectives, including identification of sites where appropriate technologies can be tested, idenification of a data management system, and preparation of 'State of the Art' documents on the various processes.

Questions also arise as to the types of activities necessary to get Developing Countries' acceptance of the most appropriate technology. That is, to determine if Developing

Countries will be willing to use older, tried and proven processes that are more in keeping with their resources rather than developed countries current technologies. The older types of treatment historically were adequate for developed countries as they developed, so an effort will also be made to identify them. Because of their concern for utilization of the project's finding, both WHO and UNEP will assist in publishing and dissemination of the project's final products.

Additional enhancements of the project also include the development of the classification of performance tests to insure the adequacy of any given processes, an in-country analytical kit, for process data the identification of manpower requirements and, perhaps, educational remedies such as relevant short courses.

The specific objectives are:

1. To develop a system of matrices dealing with treatment processes and in-country resources that will help to identify and select the optimal process(es) in terms of in-country manpower, material and acceptability;

2. To develop state of the art documents on adequate LDC processes, through literature search, use of experts, LDCs' mail survey as well as through the development of field validation studies of representative processes. These are selected to cover the important processes and the global factors such as human, social and economic resources, levels of technology, size, climate, etc.

   These studies are to be conducted by LDC contractors assisted and monitored by the University of Oklahoma Project staff and other experts.

3. To develop and test an in-country analytical kit for supporting the control and/or the evaluation of treatment processes.

4. To conduct a Technical Global Workshop on Low Cost Methods of Treatment of Water and Waste Water in Less Developed Countries to bring technical experts and contractors together to exchange ideas, approaches, and findings and to review and evaluate the program.

5. To integrate the project findings into a technical document (or documents) to be published with WHO assistance and to structure and conduct with UNEP three global conferences to bring the

findings to representative decision-makers on the selection of treatment processes in LDC's.

The overall project information flow is shown in Figure 1.

Continued Relevance of Objectives

Although many facets of the project have been worked on by others around the world, and some have made progress, there are a few who have worked on the entire system. Relevance of the objectives has naturally increased because of accelerating interest of international agencies, developing importance of technological transfer and especially in that of water and waste water treatment. In fact, the project has developed into a truly global one, with a "snowballing effect" with numerous national and international participants becoming meaningfully involved. The scope of the global contracts developed are very comprehensive in that the methods of treating water and sewage which may reasonably be used in developing countries are completely covered. The contracts themselves are more in a nature of catalyzing effect. The subcontract monetary amounts are rather small; the funds are usually only for graduate assistants at universities and/or for providing special materials. Of real importance to the participants is that of being involved with the global effort and having a mutual possibility of exchanging information at their various levels of expertise.

It has not only been interesting but gratifying to learn that more and more international agencies have "discovered" the need for more assessment of the state of the art relative to water and waste treatment processes in developing countries. The latest activity has been the formation of the "Ad Hoc Working Group on Rural Potable Water Supply and Sanitation," made up of representation from UNICEF, UNDP, UNEP, IBRD, WHO, IDRC, and OECD, who have recommended the undertaking of the development of a global network of sites to study processes similar to that initiative through this project.

This group recently surveyed selected institutes in Asia, Latin America, and Europe in an attempt to determine in effect the state of the art of rural potable water supply

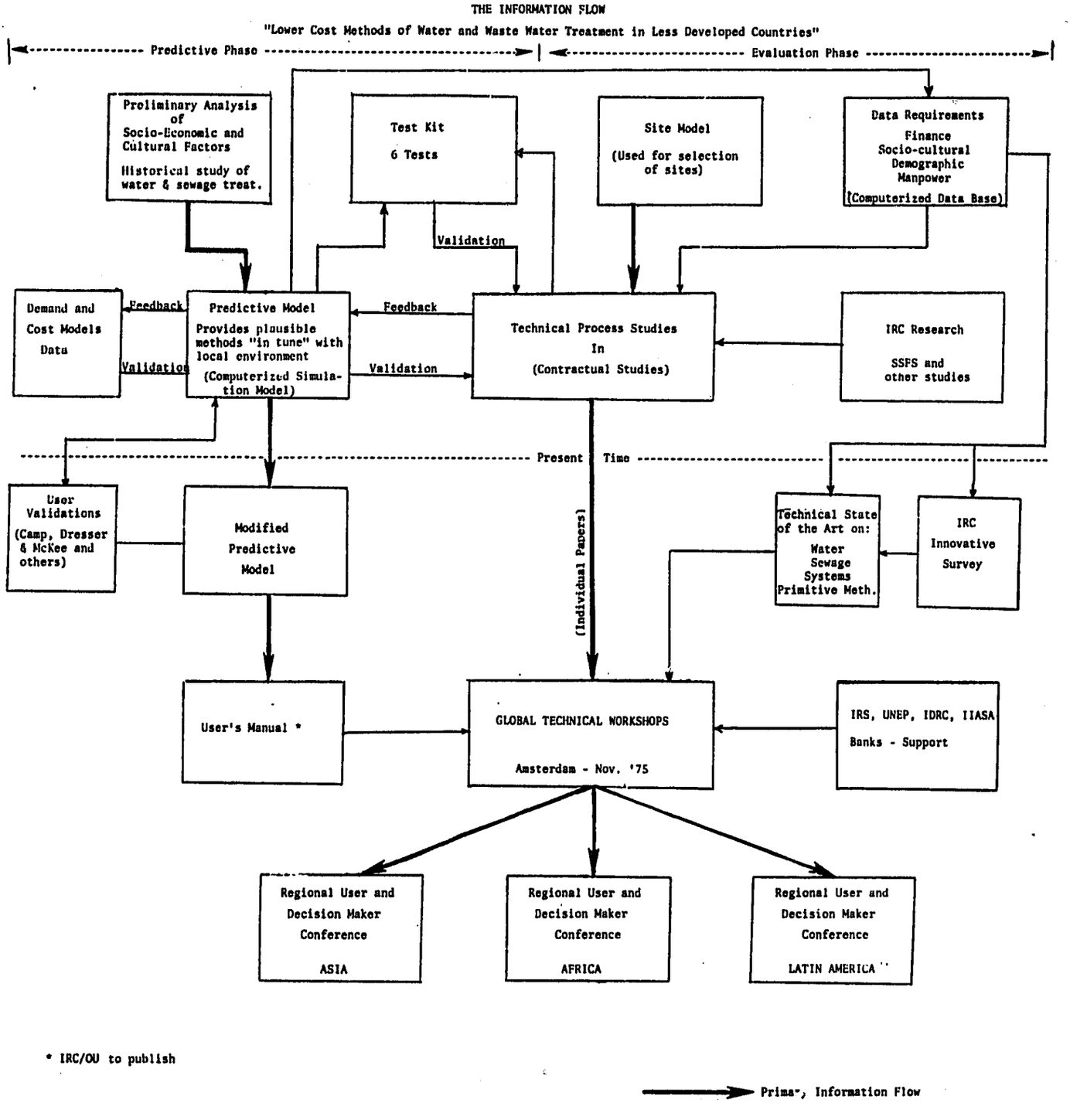
THE INFORMATION FLOW
"Lower Cost Methods of Water and Waste Water Treatment in Less Developed Countries"
Predictive Phase
Evaluation Phase
Preliminary Analysis of Socio-Economic and Cultural Factors
Historical study of water & sewage treat.
Test Kit
6 Tests
Site Model
(Used for selection of sites)
Data Requirements
Finance
Socio-cultural
Demographic
Manpower
(Computerized Data Base)
Validation
Demand and Cost Models Data
Feedback
Validation
Predictive Model
Provides plausible methods "in tune" with local environment
(Computerized Simulation Model)
Feedback
Validation
Technical Process Studies In (Contractual Studies)
IRC Research
SSFS and other studies
Present Time
User Validations
(Camp, Dresser & McKee and others)
Modified Predictive Model
(Individual Papers)
Technical State of the Art on:
Water
Sewage
Systems
Primitive Meth.
IRC Innovative Survey
User's Manual *
GLOBAL TECHNICAL WORKSHOPS
Amsterdam - Nov. '75
IRS, UNEP, IDRC, IIASA
Banks - Support
Regional User and Decision Maker Conference
ASIA
Regional User and Decision Maker Conference
AFRICA
Regional User and Decision Maker Conference
LATIN AMERICA
* IRC/OU to publish
Prima-, Information Flow

Figure 1

and rural sanitation. Ultimately the group intends to recommend the establishment of a new international effort to provide more knowledge, trained manpower, and new methods to solve the rural problems of water supply and sanitation.

Although the Ad Hoc Group is supposedly concentrating on the rural aspects of water and waste treatment, it in effect is overlapping the current AID/OU study. Every effort is being made by the Project Director and his staff to keep all such groups informed of the project's progress and to encourage cooperation and coordination at all levels of time and effort.

In keeping with this need for coordination and cooperation the IRC/NL will correlate their $250,000 study on slow sand filters with those smaller funded studies of the project.

The engineering firm of Camp, Dresser and McGee has agreed to test the predictive model on four sites; two in the Philippines and two in Indonesia; Columbia (USAID).

Others indicating support and cooperation are:

1. The World Bank indicate a need for the State of the Art Documents currently under preparation.

2. AID is interested in using a modified kit in Zaire.

3. WHO, PAHO and others have agreed to help support the international workshop and to aid in publishing and disseminating the results.

D. Accomplishments to Date

The detailed matrices are completed and operational; the resources model with a user's manual is completed, computerized and operational; the process matrices that accompany the resource model are completed; the data formatting is completed[1]

[1] These techniques were reported in the first Progress Report. The model is shown in Figure 2.

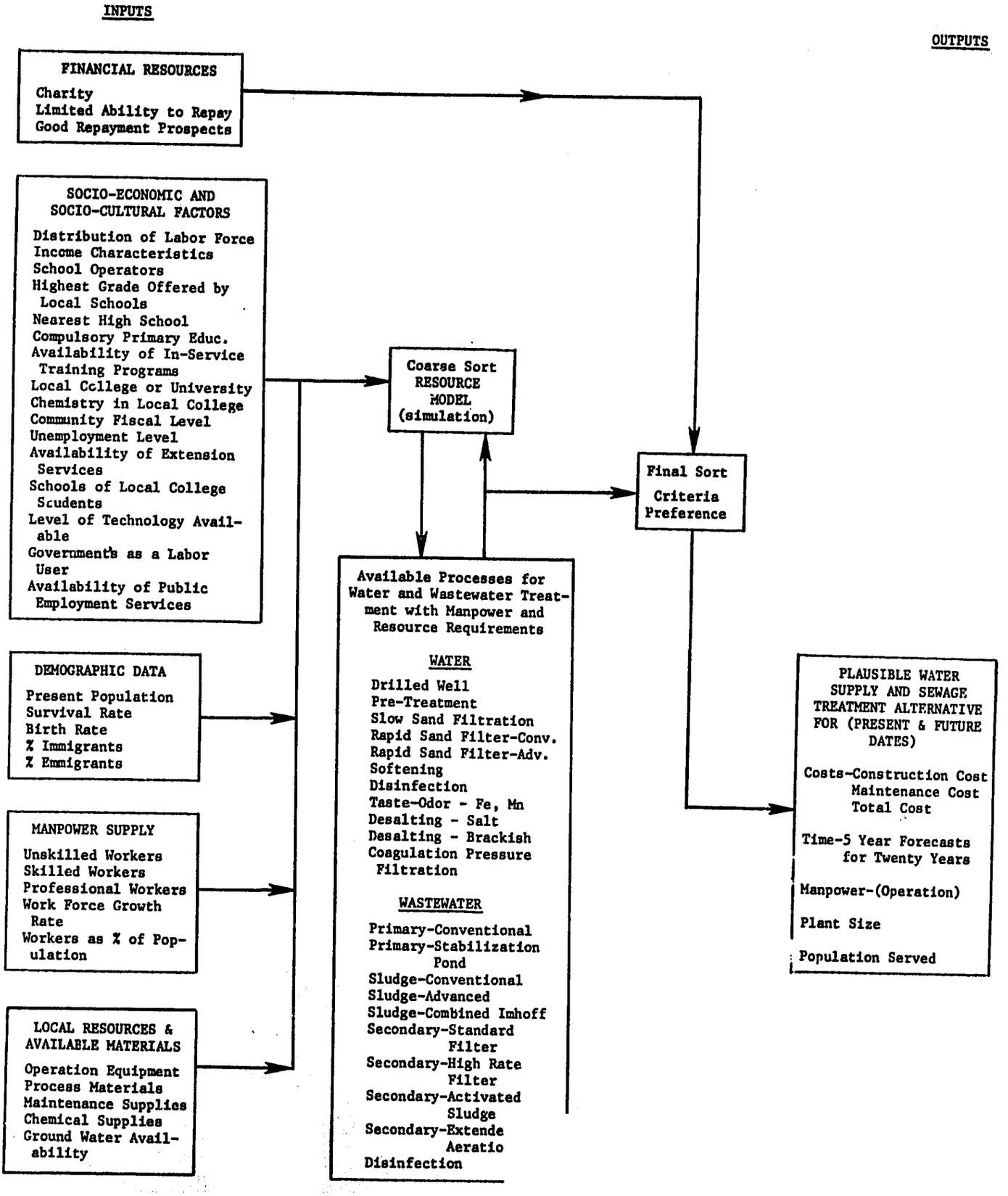

Figure 2. Data Flow for Water Treatment Method Planning Model

and has been communicated to the International Reference Center for incorporation into a study to locate innovative technology in LDCs. The needs of water and waste disposal in terms of the demographic and socio-economic parameters of LDCs are being determined (Appendix 1). The problems of data availability are beginning to resolve themselves in sampling and data processing.

As was stated earlier, the work has been undertaken in two broad divisions. One involves literature search, documentation of the various matrices, and the testing of these matrices and processes under actual LDC global conditions. The other involves in-depth at site studies of representative, unique or adaptive technology, costs, suitability, etc. Initially it was envisioned that possibly only three global coordinating sites might be selected: one in Latin America, one in Africa, and one in Asia. This approach has been modified since it has become apparent that we need several sites in Latin America (coordinated through CEPIS) and perhaps two smaller ones in the Caribbean. It also became apparent that we needed sites in the Middle East as well as in Africa. The division there has been between the arid and sea contiguous or fringe Middle Eastern Arabic countries, and those that are basically in the East and West African domain.

All of the sites have been visited, and are under contract (see Table 1). These contracts are tabulated in Appendix 2. The site data format is being finalized in cooperation with IRC/NL. As has been indicated earlier also, a number of collaborated studies have also been arranged and are shown as no cost items in Appendix 3.

The selected technical experts are functioning in two roles, one to visit the projects, and the other to assist in the preparation of the State of the Art Documents (see Appendix 1). In addition, the historic use studies are underway, and the "Global Technical Workshop on Low Cost Methods," to be sponsored by USAID, OU, WHO, PAHO and the World Bank, is being planned for November 1975 (Appendix 3).

Table 1

USAID/OU GLOBAL PROGRAM

X – Project Funds

O – Contributions

			LATIN AMERICA						AFRICA			MIDDLE EAST & NORTH AFRICA				FAR EAST								PROJECT STAFF/OTHERS-DC								SUB TOTAL			TOTAL		
			PERU/CEPIS	TRINIDAD/GOVERNMENT	ECUDOR/CEPIS	COLUMBIA/USAID	COLUMBIA/CEPIS	BRAZIL/CEPIS/IRC	GHANA/UNIV. OF GHANA/IRC	KENYA/PEACE CORPS	KENYA/UN. NAIROBI/IRC	ALGERIA/WHO	TUNISIA/OSWALD	TURKEY/METU	LEBANON/AUB	THAILAND/AIT	THAILAND/GOVERNMENT	INDONESIA/BANGDUNG	INDONESIA/CDM	INDONESIA/JAKARTA	TAIWAN/IES	PHILIPPINES/CDM	PHILIPPINES/NWPCC	IRC/NETHERLANDS	IRC/SWISS	UNIVERSITY OF LONDON	UNIVERSITY OF DELFT	TEXAS UNIVERSITY	OKLA. UNIVERSITY STAFF	WHO/GENEVA	UNEP/KENYA	O	X	O+X	O	X	O+X
PROCESSES	WATER (5)	Slow Sand Filtration							O		O						X															2	1	3			
		Rapid Sand Filtration (Con.)					X										X																2	2			
		Rapid Sand Filtration (Adv.)			X																												1	1			
		Disinfection																					X										1	1			
		Innovative Filters							O						X		X																2	3	3	7	10
	SEWAGE (6)	Lagoon/Fish								O	X								X														2	3			
		Extended Aeration											O	X							X												2	3			
		Sludge																				X											1	1			
		Sand Filters						X																									1	1			
		Dilution/Estuarial													X																		1	1			
		Innovative Treatment		O																								O					2		2	4	7	11
MODEL/DOCUMENTATION/ WORKSHOP, ETC.		Model User Study	X			O						O							O			O										4	1	5			
		Historial Studies																								X	X	X		X				4	4			
		Demand Studies	X								X																							2	2			
		State of Art																						X		X		X	X	O			1	4	5			
		Innovative – Survey Data – Management																						X/O									1	1	2			
		Technical Workshop																						O							O		2		2			
		Global Conference	O													O															O		3		3			
		Analysis/Kit	X							X								O															1	2	3	12	14	26

E. Utilization and Dissemination of Results

There is sufficient "feed back" from institutions, etc., to warrant the conclusion that the results of this project are wanted and that if successful, they could be very useful. Although the dissemination phase is the final phase, throughout the project, potential users have been kept informed and are aware of the potential results. For example: (1) USAID plans to use several of the field kits in Zaire, and there are several others interested; (2) the consulting firm of Camp, Dresser, and McGee, USAID in Columbia, and WHO in Algeria are interested in using the predictive model; and (3) the results of the innovation survey and State of the Art Documents will make it unnecessary for the World Bank to initiate such a planned study.

The principal investigator will present a paper on the project, at the June 1975 AWWA meeting in Minneapolis. This will be the seventh paper at National or International meetings requested since the start of the project.

The Ad Hoc Group discussed above (C) has indicated an interest in the project's results as well as possible cooperation and coordination.

Since there is minimal data available in many of the area where the project is addressing itself, the expected results of the project should fill definite needs of many individuals and organizations around the world. This is particularly true of adaptive and modification of essentially low technology processes - not the high technology group.

The IRC/NL, WHO and PAHO, and others, will jointly sponsor the Global Technical Workshop (Appendix 3) to facilitate the dissemination throughout the world in the appropriate technical areas.

After the completion of these process studies, the researchers involved in each instance will be brought together in a workshop in which the technical soundness

of the predictive and the valued phases of the program will be studied in detail, and finally documented. This documentation will provide a basis for three global or regional conferences for dissemination to the ultimate user and assist a developing country to accept the most appropriate technology. Since the older types of treatment historically were adequate as the countries developed, we will prepare a suitable document that will also describe these. This will aim at breaking down some of the potential barriers against the use of the project's products.

The final outputs of the project will include a state of the art on treatment of water in developing countries including historical uses, a user's manual for the predictive model, a study on the formulation of demand and cost models, and a unique water and waste test field kit using in-country materials to be used in small water plants. The final report will include technical papers published by each principal investigator on cost, efficiency, etc., of the candidate unique and innovative processes, four processes in water, five in sewage -- slow sand filtration, containment filters, rapid sand filtration, and alternates to chemicals for water; and lagoon, aerated lagoon, estuarial disposal, night soil disposal, and fish production from algae for sewage.

The contract global study sites will initiate a network that should become self sustaining on confined research on adaptive and unique technology for LDCs.

The global technical workshops are planned as a staging area for the broader dissemination of regional conferences (see Appendix 3).

Statement of Expenditures to Date

Expenditures to Date

	Category	Amount
1.	Salaries and Wages	$ 61,311
2.	Fringe Benefits	5,731
3.	Travel	20,704
4.	Consultants	4,000
5.	Equipment and Supplies	21,000

	Category	Amount
6.	Subcontracts	$ 48,000
7.	Other Direct Costs	5,000
8.	Overhead	28,654
	TOTAL	$194,400

Significant Problems and Effects

The delays normal to such projects are primarily due to those associated with individual communications and professional acceptance. Many facets of the project have been worked on by various people around the world, and individuals and organizations have made progress at present, although no organized network exists. The fact that the project is global in nature, has, in an initial sense, cast itself as a competitor of WHO, IRC, and other international agencies. Many of these agencies were skeptical of USAID's ability to make progress with such an "unreasonable" low funding level. The Bilthoven Conference in 1973 for example, requested $2 million for a similar effort, and the Ad Hoc Group of international agencies (p. 4) has spent approximately $70,000 surveying the problem definition and apparently arriving at conclusion that what should be done, is what USAID is already doing and recommending a $40 million level. This problem of overlap and communications has been largely resolved and real cooperation between the various international groups and individual investigators, and the USAID/OU project is now a fact. The small monetary amounts of the site contracts and insistence on students active in the research role almost insures the participants' self-sustaining involvement. This has actually separated those interested in money alone, from those who are more interested in the concept and rationale.

This overseas delay necessitated an extension in time. Many of the projects may well have sufficient momentum to endure on their own through a subsequent year, however additional support would be very desirable. If the sites are successful, a broad base network of self supporting research in LDCs in waste and water would be a significant output. In any event it would be remiss if the linkages developed between such a wide variety of universities and governmental agencies were not maintained at least until the projected global conferences take place.

G. Work Plan and Budget Forecast for the Final Period

The project work is divided into resource and process data, methodology or models, global field model verification and in-depth studies of unique adaptive waste and water treatment processes. The test kit and predictive methodology, including a user's manual, are completed. The basic methodology shown graphically in Figure 1, is completed. This computerized program, using socio-economic inputs as well as process cost, predicts costs for operation, maintenance, and construction at four socio-economic levels and four scale levels.[1]

The field work, just started could not begin until the technology to be tested in the field was developed with site selections that assured that all different types of innovative, adaptive and translative technology would be looked at. Our literature search to date has been established as the basis for a proposal made to the IRC to use some 900 participants of the IRC to detect the unpublished innovative and unusual techniques being used around the world. Documentation for the individual in depth process studies at the global sites has been completed and instructions for the collection and modification of all kinds of relevant data are being followed.

Each of these extended studies will require additional site visits: Latin American in October 1975; Middle East and Africa in September, 1975; and those of the Far East in August, 1975. The purpose of these visits, in addition to monitoring and assisting in the local investigations is to help strengthen the linkages between all the studies. (The consultants who are preparing the state of the art papers on water and sewage will also be used on the site visits along with the staff.) Once the draft of the state of the art documents has been developed, it will be presented at

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[1] Because low cost methods are not necessarily low technology, the process matrices are being developed to include all technological levels of treatments of water and waste water for the purpose of model development. High technology methods will not be field tested at an LDC site, unique and adaptive likely candidates will be subject to in-depth tests. This is an important distinction.

the global workshop. The experts, LDC study directors and consultants will evaluate the completed resource model and the global cost and demand studies, as well as experience a face-to-face exchange with contemporaries. Following the workshop with its suggested modifications, the state of the art papers, the literature surveys, the direct mailings, the cost demand studies, and the historic practices studies, and the on-site global studies will be assimilated. The documents will be printed by WHO and along with the technical report on each contract or process will form a basis for regional and global dissemination, perhaps through at least three global conferences.[2] The global conferences address themselves to the important aspects on the problems associated with obtaining acceptance of recommended technology by the LDCs. The program is shown graphically in Figure 3.

As can be noted on the Activities chart, the project terminates before some benefits that were not part of the original proposal, but vividly identified en route, can be capitalized on. It has been indicated that a longer support period for the contracts might have the added advantage of strengthening the nucleus of water and sewage Research Centers -- even though, the contractual obligations can be completed in the present time frame -- such support would approximate $30,000 in contracts. It should also be noted that USAID, might want to capitalize on the entire study to a greater degree by holding regional and global dissemination conferences. This could cost $20,000, mostly for travel. Both of these activities are suggested as possible follow-on second contracts, by these organizations or others, and perhaps, might be "looked at" for matching funds from interested agencies such as UNEP WHO, etc.

[2]Because of the credibility of acceptance, it is planned to study the problems that must be overcome in getting LDC's to use more suitable or appropriate technology. It is only the rather low technology processes that has not been sufficiently studied in-depth.

Budget Statement for the Final Year

Category	Amount
Salaries and Wages	$22,000
Fringe Benefits	2,600
Travel and Transportation	11,000
Consultants	9,000
Equipment and Supplies	1,000
Subcontracts	3,000
Other Direct Costs	15,000
Overhead	11,000
TOTAL	$74,600

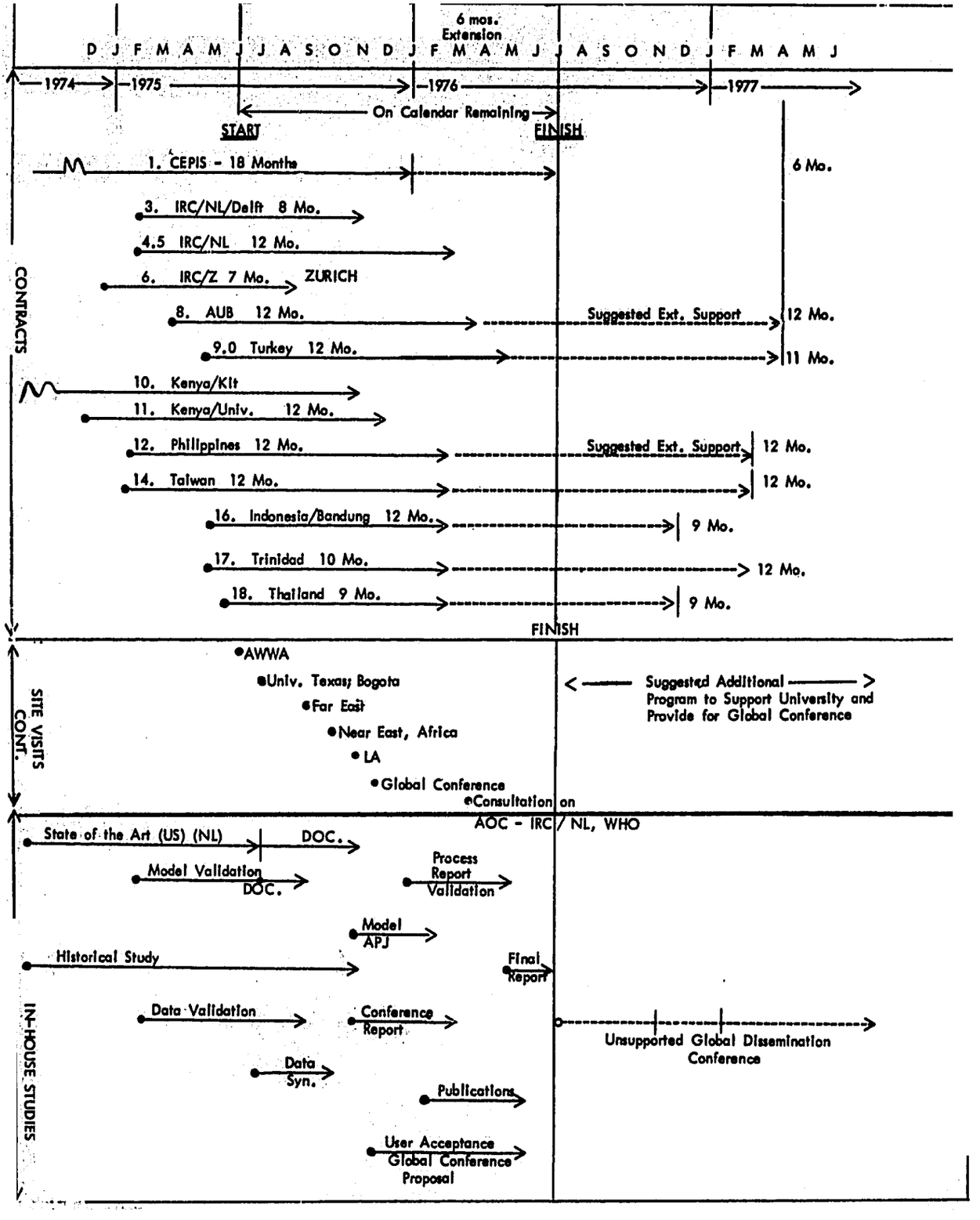


FIGURE 3: ACTIVITIES CHART

APPENDICES

APPENDIX I

INFORMATION HANDLING AND DEMAND/COST MODELS

(i) Innovative Survey on Practical Solutions in Drinking Water and Waste Disposal for Developing Countries

(ii) State of the Art Reviews on Water and Wastewater Treatment Processes in Developing and Developed Countries

(iii) Demand and Cost Models

APPENDIX II

SUB-CONTRACTED STUDIES

(i) USAID/OU Project Water and Sewage Sub-Contracted In-Depth Studies (Overall Programs)

(ii) Identification of Sub-Contracted In-Depth Studies by Water and Sewage Processes

(iii) Detailed Status of Sub-Contracted In-Depth Studies

(iv) Possible Alternatives to Some In-Depth Studies

APPENDIX III

COLLABORATED STUDIES

(i) IRC/NL Sand Filter Study Participating Institutes

(ii) Model Validation Studies

(iii) Sewage Lagoon Study

(iv) Water Field Kit Test and Lagoon Study in Kenya

(v) Global Technical Workshop on Compatible Water & Waste Water Treatment Methodology for Developing Countries

INFORMATION HANDLING
AND
DEMAND/COST MODELS

(i) Innovative Survey on Practical Solutions in Drinking Water and Waste Disposal for Developing Countries

(ii) State of the Art Reviews on Water and Wastewater Treatment Processes in Developing and Developed Countries

(iii) Demand and Cost Models

APPENDIX I (i)

WHO INNOVATIVE SURVEY

ON

PRACTICAL SOLUTIONS IN DRINKING WATER

AND

WASTE DISPOSAL FOR DEVELOPING COUNTRIES

Appendix I (i)

who international reference centre for community water supply

the hague, the netherlands
13 parkweg, telephone 070 - 514441
telegr : worldwater the hague, telex: 33604

date
eference
eference
nclosure
subject Practical Solutions in Drinking Water Supply and Wastes Disposal for Developing Countries.

Dear

As you know, engineers who are designing systems for drinking water supply and wastes treatment and disposal, are often making use of existing techniques and information from existing literature. In other cases they rely on personal experience.

Ofcourse, textbooks have been written on drinking water supply and waste disposal. However, they usually deal with the latest technology which may not be applicable or appropriate in the area where one is working. Limited resources, with respect to finance, material and spare parts on the one hand and problems as to lack of trained personnel and even sociological problems on the other hand, often prevail in developing countries.

Inventive men all over the world and in the lapse of time have improvised, invented and adapted devices in providing society with the drinking water and sanitary services it so requires. They have to do so, when funds are limited, specific material not available or simplified solutions are needed. Practising sanitary engineers may in their career have developed or met with some innovative device or process as mentioned. There should be a wealth of information on these

techniques or practical solutions, since every engineer in seeking a more optimal performance is making adjustments or adaptations. In many cases they even do so for the simple reason in order to keep the supply or services running.

Scattered as this information may be, if it is compiled to a reference of "Applications of processes using indigenous resources, self help techniques, etc.," and regularly updated and widely made available, it can become of great value. It will then be available to engineers, who each in their own locality and with limited resources are struggling trying very hard to provide their fellow-men with the necessary sanitary services. And so we have directed this letter to a selected number of practising Sanitary Engineers who are involved in the provision of drinking water supply and the disposal of waste.

By means of this questionnaire we intend to make a start with such a survey and information collection; it results from a cooperation between the International Reference Centre for Community Water Supply and the University of Oklahoma. Application of certain techniques may very well be widespread and generally accepted but never published. We feel that a collection of such data is very much needed. Therefore the University has started a thorough survey of the literature on innovative and adoptive technologies for water and sewage treatment as elaborated above.
The International Reference Centre for Community Water Supply is now requesting your collaboration in this effort. We should like to request you to make such information available to us so that we can make it widely known. This, we feel, may help the increased provision of drinking water and better sanitary services especially in developing countries. It goes without saying that your cooperation will be duly acknowledge in the book. If every one who is working in this field would search his files or his territory and report at least one successfu device, process or even untested idea to our Centre, a proces of extremely valuable information exchange will be started.

From this ultimately both information supplier and receiver will benefit.

Objectives

This action is intended to collate data, design and processes from the field, which are innovative with respect to more simple operation, easier control, use of readily available material, low cost and adaptation to local situations, conditions which apply to circumstances prevailing in developing countries.

Which kind of information are we looking for ?

Some examples of information which we think are of grat interest are:

- Bank filtration: Abstracting ground water near a river (Water resource)
- Lifting device for water such as Persian wheel(hydraulic) locally developed handpump etc. (pumping)
- Simple constant dosing of alum (Chemical dosing
- Mixing channel: Flocculation by means of hydraulic force (Flocculation)
- High rate settler; use of multiple plates or tubes (Sedimentation)
- Slow sand filters; use of local materials (Treatment)
- Local filtermedia: coconut husks, etc. (Filtration)
- Elimination of rate control in filtration (Process Control)
- Applying of hypochlorite in a perforated pot hung in the water (Disinfection)
- Bamboo pipes for watertransport: succes. limitations (Distribution)
- Public standposts sturdy construction, effective management (Distribution)
- Waste water collection, simple waste treatment.

Available data on construction, cost, operation and maintenance will be very useful also.

Why should you contribute ?

- because you can draw other people's attention to some untried idea of yours;
- because you may find from the intended guide that for some problems you have been struggling with, a solution might have been found in another part of the world (you will surely get a copy of that guide);
- because you might like to contribute to this guide and help people to obtain their sanitary services in a more efficient and cheaper way at an accelerated pace by providing them with self-help techniques.

Please indicate your intention to contribute or give reference to prospective contributors by sending back form 1 by return mail. Contributions are anticipated not later than 31 May 1975.

We sincerely hope that this project can have your attention and support.

Thanking you for your interest and response.

Sincerely yours,

Drs. J.M.G. van Damme
Manager.

FORM 1.

Intent of Contribution

To: WHO International Reference Centre for Community Water Supply, The Netherlands.

I am/am not* preparing a note/idea for your data collection on Practical Solutions in Drinking Water Supply and Waste Treatment for Developing Countries.
It concerns the following topic: ..
It will be sent to you before: ....
(ultimate date 31 May 1975).
I suggest you send your questionnaire also to

Mr.:
Address:

Mr.:
Address:

Signed:
Address:

* Circle appropriate answer

Please send this sheet to IRC by return of mail.

who international reference centre for community water supply

the hague, the netherlands
13 parkweg, telephone 070 - 514441

Re: Practical Solutions in Drinking Water Supply and Waste Disposal for Developing Countries.

Name of Innovation/Practical Solution:

the device/process/method is tested ☐ untested ☐

Subject area: water supply ☐ water treatment ☐ distribution ☐
waste collection ☐ waste treatment ☐ other ☐

Location: Country . City/Village

Characteristics of device/process/method.

System is an adaptation ☐ a simplification ☐ uniqu

Significant use of local material: yes ☐ no ☐

Cost saving ☐ foreign currency saving ☐

Gives: quality improvement ☐ capacity increase ☐ better efficiency ☐

Operation: simple ☐ needs special skill ☐

Spare parts: local ☐ import ☐

Acceptance by community: good ☐ requires promotion ☐

Background information of the community in which the innovation is found

Community: urban ☐ rural ☐ Number of people: ☐

Major means of living: agriculture ☐ trade ☐ industry ☐ other ☐

Drinking water: Consumption l/cap/day; Price US$ 0, /cu.m.

Community water supply:

Connection: house ☐ public standposts ☐ other ☐

source : surface water ☐ well ☐ other ☐

supply : gravity ☐ handpump ☐ electric pump ☐ other ☐

process : filtration ☐ chemical treatment ☐ disinfection ☐ other ☐

operation/maintenance: good ☐ adequate ☐ inadequate ☐

Major sewage disposal:

individual ☐ municipal ☐

treatment: yes ☐ no ☐

☐ Please check the appropriate box.

Description of the innovation

Please indicate the principle of the device/process or method reported.
A sketch, diagram or picture will be helpful.
Please include operational and cost data (if available).

Reference: publication, manufacturer if any

Reported by: Name :
Title :
Address:

Example: Practical Solutions in Drinking Water Supply and Waste Disposal.

Name of Innovation: Simple hypochlorinator for water disinfection

Country: Sudan

Material: Used plastic jerrycan

Characteristics: self help, local construction

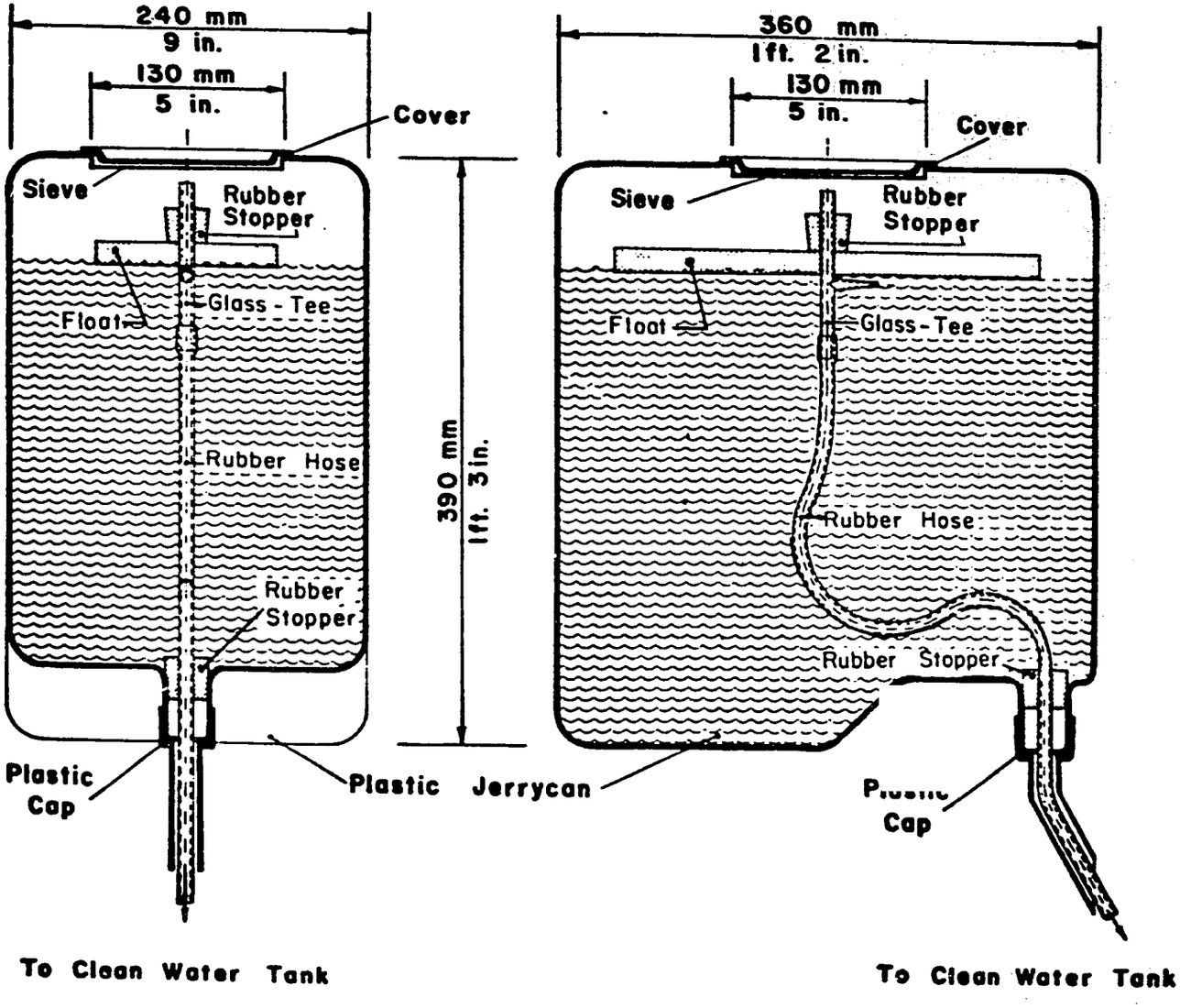
Principle: Constant dosing of a hypochlorite solution by arranging a constant head of liquid above the opening of the glass-tee (see sketch).
The dose can be changed by:
1. using another opening size of the tee
2. changing the concentration of the solution.

Operational difficulties:

1. the orifice should regularly be cleaned (clogging)
2. the liquid should "freely" fall through the orifice into the rubber hose (otherwise the constant head principle will not apply).

Cost: Total cost US$ 9.00

Reported by: H.E. Grombach. WHO Project Sudan 42. referred in IPSED



PLASTIC JERRYCAN CHLORINATOR

APPENDIX I (ii)

STATE OF THE ART REVIEWS

ON

WATER AND WASTEWATER TREATMENT PROCESSES

IN

DEVELOPING AND DEVELOPED COUNTRIES

STATE OF THE ART REVIEWS
ON
WATER AND WASTEWATER TREATMENT PROCESSES
IN
DEVELOPING AND DEVELOPED COUNTRIES

I. Purpose

The purpose is to provide an overview of the state of the art of water and wastewater treatment in developed and developing countries. It will not cover every process or system in minute detail; rather it aims to provide the reader with background information on the subject, and serve as a reference point for further detail.

II. Approach

A. A survey will be made of the published literature including articles, books, documents, and papers written in the English language (or translated into English) as well as German, French and Dutch. The period covered is 1960 to present. The literature will be that reports on the application of one or more processes that deal with the subject.

B. A review of the data/information from the IRC/NL survey of unpublished materials will also be made and incorporated in this study.

III. Report

In effect, each report will be a comprehensive reference to currently available treatment operations and/or processes. There will be one on water and one on wastewater. Information will be provided on the reliability of processes,

performance data, economic factors, and range of commercially available equipment as an aid to those individuals/organizations engaged in water and wastewater treatment management. In addition the reports will be useful to the researcher as well as those who are more involved in planning in the larger framework of a country's health and economy. The following is presented as the working outline of the reports. The first outline is the general one used for both reports. The second and third is for water and wastewater treatment respectively.

A. General Outline

1. Recommendations and Conclusions
2. Introduction and Background
3. The Problem (Water and Wastewater Problems): Especially as applied to developing countries (Urban as well as rural).
4. General Processes Employed
   a. Developed Countries
   b Developing Countries
5. Advanced Processes Employed
   a. Developed Countries
   b. Developing Countries
6 Innovative and Adaptive Processes
   a. Developed Countries
   b. Developing Countries

Appendixes

Information Resources by Country

(1) Individuals

(2) Organizations (Reference Centers, consultant, etc.)

b. Bibliographies:

The bibliography will contain general, selected and abstracted references that pertain to the concepts,

principles or results of the application of the processes described in the text of the report.

(1) General

(2) Selected:

i. Cited

ii. Abstracted (Descriptors and identifiers most descriptive of the documented abstracts will be included).

c. Glossary:

Definitions of all pertinent terms

d. Tabulation of Processes by availability (manufacturer, costs, etc.)

B. Water Treatment

1. The processes as indicated in the general outline will be broken down by (1) General; (2) Advanced; and (3) Innovative and Adaptive. These in turn will be divided in terms of developed and developing countries.

The processes covered are:

PW1 Drilled Well
PW2 Pre-Treatment
PW3 Slow Sand Filtration*
PW4 Rapid Sand Filter - Conventional*
PW5 Rapid Sand Filter - Advanced*
PW6 Softening
PW7 Disinfection*
PW8 Taste-Ordor - Fe, Mn
PW9 Desalting - Salt (Sea Water)
PW10 Desalting - Brackish
PW11 Coagulation Pressure Filtration
PW12 Innovative - Containment, etc.*

---

* Contracted field studies of AID/OU.

NOTE: These categories (PW and PS) were developed for the predictive model, and may be expanded as needed.

Waste Treatment

1. The processes covered are:

PS 1 Primary - Conventional

PS 2 Primary - Stabilization* Pond (Lagoon)

PS 3 Sludge - Conventional

PS 4 Sludge - Advanced*

PS 5 Sludge - Combined Imhoff

PS 6 Secondary - Standard Filter

PS 7 Secondary - High Rate Filter

PS 8 Secondary - Activated Sludge

PS 9 Secondary - Extended Aeration

PS 10 Disinfection

PS 11 Tertiary (RD, IX, Combustion)

PS 12 Innovative (Estuarial Disposal, Fish Production)*

2. Process Description:

Each process will be described in narrative as well as accompanied by flow or schematic charts. The following will be covered:

(1) Advantages

(2) Limitations

(3) State of Development

(4) Costs:

a. Operational

b. Construction

(5) Needed R&D

* Contracted field studies of AID/OU

3. Process compilations will include:

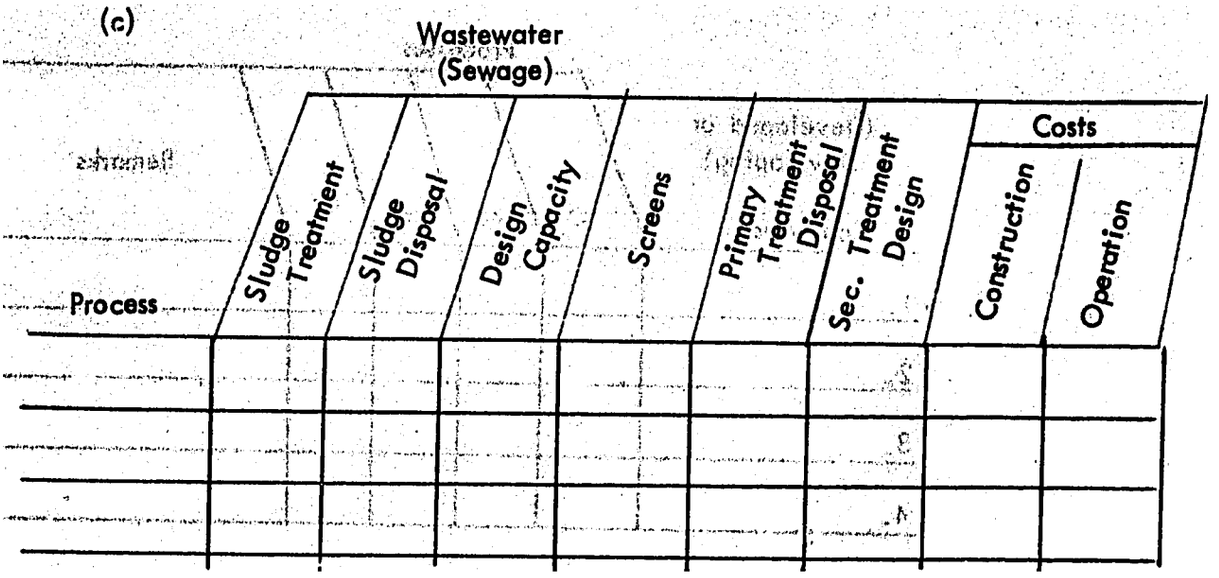
(a)

(Developed or Developing) Countries	Processes 1.	2.	3.	4.	Remarks
1.					
2.					
3.					
4.					

(b)

Process	Water: Country	Water Source	Sub-treatment Method	Capacity	Filters	Dispersion Method	Costs: Const.	Oper.

(c)


Wastewater
(Sewage)
Process
Sludge Treatment
Sludge Disposal
Design Capacity
Screens
Primary Treatment Disposal
Sec. Treatment Design
Costs
Construction
Operation

APPENDIX I (iii)

DEMAND AND COST MODELS

Appendix I-(iii)

DEMAND AND COST MODELS

Introduction

Predictive models to provide estimates of water requirements and treatment cost have been created for the developed countries. There are quite a number of responsive models, using estimated population, income, urbanization, etc. Before designs can be undertaken, the demand for water or amounts of sewage must be provided. These estimates along with cost estimates are necessary to validate the overall predictive model.

In developing countries, most of the water supply and waste water disposal constructions are for new systems. The socio-economic and cultural conditions in developing countries are different from the United States. It is not known if the criteria used in the developed countries for design of water supply will be of use. It is felt, from what experience is available, that it will not be of use, so this study is aimed at developing methods to estimate demand and costs for construction and maintenance of water and waste water system in developing countries.

The models developed in these studies are based on the assumption that economic, labor and resources conditions in developing countries are generally different from those in the highly industrialized countries, but the idea that the methodology of previously developed format might be useful. However, little information is known about water and waste water demand and

costs in these countries and all present data on demand and cost of water and waste water are mainly available for the United States (1,2,3,4) and they do not include some of the developing countries variables which may drastically affect the costs of water and waste water systems.

Objective

The purpose of this study is to develop mathematical predictive equations for estimating demand and cost of water and waste water in developing countries.

In this study, four sub-models are being developed as shown in the following and eventually all will be grouped together as shown in Figure 1:

1. Water Demand Model for Developing Countries
2. Waste Water Discharge Model for Developing Countries
3. Cost of Water Treatment in Developing Countries
4. Cost of Waste Water Treatment in Developing Countries

The basic technique used in this study is stepwise multiple regression technique. Predictive equations for water demand, waste water generation, costs of water and waste water processes in developing countries are developed by using available cost data on slow sand filters, rapid sand filters, stabilization ponds, and activated sludge from Africa, Asia and Latin America. The equations for estimating water demand, waste water discharge, water and waste water costs by processes are in the following form:

$$Y = B_0 + B_1 X_1 + B_2 X_2 + B_3 X_3 \cdots + B_i X_i \quad \text{for } i = 1, 2, 3 \ldots$$

where Y = variable to be estimated, e.g., water demand

X_i = variables used in making estimates, see Figure 1

B_i = regression coefficients.

Some of the predictive equations for water demand (equations 2, 3, 4) and samples of the applications of the end product of the models are shown on Sample Problem of A Practical Application of the Models and Figure 2.

Abbreviations of Terms Used in Demand and Cost Models

Dw.Af = Water demand in Africa gallons per capita per day
Dw.As = Water demand in Asia gallons per capita per day
Dw.LA = Water demand in Latin American gallons per capita per day
Dw.DC = Water demand in Developing Countries gallons per capita per day
Dww.Af = Waste water demand in Africa gallons per capita per day
Dww.As = Waste water demand in Asia gallons per capita per day
Dww.LA = Waste water demand in Latin American gallons per capita per day
Dww.DC = Waste water demand in Developing Countries gallons per capita per day
Cwc.Af* = Unit construction cost in Africa in 1975 dollars
Cwc.As* = Unit construction cost in Asia in 1975 dollars
Cwc.LA* = Unit construction cost in Latin American in 1975 dollars
Cwc.DC* = Unit construction cost in Developing Countries in 1975 dollars
Cw.op.Af* = Unit operational and maintenance cost in Africa in 1975 dollars
Cw.op.As* = Unit operational and maintenance cost in Asia in 1975 dollars
Cw.op.LA* = Unit operational and maintenance cost in Latin America in 1975 dollars
Cw.op.DC* = Unit operational and maintenance cost in Developing Countries in 1975 dollars

X_1 = Price of treated water $/1000 gallons

X_2 = Population of the town in thousands

X_3 = % of National Literacy

X_4 = % of public stand post

X_5 = % of home connected to water supply

X_6 = Average annual income in 1975 $

X_7 = Average annual temperature in ^{o}F

X_8 = Percentage of cost of imported water supply materials

X_9 = % connected to public sewerage system

X_{10} = % of household system

X_{11} = National average person per household

X_{12} = Design population in thousands

X_{13} = BOD of influent in mg/l

X_{14} = BOD of enfluent in mg/l

X_{15} = BOD removal efficiency

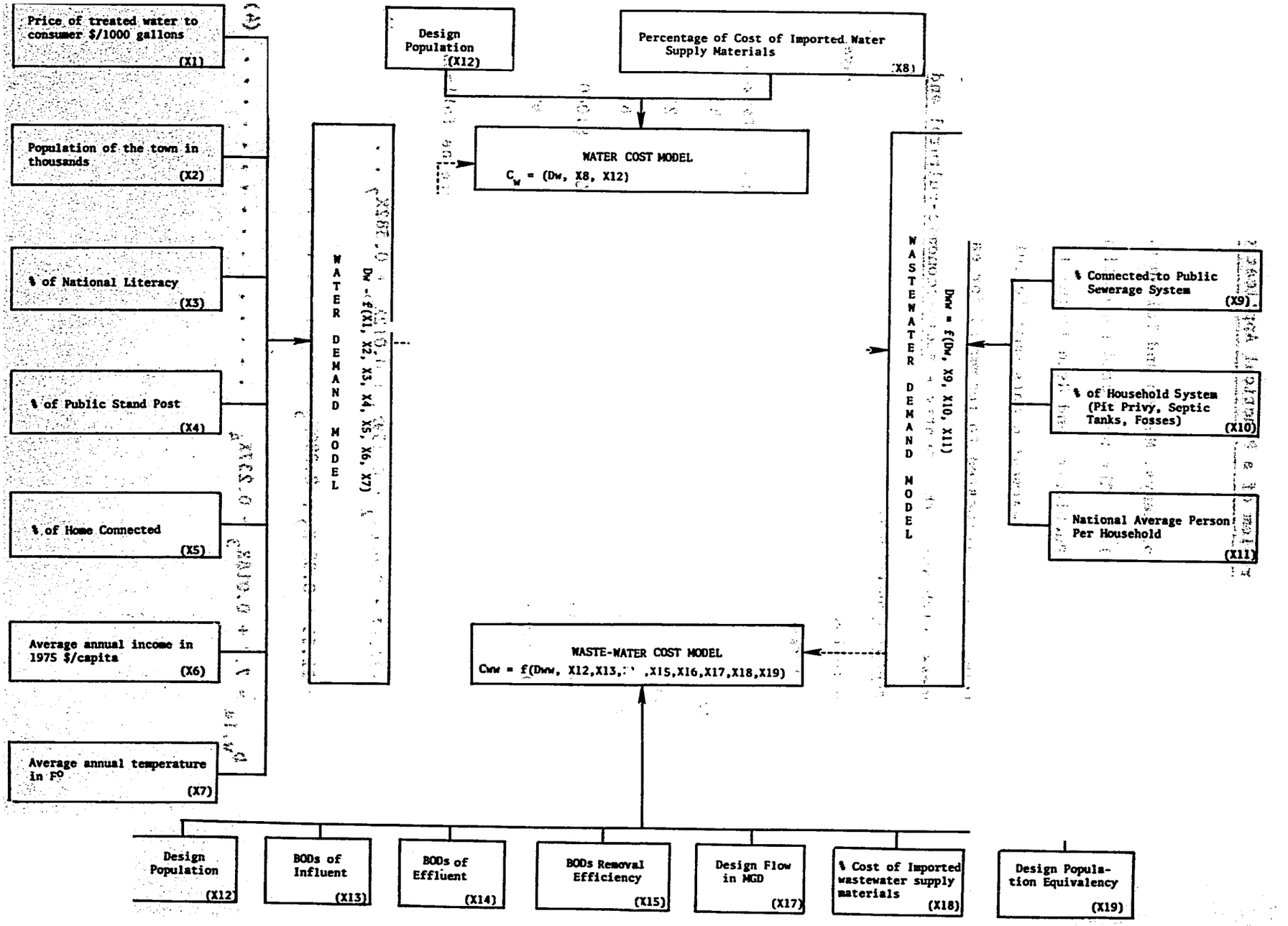
X_{17} = Design flow in MGD

X_{18} = % cost of imported waste water supply materials

X_{19} = Design population equivalency

*These equations will be developed for each water and waste water processes e.g. Slow Sand Filter, Rapid Sand Filter, Activated Sludge, and Stabilization Pond.

Figure 1. RELATIONSHIP BETWEEN WATER-WASTEWATER DEMAND MODELS & WATER WASTEWATER COST MODELS FOR DEVELOPING COUNTRIES



Sample Problem of a Practical Application of the Models

The Governments of Kenya, Mexico and Taiwan want to build a small new town in the interior. The projected population for each town (Kijiji Kipya, Nuevo Pueblocito and Hsin Tsein) is to be 5,000. Both water and waste water treatment plants must be built simultaneously. A consulting firm is requested to recommend for each new town a low cost process which suits the country's socio-economic-cultural and environmental conditions.

The following are some historical data for each region in Kenya, Mexico and Taiwan, respectively:

	Kenya	Mexico	Taiwan
(X3) % of National Literacy	65	65	85
(X4) % of Public Stand Post	65	45	25
(X5) % of Home Connected	25	45	65
(X6) Average Annual Income	$1060	$1060	$1060
(X7) Average Annual Temperature	80	40	60

The sample predictive equations for each region are as follows

$$D_{w.af} = -22.17 + 0.046X_2 + 0.359X_3 + 0.012X_6 + 0.582X_7 \qquad (2)$$

$$D_{w.as} = 22.55 + 0.033X_2 + 0.080X_5$$

$$D_{w.la} = 7.7 + 0.018X_3 + 0.237X_4$$

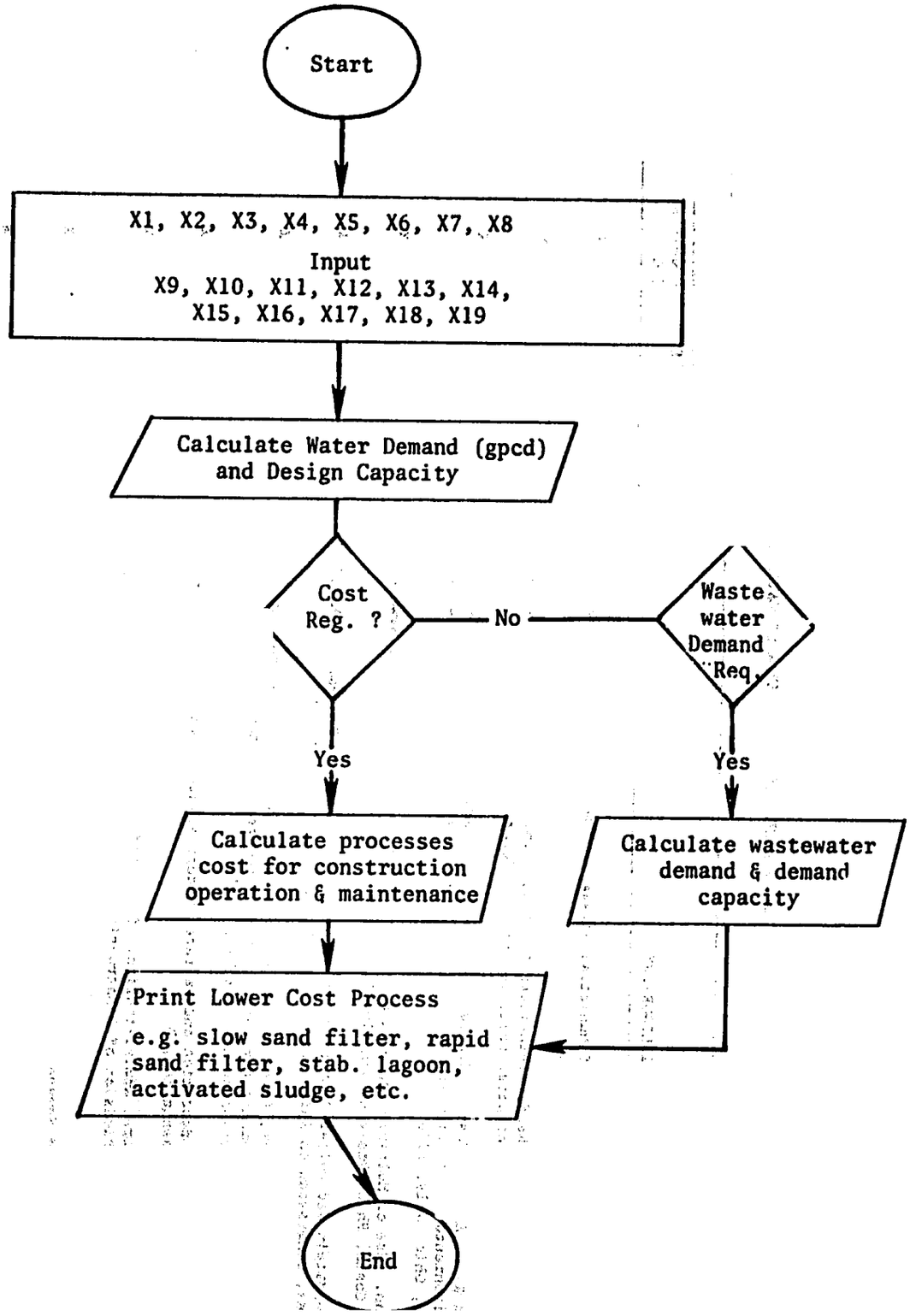


Figure 2. Demand and Cost Models Flow Chart

WATER AND WASTEWATER DEMAND AND COST OF WATER-WASTEWATER PROCESS BIBLIOGRAPHY

	BIBLIOGRAPHY	LESS DEVELOPED COUNTRIES (LDC)	DEVELOPED COUNTRIES (DC)	WATER AND WASTEWATER DEMAND	COST OF WATER AND WASTEWATER PROCESS
1	T. A. Butts and R. L. Evans. Cost of Municipal Sewage Treatment Plants in Illinois, State Water Survey, Urbana, 1970.		X		X
2	Kanti L. Shah and George W. Reid. Techniques for Estimating Construction Costs of Water Treatment Plants, Journal of Water Pollution Control Federation, May. 1970.		X		X
3	R. Smith and R. G. Eiler. Cost to Consumer for Collection and Treatment of Waste, U. S. Environmental Protection Agency, Advanced Waste Treatment Research Laboratory, Cincinnati, Ohio, July, 1970.		X		X
4	J. R. Assenso. Use of Multiple Regression Techniques for Estmating Municipal Sewage Treatment Costs, Ph.D. Dissertation, The University of Oklahoma, 1963.		X		X
5	Steven M. Goldstein and Walter J. Moberg, Jr. Wastewater Treatment Systems for Rural Communities, Commission on Rural Water. Washington, D. C., 1973, p. 89.		X		X
6	W. L. Patterson, R. F. Benker, Black and Veatch Consulting Engineers. Estimating Costs and Manpower Requirements for Conventional Wastewater Treatment Facilities, U. S. Environmental Protection Agency. October. 1971.		X		X
7	U. S. Department of Health, Education and Welfare. Modern Sewage Treatment Plants — How Much Do They Cost?, Washington, D. C.		X		X
8	Federal Water Pollution Control Administration. Sewer and Sewage Treatment Plant Construction Cost Index, Division of Construction Grants, Washington, D. C., 20242, December, 1967.		X		X
9	C. J. Vebr. How Much Should Sewage Cost?, Engineering News Record, Vol. 141, No. 16, October, 1948, p. 84.		X		X
10.	Estimating Staffing for Municipal Wastewater Treatment Facilities, J. S. EPA, May, 1973.		X		X
11.	Diachishin, A. M. New Guide to Sewage Plants Costs, Engr. News Record 159, 15, 316, October. 1957.		X		X

WATER AND WASTEWATER DEMAND AND COST OF WATER-WASTEWATER PROCESS BIBLIOGRAPHY
(continued)

	BIBLIOGRAPHY	LESS DEVELOPED COUNTRIES (LDC)	DEVELOPED COUNTRIES (DC)	WATER AND WASTEWATER DEMAND	COST OF WATER AND WASTEWATER PROCESS
12	Rowan, P. P., Jenkins, K. H., and Butler, D. W. Sewage Treatment Construction Costs Journal Water Poll. Control Fed., 32, 594, 1960.		X		X
13	Logan, J. A., et. al. Analysis of the Economics of Wastewater Treatment, Journal Water Poll. Control Fed., 34, 860, 1962		X		X
14	The Cost of Columnar Denitrification for Removal of Nitrogen from Wastewater, R. Smith, January, 1972		X		X
15	Smith, R. and W. F. McMichael. Cost and Performance Estimates for Tertiary Wastewater, Tertiary Processes, June, 1969.		X		X
16.	McMichael, W. F. Costs of Filter Processing Domestic Sewage Sludge, August, 1973.		X		X
17.	McMichael, W. F. Costs of Hauling and Land Spreading of Domestic Sewage Treatment Plant Sludge, July, 1973		X		X
18.	McMichael, W. F. and Smith, R. Cost and Supply Analysis for Alum and Methanol Used in Wastewater Treatment, August 1971.		X		X
19.	Computerized Design and Cost Estimation for Multiple Hearth Sludge Incinerators, Rocketdyne, July, 1971.		X		X
20.	Eiles, Richard G. and Smith, R. Wastewater Treatment Plant Cost Estimating Program, EPA, Cincinnati, Ohio.		X		X
21.	Launa, Donald T. Planning Small Water Supply in Developing Countries, Office of Health, Agency for International Development	X		X	X
22.	Low Cost Waste Treatment, Central Public Health Engineering Research Institute, Nagpur, India, 1972.	X			X
23.	White, G. F. and others. Drawers of Water. The University of Chicago Press, 1972.	X		X	X

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(continued)

	BIBLIOGRAPHY	LESS DEVELOPED COUNTRIES (LDC)	DEVELOPED COUNTRIES (DC)	WATER AND WASTEWATER DEMAND	COST OF WATER AN WASTEWAT PROCESS
24.	Low Cost Distribution Systems in Guatamala, Proceedings of the International Conference on Water for Peace, Washington, D. C., 1967.	X	X		X
25.	Sewell, W. R. and others. Forecasting the Demands for Water, Ottawa Policy and Planning Branch, Department of Energy, Mines and Resources.		X	X	X
26.	Dieterich, B. H. and Henderson, J. M. Urban Water Supply Conditions and Needs in Seventy-Five Developing Countries, WHO Public Health, Paper 23, Geneva, 1967.	X	X	X	X
27.	Jones, P. H. Low Cost Wastewater Treatment Facilities for Rural Areas, Institute of Environmental Sciences and Engineering, University of Toronto.		X		X
28.	Warner, Dennis. Rural Water Supply and Development: A Comparison of Nine Villages in Tanzania. Economic Research Bureau Paper, No. 69.17, Dar es Salaam University College.	X	X	X	X
29.	Mau, G. E. Sewage Treatment Plants Costs in Kansas. Sewage and Industrial Wastes, Vol. 30, No. 12, December 1958.		X X		X X
30.	Howell, D. H. and Dubois, D. F. Design Practices and Costs for Small Secondary Sewage Treatment Plants in the Upper Midwest, Sewage and Industrial Wastes, Vol. 30, No. 1 1958.		X X		X X
31.	The Responsibilities of the National Water and Sewerage Corporation, Uganda, The Provincial Governors/District Commissioners, C. F. Kasozi - Kaya Managing Director of the National Water and Sewerage Corporation.	X		X	X
32.	Water Desalination in Developing Countries, United Nations, New York, 1964.	X		X	X
33	Koenig, Louis. Cost of Water Treatment by Coagulation, Sedimentation, and Rapid Sand Filtration, AWWA, Vol. 59, No. 3, March 1967.		X		X
34.	Standard Procedure for Estimating Costs of Conventional Water Supplies Manual, Office of Saline Water, United States Department of the Interior, 1963.		X		X

WATER AND WASTEWATER DEMAND AND COST OF WATER-WASTEWATER PROCESS BIBLIOGRAPHY
(continued)

BIBLIOGRAPHY	LESS DEVELOPED COUNTRIES (LDC)	DEVELOPED COUNTRIES (DC)	WATER AND WASTEWATER DEMAND	COST OF WATER AND WASTEWATER PROCESS
35. Interim report of a research project on low-cost Water Technologies, Intermediate Technology Development Group Ltd., 1972	X			X
36. Lee, Terence. Residential Water Demand and Economic Development, University of Toronto Department of Geography, Research Publication, No. 2, Toronto, University Toronto Press.	X			X
37. Lwegarubla, F. K. Forecasting Water Requirements in Developing Countries with Special Reference to Tanzania, U.N. Ad Hoc Group of Experts on Water Requirements Forecasting, Budapest, May 1972.	X		X	
38. Stop the Give Gallons Flush: A Survey of Alternative Waste Disposal Systems. Minimum Cost Housing Studies of McGill University, Montreal, Canada, 1973.	X	X	X	X
39. Henderson, John M. Report on Global Urban Water Supply Costs in Developing Nations, 1961-1975, International Cooperation Administration, Washington, D. C.	X			X
40. Ginn, H. W. and others. Design Parameters for Rural Water Distribution Systems. Journal of the American Waterworks Association 58, 1966.		X	X	
41. Cost of Rural Water and Village Sanitation in the South-East Asia Region. WHO Chronicle 21, 1967	X			X
42. True Cost of Conventional Water, American Water Works Association, Las Vegas, Nevada, May 16, 1973.		X		X
43. J. H. Dawes and Magne Wathne. Cost of Reservoir in Illinois, Illinois State Water Survey, Urbana, 1968.		X		X

Appendix II

SUB-CONTRACTED STUDIES

(i) USAID/OU Project Water and Sewage Sub-Contracted In-Depth Studies (Overall Programs)

(ii) Identification of Sub-Contracted In-Depth Studies by Water and Sewage Processes

(iii) Detailed Status of Sub-Contracted In-Depth Studies

(iv) Possible Alternatives to Some In-Depth Studies

NOTE: All the Code No's in Appendix II are just for identification purposes. They are not in complete consecutive order.

APPENDIX II (i)

USAID/OU PROJECT WATER AND SEWAGE
SUB-CONTRACTED IN-DEPTH STUDIES
(OVERALL PROGRAMS)

Appendix II (i)

USAID/OU PROJECT WATER AND SEWAGE SUB-CONTRACTED IN-DEPTH STUDIES

Overall Programs

Code No.	Country	Title of Study	Person in Charge	Institution	Date Start/End	Duration	Amount U.S. $	Brief Description of Project	Comment
1	Lima, Peru	Evaluation of Lower Cost Methods of Water Treatment in Latin America	Ing. Odyer Sperandio	Dept. of Engr. and Environmental Science Pan American Health Organization	6-1-74/ 12-31-75	19 Months	$20,000 (CEPIS - $26,432)	To evaluate lower cost methods of water treatment in Latin America.	Sub-contract sent out on 6-24-74 signed on 10-25-74
3	Delft, The Netherlands	A Study on Historical Methods of Water and Sewage Treatment	Professor Knoppert	Delft University	12-1-74/ 8-1-75	8 Months	$2,000	This is principally a survey on historical methods of water treatment in Europe and North America. Sewage treatment method will also be included.	Sub-contract sent out on 11-14-74 (handled through IRC-Van Damme)
4 & 5	The Hague, The Netherlands	Studies Related to Low Cost Methods of Water and Waste Water Treatment in Less Developed Countries	Dr. J. M. C. Van Damme	WHO International Reference Center	12-1-74/ 12-1-75	1 Year	$5,000	(1) A survey of Innovative or Practical Methods for Water and Sewage Treatment; (2) An In-depth study of the Use of Sand Filters for Water Treatment in Several Developing Countries; (3) State of the Art Documents of Water and Sewage Treatment	Sub-contract sent out on 12-9-74. Signed on 4-2-75
6	Dubendorf; Switzerland	A Study on Historical Methods of Water and Sewage Treatment	Dr. H. R. Wasmer, Dipl. Ing	EAWAG	12-1-74/ 6-1-75	6 Months	$2,000	Basically it is a survey on historical methods of sewage treatment in Europe and North America. Study on water treatment will also be included.	Sub-contract sent out on 11-13-74 Signed on 11-22-74
8	Beirut, Lebanon	(1) Utilization of Seawater in the Treatment and Disposal of Sewage, and (2) A Study of Using Asbestos and Pine Needles for Filtration in Water Treatment	Dr. George M. Avoub and Dr. Aftin Acra	American University of Beirut	12-1-74/ 12-1-75	1 Year	$7,500	(1) This is research to explore the possibility of developing an acceptable process for the treatment and disposal of sewage by using seawater and low cost in country materials; (2) It will study the development of containment filter for water treatment by using asbestos and pine needles as treatment media	Sub-contract sent out on 11-18-74 signed on 4-30-75

Appendix II (i) Continued

Code No.	Country	Title of Study	Person in Charge	Institution	Date Start/End	Duration	Amount U.S. $	Brief Description of Project	Comment
9	Ankara, Turkey	Upgrading of an Oxidation Pond to an Aerated Lagoon	Dr. S. Erol [illegible]	Environmental Engr. Dept Middle East Technical University	12-1-74/ 12-1-75	1 Year	$7,500	It is a study of upgrading an oxidation pond to an aerated lagoon. It will explore the possibility of increasing capacity by including aeration.	Sub-contract sent out on 11-14-74
11	Nairobi, Kenya	Research in Kenya on Socio-Economic Conditions which Pertain to Cost of Construction and Operation of Water and Sewage Treatment Facilities and Quantity of Water Consumption	Dr. Erasto Muga	University of Nairobi	12-1-74/ 12-1-75	1 Year	$5,000	The research will deal with socio-economic conditions in Kenya as relating to water and sewage treatments.	Sub-contract sent out on 11-13-74 Signed on 12-5-74
12	Manila, Philippines	A Water Sterilization Study in the Philippines	Dr. Reynoldo Lesaca	National Pollution Control Commission	12-1-74/ 12-1-75	1 Year	$5,000	To study water sterilization in the Philippines, primarily in the maintenance problems during processing.	Sub-contract sent out on 12-10-74 and signed on 1-21-75
14	Taipei, China	"The Study of Microbial Treatment of Night soil and Sewage Sludge"	Mr. Mei-chan Lo	Insitute of Environmental Sanitation PHA	12-1-74/ 12-1-75	1 Year	$7,500	To study the treatment of night soil and sewage sludge	Sub-contract sent out on 1-14-75 and signed on 2-3-75
16	Jakarta, Indonesia	A Study on the Ultimate Disposal of Lagoon Effluents as Nutrients for Fish Production	Dr. Wilfredo Reyes	WHO Representative at Indonesia	12-1-74/ 12-1-75	1 Year	$4,000	To study the ultimate disposal of lagoon effluents as nutrients for milkfish.	Sub-contract sent out on 12-10-74
18	Bangkok, Thailand	A Study of Slow and Rapid Sand Filters for Water Treatment	Mr. Charu Chandr Praphorn	Division of Environmental Health, hailand inistry of ealth	12-1-74/ 12-1-75	1 Year	$3,000	To study problems associated with the design and operation of filters used in filtration.	Sub-contract sent out on 12-10-74

APPENDIX II (ii)

IDENTIFICATION OF SUB-CONTRACTED IN-DEPTH STUDIES BY WATER AND SEWAGE PROCESSES

Appendix II (ii)

IDENTIFICATION OF SUB-CONTRACTED IN-DEPTH STUDIES BY WATER AND SEWAGE PROCESSES

A. Water Process

Process	Country and Institute	Code No*
Slow Sand Filter	Thailand/Ministry of Health	18
Rapid Sand Filter	Peru/ CEPIS	1
Coconut Filter (Containment Filter)	Thailand/Ministry of Health (and others)	18
Alternative to Chlorine (Cl_2)	Philippines/National Pollution Control Commission	12

B. Sewage Process

Process	Country or Institute	Code No.*
Lagoons	Indonesia	16
Oxidation Ponds (Aerated Lagoon)	Turkey/Middle East Technical University	9
Estuarial Discharge & Chemical Treat.	Lebanon/American University of Beruit	8
Night Soil, Algae	Taiwan/Institute of Environmental Sanitation	14
	Trinidad	In the process of drafting the study proposal

*See Appendix II (i)

APPENDIX II (iii)

DETAILED STATUS

OF

SUB-CONTRACTED IN-DEPTH STUDIES

Appendix II (iii)

DETAILED STATUS OF SUB-CONTRACTED IN-DEPTH STUDIES

All the following status reports are identified by the Code No.'s corresponding to those shown in Appendix II (i). The Code No.'s are followed by the sub-contracted organization, person-in-charge, and the location of the organization.

CODE No. 1

CEPIS/PAHO/SPERANDIO - LIMA/PERU

TITLE: "Evaluation of Lower Cost Methods of Water Treatment in Latin America"

A. A Brief Description of the Project

The purpose of this project is to study and evaluate lower cost methods of water treatment in Latin America.

B. Present Level of Accomplishment

CEPIS initiated the in-house preparation of the project, and its water treatment adviser traveled to Ecuador, Bolivia and Brazil in order to establi contacts in the field and select the sites for the water plant studies.

Four places were selected to conduct the research: Cuenca (Ecuador), Cochabamba (Bolivia), Linhares and Prudentopolis (Brazil). Viradouro and Cordeiropolis, both in the State of Sao Paulo, Brazil, were selected as substitute sites in the event that any of the first four sites does not work out.

Description of the Sites

Cuenca (Ecuador)

Cuenca is a city located in the Andes, at 2500 m above sea level, with a total population of 120,000. The designed capacity of the water treatment plant is 120 lt/sec, and it has been upgraded to 360 lt/sec by constructing two new hydraulic flocculators, including asbesto-cement plates in two of th three settling basins, changing the sand media filters to dual media filters, and taking out the rate controllers to work with variable declining rate.

The treatment plant is operated by the Empresa de Teléfonos, Agua Potable y Alcantarillado (ETAPA), owned by the local government.

Contacts were made with this agency and they gladly offered their full cooperation. Tests will start as soon as the agreement between CEPIS and ETAPA is formalized.

As an incentive for the local water works personnel in charge of the investigation, a supplementary salary of US$ 50.00 per month was offered to the chemist (US$ 600 per 12 months) and a total of US$ 900 to the operation engineer who will coordinate the collection of data.

Some equipment will be needed, such as jar test apparatus, colorimeter and a Hach kit with a total cost of US$ 1200.

2. Cochabamba (Bolivia)

Cochabamba is a city of 300,000 inhabitants and located at 2500 m above sea level. At the moment, a new treatment plant with a maximum capacity of 230 lt/sec is under construction with IDB funds. The installations are practically finished, but there are still some details lacking.

The plant consists of one horizontal hydraulic flocculator, three high-rate settling basins with asbesto-cement plates, and six declining rate dual medial filters, that are backwashed without auxiliary pumps.

The plant, which is scheduled for completion this May, is administered by the Servicio de Agua Potable, Alcantarillado y Desagues Pluviales (SEMAPA) of Cochabamba, a government agency. They have enthusiastically agreed to collaborate with the project and will start collecting data as soon as an agreement is formally established between SEMAPA and CEPIS.

As an incentive for local water works personnel, a supplementary salary of US$ 50 per month (US$ 400 in eight months) was offered to the water chemist, and a total of US$ 900 to the engineer in charge of collecting the data at the completion of the study.

The equipment needed will be a colorimeter and a Hach kit with a total cost of US$ 1000.

3. Linhares (Brazil)

Linhares is a city by the sea in the State of Espiritu Santo, Brazil with a population of 40,000 inhabitants.

Recently two upflow filters were constructed with a capacity of 80 lt/sec to complement the conventional treatment plant with a capacity of 36 lt/sec.

This site presents the possibility of comparison between conventional treatment (coagulation, sedimentation and filtration) and contact clarifier treatment. It offers the additional advantage that it has been keeping useful records in the past, which could be analyzed and compared with those at Colatina, a near-by city that also has upflow filters.

The plant is administered by the Fundaçao de Serviço Especial de Saúde Pública (FSESP), a national agency of the Ministry of Health.

As an incentive for the local water works personnel in charge of the investigation, a supplementary salary of US$ 100 per month was offered to the water chemist (US$ 800 in eight months) and a total of US$ 1000 to the engineer who will coordinate the collection of data.

The only equipment needed will be a potentiometer and a colorimeter with a total cost of US$ 800.00

4. Prudentopolis (Brazil)

This is a village in the State of Parana, Brazil, with a total population of 8000 inhabitants.

At the moment, a treatment plant is under construction that is due for completion in May with a capacity of 11 lt/sec.

The plant has a very compact and economical design. One mechanical flocculator, four high-rate settling basins, and four dual media declining-rate filters of the self-backwashing type are located in an area of 4 x 4 m.

This plant is being constructed and administered by the Companhia de Saneamento do Paraná (SANEPAR), which has offered its full collaboration to the research project. They are prepared to temporarily assign three waterworks operators to the plant, in order to have round-the-clock attendance (normally this is not done) and make it possible to collect day and night data.

An additional salary of US$ 100 per month was offered to each of the waterworks operators (US$ 2400, three operators, 8 months). The engineer in charge of the research did not accept supplementary payments.

The equipment needed will be a jar test apparatus, a colorimeter, a potentiometer, and a spectronic 20; all with a total cost of approximately US$ 2000.

Data to be collected

It was agreed with all the agencies involved in the project that it will cover the following areas:

1. Economical study - Data on the investment made in the construction and operation of the treatment plant, according to a questionnaire which will be submitted to them.

2. Demographic and socio-economic study - Data on population and state of development of the community according to a questionnaire which will be submitted to them.

Technical evaluation of the plant - It will cover day-and-night operational records that describe the efficiency of each process. This will be a highly detailed type of information taken with specialized equipment, which will make it possible to obtain precise curves for evaluating the plant.

C. Work Remaining to be Done

The development of the project in the following month will be:

To sign the sub-contract with the water agencies in charge of the field investigation.

To purchase the equipment needed and proceed with the distribution according to the list included in the appendix.

To start the collection of data as soon as the agreement between the water agencies and CEPIS is signed.

DE No. 3

DELFT UNIVERSITY/PROFESSOR KNOPPERT - DELFT/THE NETHERLANDS

TITLE: "A Study on Historical Methods of Water and Sewage Treatment"

A. A Brief Description of the Projec

This is principally a survey on historical methods of water treatment in Europe and North America. Sewage will also be included.

B. Present Status

The sub-contract is being handled through IRC/N

CODE No. 4 & 5

INTERNATIONAL REFERENCE CENTRE/VAN DAMME - THE HAGUE/N.L.

TITLES: (1) "A Survey of Innovative or Practical Methods for Water and and Sewage Treatment"

(2) "An In-depth Study of the Use of Sand Filters for Water Treatment in Several Developing Countries"

(3) "State of the Art Documents on Water Treatm

A. A Brief Description of the Projects

(1) Project involves the data collection on innovative practical solutions on drinking water supply and waste water disposal by the WHO International Reference Centre for Community Water Supply. The study is aimed at a survey of field practices which are usually not obtainable from recorded sources. The details to be surveyed include:

a. The merits of construction
b. Cost savings
c. Ease of maintenance
d. Acceptance by community
e. Level of Technology of the Community where device i located.

(2) This IRC/NL study is divided into two phases. General objectives of phase one is to study the performance of slow sand filters under specific conditions and possible adoption of the system to local conditions including a possible use of locally available materials. Phase one consists of essentially pilot studies. This will be followed by phase two which consists of village pilot plans.

(3) This study consists of State of the Art documents on:

a. Water treatment in general.
b. Village (or rural), private emergency, temporary, innovative, practical or other devices used for water or waste water treatment.

The IRC/NL will select, in cooperation with OU, the expert for this study.

B. Present Level of Accomplishment

(1) The questionnaire has been designed and pilot tested. Presently it is being mailed to all personnel at WHO and all of the IRC's mailing list. It has been requested that the data (the completed questionnaire) be completed and returned by June 1, 1975.

The data will form the basis for a state of the art document to be drafted by a consultant. In his letter of March 25, 1975, Van Damme stated that the selection of the consultant was to be done in April, 1975.

(2) The IRC/NL has a study on slow sand filters already started at a cost of $250,000. They have agreed to use our data format and publish the same information to us that we would have gotten had we had individual contracts under this auspices. These contracts are with Brazil, Sudan, Turkey, Thailand, Kenya, India, and Ghana.

(3) The consultants have been selected and the terms of reference drafted. Further details will have to be worked out concerning what is expected from the state of the art document on water treatment.

Work Remaining To Be Done

(1) Analysis of the survey data by the consultant. The compiling of the data is meant for use in the workshop planned for November 1975.

(2) All of the documents will be reviewed by both the IRC/NL and OU. The complete final report should be ready for review by Summer 1975. This will be in time for the International "Workshop" scheduled

CODE No. 6

EAWAG/WASMER - DUBENDORF/SWITZERLAND

TITLE: "A Study on Historical Methods of Wastewater Treatment"

A. A Brief Description of the Project

This is basically a survey on historical methods of sewage treatment in Europe and North America. Study on water treatment will also be included.

B. Present Level of Accomplishment

A 35 page report has been prepared with the following contents:

Water Technology - Antiquity and Middle Ages

Introduction: Objectives, Information Sources

Antiquity: Water Utilization for Irrigation, Drinking Water
Water Supply through Wells and Springs
Conduits, "Dew Mounds"
Water Treatment
Wastewater Discharge
Examples
Conclusions

Middle Ages: Water Utilization,
Various Uses
Water Supply, Fountains, Surface Water
Wastewater Discharge

C. Work Remaining to be Done

The report has been prepared in German. It is now being reviewed. Some of the technical findings need to be shown in greater detail, whereas some of the "historic background information" will be shortened.
The revised report has to be translated into English.

CODE No. 8

AUB/AYOUB - BEIRUT/LEBANON

TITLE: (1) "Utilization of Seawater in the Treatment and Disposal of Sewage"

(2) "A Study of Using Asbestos and Pine Needles for Filtration in Water Treatment"

A. A Brief Description of the Project

(1) This is research to explore the possibility of developing an acceptable process for the treatment and disposal of sewage by using seawater and low cost in-country materials.

(2) It will study the development of containment filter for water treatment by using asbestos and pine needles as treatment media.

B.

The sub-contract was signed on April 30, 1975 and works are now underway.

METU/ULUG - ANKARA/TURKEY

TITLE: "Upgrading of an Oxidation Pond to an Aerated Lagoon

A. A Brief Description of the Project

It is a study of upgrading an oxidation pond to an aerated lagoon. It will explore the possibility of increasing capacity by including aeration.

B. Present Level of Accomplishment

The sub-contract has not been signed and returned. However, with the approval of Oklahoma University on several minor modifications requested by METU, the signed sub-contract should be returned to Oklahoma University anytime now. Oklahoma University has also arranged Mr. Jacobs from the Aqua-Aerobic International, a U. S. company, to meet with Dr. Ulug concerning the 5 hp aerator to be delivered to METU.

C. Work Remaining to be Done

A full-scaled research activity of this project should be underway soon.

CODE No. 11

UNIVERSITY OF NAIROBI/MUGA - NAIROBI/KENYA

TITLE: "Soci-Economic Conditions which Pertain to Cost of Construction and Operation of Water and Sewage Treatment Facilities and Quantity of Water Consumption in Kenya"

A. Brief Description of the Project

This research will deal with socio-economic conditions in Kenya as relating to water and sewage treatment. To be more specific, the research is currently dealing with the following aspects:

1. A survey of socio-economic conditions prevailing in Kenya as a whole, which have a bearing on the research.

2. Actual case studies in three chosen sites, namely, Kisumu Town, Nyeri Town, and Mombasa Town, to show the reality of the situation.

B. Present Level of Accomplishment

Concerning No. 1 above, currently the relevant data is being collected and almost half of the total number of items planned to be covered has been done.

Concerning No. 2 above, visits to Nyeri Town and Kisumu Town have been made, and samples of the population that are to be studies have been chosen. Consequently, data are being collected in these two sites.

C. Work Remaining to be Done

1. It is planned to continue collecting data on socio-economic conditions in Kenya which pertain to the research. About the same amount of time spent in collecting the first portion of the data will have to be spent in collecting the remaining half of the data.

Field work is planned for Mombasa Town where no field work is going on at present.

Data collection in Nyeri Town and in Kisumu Town is not completed yet. Collection of these data will need to be completed

The task of analyzing data to be collected from Nyeri Town, Kisumu Town, and Mombasa Town will begin soon.

CODE No. 12

NPCC/LESACA - MANILLA/PHILIPPINES

TITLE: "A Water Sterilization Study in the Philippines"

A. Brief Description of the Project

This research will study water sterilization in the Philippines, primarily in the maintenance problems during processing.

B. Present Level of Accomplishment

Preliminary work, like evaluation of qualified personnel who can handle the work, literature surveys, preparation of necessary laboratory reagents, selection of suitable analytical methods, taking into consideration the simplest yet analytically acceptable method has been done.

Study emphasis has been focused on four (4) areas, all of which are representative of the conditions existing within a specific locality. The areas classified are as follows:

1. Small towns or cities with no existing water treatment where residents have to depend entirely on artesian wells (drilled wells), open dug wells, sanitary dug wells (enclosed with pump), deepwells and infiltration galleries for their water supply.

2. Areas which depend on natural springs and other surface water as source of water supply.

3. Areas served by waterworks systems with centralized water treatment but the consumers have to report to either one or the different types of wells as supplementary water source due to water shortage especially during the summer months.

4. Housing subdivisions with centralized water system but lacking proper treatment prior to distribution.

To establish base-line information as to the approximate number of wells and springs in the country, an inquiry from the Wells and Springs Section of the Bureau of Public Works was conducted. Present available information from said office revealed that there are 25,500 artesian wells (drilled wells) throughout the Philippines serving approximately 350 people per well. It has also been gathered that big-cased deepwells which serves as water sources for water works systems are estimated to a total of about 1,000 throughout the country. The Philippines is richly endowed with natural springs which accounts for the 7,000 spring development projects all over the country. Some regions have to resort to infiltration galleries as water source without any preliminary water treatment also.

C. Work Remaining to be Done

In order to have a more complete background regarding the actual number of wells, springs and other sources of water supply in a specific locality, inquiry from local municipal health officers and other authorities will also be undertaken. Simultaneously, pin-pointing of the sampling areas and initial water sampling will also be carried out.

A preliminary chlorination on a small laboratory scale (about 2 liters in glass jars) of the different water samples will be tried using HTH, chlorinated lime and sodium hypochlorite as chlorine gas alternates. The quality of the water samples before and after sterilization will be determined using the simplest but accurate method.

Dosages from 0.05 mg/l to 1.00 mg/l will be applied using HTH only because of its high percentage of available chlorine. Chlorinated lime and sodium hypochlorite owing to its very low percentage of available chlorine will be applied in dosages ranging from 1.00 mg/l up to 10 mg/l. Other dosages, however, will be tested if necessary, as the study progresses.

Based on the most ideal confirmed dosage, actual water source sterilization will be accomplished. From the standpoint of economics, the study will be carried out in some already existing water sources for specific localities.

As soon as the data is compiled, all the results will be evaluated and the final report will be prepared.

CODE No. 14

IESPHA/LO - TAIPEI/CHINA

TITLE: "The Study of Microbial Treatment of Night Soil and Sewage Sludge"

A. Brief Description of the Project

To study the treatment of night soil and sewage sludge in Taiwan.

B. Present Level of Accomplishment

The research schedule of this project is shown in the attached Table T-1. The first two parts of study, the study preparation and the pretreatment study, have been done. The works done for these two parts are shown in the attached Table T-2.

Work Remaining to be Done

The rest of the study is expected to be finished between April and November as shown in Table T-1. Detailed works involved in each part are shown in Table T-2.

Table T-1

	Work Schedule											
	1974	1975										
	Dec.	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.
Study Preparation	■	■										
Pretreatment study			■	■								
Treatment by PSB study					■	■						
Treatment by Chlorella study							■	■				
To Harvest PSB population study					■	■						
To Harvest Chlorella study							■	■				
Continuous Operation study									■	■	■	
Cost Comparisons for: a) treatment and algae recovery, and b) treatment and discharge c) pasturization and application to soil.										■	■	
Writing Report												■

Table T-2

	Works have been done	Works remaining to be done
Study preparation	Adding study instrument including an oven and a centrifuge, renovating the pilot plant and setting up study schedule.	
Pretreatment study	The study of the character of nightsoil and the culture of green algae and PSB for seeding.	
Treatment by PSB study		The study of the characteristics of PSB, nightsoil and sewage sludge treatment by PSB including parameters of pH, temperature, depth of liquor and duration.
Treatment by Chlorella study		The study of the characteristics of green algae, nightsoil treatment by green algae including parameters of pH, CO_2, depth of liquor, temperature and duration.
To Harvest PSB population study		The study of the best way for PSB collection and the quantity of the product.
To Harvest Chlorella study		The study of the best way for green algae collection and the quantity of the product.
Continuous Operation study		Continuous treatment by PSB and green algae ; the thicker nightsoil is treated by PSB then it is treated by green algae to see how the process is practical or not.
Cost Comparisons for: a)treatment and algae recovery,and b) treatment and discharge c) pasturization and application to soil.		The cost comparisons between treatment and algae; treatment and discharge;pasturization and application to soil.
Writing Report		Writing this year's report. Planning a 20-ton plant.

WHO/REYES - JAKARTA/INDONISIA

TITLE: "A Study on the Ultimate Disposal of Lagoon Effluents as Nutrients for Fish Production"

A. A Brief Description of the Project

To study the ultimate disposal of lagoon effluents as nutrients for milkfish.

B. Present Status

The sub-contract was sent in December 1974. However, it turns out that Dr. Wilfredo Reyes, the WHO representative in Indonisia, cannot sign or supervise the sub-contract, even though he is attached to the faculty in Bandung. He has been making an effort to see if the study can be supervised by other people. Unfortunately, the Government of Indonesia through BAPPENAS has apparently not acted upon the request of the Institute of Technology Bandung (ITB) for approval of the cooperative research project between OU and ITB and hense, ITB will not be able to undertake the study at the present time.

The proposed study is a very relevant one and it should be conducted, besides, Dr. Reyes should also be kept involved in the USAID/OU Project.

CODE No. 18

MINISTRY OF HEALTH/PRAPHORN - BANGKOK/THAILAND

TITLE: "A Study of Slow and Rapid Sand Filters for Water Treatment"

A. A Brief Description of Project

To study problems associated with the design and operation of fi
ters used in filtration.

B. Present Status

We have been informed that the sub-contract has been signed and is on it's way to the States.

APPENDIX II (iv)

POSSIBLE ALTERNATIVES

FOR SOME IN-DEPTH STUDIES

POSSIBLE ALTERNATIVES FOR SOME IN-DEPTH STUDIES

to contractual complications. The Indonesia study would be very useful. There are also some problems associated with the possible studies in Kenya due to the loss of personnel there. With these losses in mind, other suggested alternatives which might be explored are indicated in the following.

First, there is the possibility of conducting a study in Saudi Arabia. After some discussions with them, it seems there is a potential which would require very little money other than simply for communications on our part. Some studies on the application of the sewerless toilet might be feasible. Since water is expensive in Saudi Arabia, it is possible to get trade-offs between water savings against the energy cost on such a toilet.

Next, it might be worthwhile to find a site to explore the possibility of the small scale water pasteurizer as an alternative to sterilization. Apparently, there would be a world-wide market for such a device.

There is also a possibility for another exploration in Taipei. An additional proposal from Taipei has been received. This new proposal proposed to conduct a study on the planning approach to municipal sewage

disposal in Taiwan by looking at the developmental conditions and their relationships to other alternatives. This is pretty close to the kinds of studies that one of the O. U. students, Ms. Adams, is already undertaking under the AID's auspices. But it seems that this would provide an additional practical field study platform. The Taipei exercise simply request the consulting assistance of Mr. Swisher and Professor Reid.

Similar to the Taipei proposal, the same study could also be undertaken in Trinidad with a narrower objective of simply testing a single alternative, namely the sewerless toilet. While Dr. Talboys is in Trinidad, he would be in a position to supervise this study

It might also be possible to go back to Ghana, to Albert Wright at Kamasie and to have a look at the possibility of some of the more innovative and modern applications to some filtration techniques which are not being explored by the Van Damme's IRC/NL group. This could be very profitable.

Finally, some other elements might be explorable. One is to coordinate a study with the Canadians through Dr. Michael McCary and the other is with the IIASA in Laxemberg, Austria. The latter probably would have to be worked out through the American Academy of Sciences. However, this European group is becoming very interested in water quality modelling in developing countries which might fit into our modelling studies as a project since we really don't have a modelling project at the present time. Some communication with them has been initiated.

Appendix III

COLLABORATED STUDIES

(i) IRC/NL Sand Filter Study Participating Institutes

(ii) Model Validation Studies

(iii) Sewage Lagoon Study

(iv) Water Field Kit Test and Lagoon Study in Kenya

(v) Global Technical Workshop on Compatible Water & Waste Water Treatment Methodology for Developing Countries

APPENDIX III (i)

IRC/NL SAND FILTER STUDY

PARTICIPATING INSTITUTES

Appendix III (i)

IRC/NL SAND FILTER STUDY PARTICIPATING INSTITUTES

BRASIL:	Universidade de Sao Paulo Chefo de Departemento de Hidraulica e Saneamento SAO CARLOS	Dr. Rui Carlos de Camargo Vieira
GHANA:	University of Science & Technology Department of Civil Engineering KUMASI	Prof. A. M. Wright Mr. J. G. Monney Mr. T. C. L. Brew Mr. J. Bruce
INDIA:	National Environmental Engineering Research Institute NAGPUR	Prof. N. Majumder Mr. S. Gadkari
KENYA:	University of Nairobi Department of Civil Engineering NAIROBI	Prof. R. Jones Dr. K. Y. Baliga Dr. A. Bayoumi
PAKISTAN:	University of Engineering and Technology IPHER LAHORE	Prof. M. Islam Sheikh Prof. Dr. K. M. Yao Dr. M. Nawaz Tarig
SUDAN:	University of Khartoum Faculty of Engineering and Architecture KHARTOUM	Dr. Idris A. Mahmoud
THAILAND:	Asian Institute of Technology Environmental Engineering Division BANGKOK	Prof. M. B. Pescod Dr. Nguyen Cong Thanh
TURKEY:	Middle East Technical University Environmental Engineering Department ANKARA	Dr. S. Erol Ulug

APPENDIX III (ii)

MODEL VALIDATION STUDIES

Appendix III (ii)

Model Validation Studies

1. Model Study in Columbia

A Model Study will be conducted who is with the USAID/Columbia.

2. Model Study in the Philippines

A Boston environmental engineers consultant firm, "Camp, Dresser and McKee International (CDM)", will collect data in the Philippines for the model studies.

Data requirements have been sent by CDM to their representative in the Philippines. CDM is planning to provide data from the Philippines Ten Cities Water Supply and the Surabaya Water Supply and Wastewater Study project as input for the model's computer program. CDM's Philippines project involves study of water supply for ten widely separated cities or urban districts having populations of the order of 50,000 to 100,000 or more, each presenting a distinct and different problem. Some of these should provide good test cases for the model. Data are expected to be collected by the Summer of 1975.

3. Model Study in Algeria

In Algeria, through Dr. Schulmann who is with the WHO office in Copenhagen, there is a possibility of model testing at their expense. Of particular interest to them is the application of the Model developed by OU for the studies on national level. They have indicated that at the present moment they are searching for funds to conduct study on the development of water and sewage plants in that country.

APPENDIX III (iii)

SEWAGE LAGOON STUDY

APPENDIX III (iv)

WATER FIELD KIT TEST
AND
LAGOON STUDY IN KENYA

Appendix III (iii)

SEWAGE LAGOON STUDY

In Tunisia, the AID/OU project has a small study which is simply the aquisition of data collected by Dr. Oswald, who is with the University of California at Berkeley, on the operational lagoons.

Appendix III (iv)

WATER FIELD KIT TEST AND LAGOON STUDY IN KENYA

The main purpose of this study is to conduct a study of lagoon operation and to test the Water Test Field Kit through the assistant provided by Dr. Ken Govaerts of the Peace Corps in Nairobi. The Water Test Field Kit test has been done and the evaluation results will be considered for further modifications of the kit. Dr. Govaerts is also planning to collect field data for the lagoon study himself. Several visits for waste water systems have been planned.

APPENDIX III (v)

GLOBAL TECHNICAL WORKSHOP
ON
COMPATIBLE WATER & WASTE WATER TREATMENT
METHODOLOGY FOR DEVELOPING COUNTRIES

Appendix III (v)

GLOBAL TECHNICAL WORKSHOP ON COMPATIBLE WATER & WASTE WATER TREATMENT METHODOLOGY FOR DEVELOPING COUNTRIES

Voorburg, The Netherlands

November 16-23, 1975

OBJECTIVE: To bring together key field people and selected experts on water and wastewater treatment technology to enable them to exchange information and to establish a basis of commonality, thus furthering a global acceptance of concepts of adaptive and innovative technology for developing countries.

PARTICIPANTS

(2) Institutional participants may send additional representatives.

SPONSOR: USAID/OKLAHOMA Project & IRC/N

CO-SPONSORS:
UNEP
WHO
PAHO
BANKS
Others

Program Schedule

Sunday, 16th 15.00 hrs: Introduction, Reception

Monday, 17th a.m.

New International Approach to Rural Water Supply and Sanitation - Dieterich , WHO

Low Cost Water and Waste Treatment in D.C. AID/OKLA Project - Reid, OKLA

IRC - Community Water Supply in D.C., Innovative Survey, Slow Sand Filtration - Van Damme , IRC/NL

Monday, 17th cont.

p.m.

General Discussion, Chairman - Butrico (PAHO)

Rapporteur - Law, (OU)

Tuesday, 18th

State of the Art - Chairman, Swisher

1. Low Cost Water Treatment - Huisman, Delft
2. Low Cost Sewage Treatment - Malina, Texas U/OU
3. Systems - Discenza, Maine U/OU
4. Innovative Survey - Tjook, IRC/NL

Rapporteur - Martin, (OU)

p.m.

Workshop: Group Sessions

1. Water Technology
2. Sewage Technology
3. Information Group
4. Systems

Wednesday, 19th

a.m. & p.m.

Workshop: Group Sessions

1. Water Technology
2. Sewage Technology
3. Information
4. Systems

Chairman	Rapporteur
1. Arbolata (CEPIS)	1. Malina (Texas/OU)
2. Reyes (WHO)	2. Canter (OU)
3. Tjook (IRC)	3. Martin (OU)
4. Warford (WB)	4. Discenza (Maine/OU)

Thursday, 20th a.m.

General Session - Summary of Workshops

Chairman	Reports
1. McCarry (Canadian)	1. Arbolata 2. Reyes 3. Tjook 4. (See Saturday)

p.m.

General Discussion, Continued and Historic Studies and Village or Emergency Studies - Don (London)

Friday, 21st a.m. Systems Approach

General Considerations - Reid (OU)

Socio-Economic Data - Warford (World Bank)

Models - Discenza (Maine/OU)

p.m.

Technical Data - Law (OU)

Validation - Camp/Dresser/McGee (To be selected)

Transfer/Implementation - Van Damme (IRC)

Chairman - Shipman (World Bank)

Saturday, 22nd Regional Conferences Planning Panels

a.m.

General Format Transfer Phenomena - Reid (OU)

4 Workshop Reports - Warford

Panals . . .

Latin America - Sperandio (CEPIS)

Mid East/Africa - Ayoub (AUB)

Far East - Pescod (AIT)

Rapporteur - Law (OU)

Saturday, 22nd p.m.

Closing Session - Summary

Global Conferences and Reports
- LA - Sperandio (CEPIS)
- ME - Ayoub (AUB)
- FE - Pescod (AIT)

Chairmen - Van Damme/Reid

Rapporteur- Canter (OU)

Proceeding General Editor - Martin (OU)
Content Review/Control - Reid and Van Damme

Background Papers

1. Users Model
2. O.U. Study
3. Kits
4. State of Art, Draft - Water
5. State of Art, Draft - Sewage
6. Historic Studies - Reid
7. Innovative Designs
8. State of Art, Draft - Village Emergency Techniques
9. Project Reports