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WATER FOR THE WELL-BEING OF RURAL PEOPLES

This working paper is designed to serve as the first of a series of background documents for the Lausanne Seminar. It examines the rural water supply and sanitation problem from the standpoint of the approach developed in the course of the IDRC study. The essence of the approach is not easily captured in a single simple label. It is characterized by a search for appropriate technology and a user-choice principle in the context of a risk-benefit framework.

Seminar participants are asked to review this and other draft papers that will be presented to help in the formulation of research goals and directions, and to specify priorities among them. In a few cases it is hoped that detailed proposals will be formulated.

An Overview

It is authoritatively stated that a very large proportion of the people living in villages in developing countries do not have "access to safe and adequate supplies of water."[1] In varying degrees, and in many different ways, people are forced to rely upon sources that are a constant threat to their health, or which yield insufficient quantities, or which are so far removed that in many cases several hours each day is spent in obtaining water. In some circumstances all three of these limitations apply simultaneously, and there are very few places indeed where none of them obtains.

Substantial efforts have been made to alleviate these difficulties by many groups and organizations from the international level to the very local. Even greater efforts are proposed.[2] Estimates of the overall magnitude of the problem, and the steps being taken are described below in some detail. It is clear, however, that the rate of progress is low in relation to the need. By one estimate (see Table 1 below) at least, there will be more people living in rural areas without "access to safe and adequate supplies of water" in 1980 than there were in 1970. By the present methods and approaches it is proving difficult to keep pace with the population growth, in spite of the ambitiousness of the programmes proposed.

A point of departure for the present study, therefore, is the need to examine what might be done in relation to what is being done, and to see where possibilities for improvement might lie. In recognition of this need, at the initiative of OECD and with the support of the International Development Research Center (Ottawa), an investigation is underway to determine if ways might be found to accelerate considerably the rate of progress, such that better conditions of water supply and sanitation might be brought within reach of the rural populations faster than the populations are growing, and the prospect of a radical improve-

ment brought into view.

This investigation has involved a review of the considerable literature, the collection of considerable data, discussion with many experienced professionals, and field enquiries in Africa, Asia, and Latin America. In addition, the advice and suggestions of international agencies has been freely given, and an expert seminar has been held in Ottawa (August 17-18, 1972). From these activities some tentative conclusions have been formed. They are still in the nature of hypotheses to be tested and confirmed or refuted, and are likely to remain so to a large extent. What constitutes a strategy for effectively accelerating the rate of progress in the provision of better rural water supplies and sanitation is, and will remain, a matter of judgement at least until it is put to the practical test of trying to carry it out. There will remain some who think that a more rapid rate of improvement is either impossible or if possible then undesirable. If such councils prevail, they will be proved true, for the first and most essential ingredient for progress is the belief that progress is possible and desirable.

The suggestion that improvements may even be undesirable is rarely made in public or in printed form. And yet there are economists who agree that the benefits cannot be shown to justify the costs,[3] engineers and public health officials who "prefer to maintain the high health risk for the population rather than to risk [his] reputation as a purveyor of the near perfect."[4] More deeply rooted than both these ideas is the unspoken fear that improvements that raise the survival rate of the young may be self-defeating by accelerating yet further the rate of population growth. Untenable though it is, this moral judgement does point to the need to do more than provide for the survival of more human beings.

This investigation began with the strong predisposition to find that accelerated progress is possible. It has to be recognized, however, that wishing so will not make it so. And moreover there are severe dangers in over-enthusiasm for a course however meritorious it may seem. To become deluded that much can be done to accelerate the provision of safe and adequate supplies of water to the hundreds of millions of people in need, when this is not the case, would be worse than to set off on a wild goose chase; it would be to divert limited resources of money, manpower, and energy away from other sectors where it might do more good.

The tentative conclusions of this enquiry are that if more rapid progress is possible at all, it lies in the adoption of three straightforward steps. These are:

1) a re-orientation and expansion of research and development activities towards the creation of appropriate technology for water supply and sanitation systems in rural areas;
2) a re-orientation of the basic philosophy towards a risk-benefit approach with a substantial role for user-choice, and
3) the combination of these two into an expanded and coordinated programme.

These conclusions appear to be at variance with much conventional wisdom, and to that extent they are surprising. It is worth examining some features of the debate about each and the rationale for our judgement.

Appropriate Technology

It is true that research and development of the sort proposed here has been relatively neglected. A conventional view, however, asserts that since water is such a basic necessity for human life some of the most inventive minds have been at work devising ways in which it may be procured for the use of village communities. There is in fact an enormously rich variety of water supply technology using wells, springs, streams, pumps, infiltration galleries, and so on. It is churlish therefore to suggest that the technology is not available. Furthermore, research and development in new technology is always being carried out. There is no quarrel with these assertations. It is clear, however, that the needs have changed. Villages in the third world are not the same now as they were; they have changed in many respects; they are larger and more numerous and almost everywhere the pressure of population on resources is greater than ever before. Also the advance of science and technology has created new opportunities which have not been vigorously exploited for possible applications to rural water supply. There are perhaps good reasons why this has been so. Men have thought it not worthwhile to try and develop new technologies or even to improve radically the old ones, in a field that has been so long established, and seems so rich in alternative ways of doing things. It is the very richness of the traditional technology which has inhibited the search for the radically new.

The following statement from an engineer in Malaysia is quite typical of many comments received from the field:

> There is very little need for new technology although continued research and development are desirable. The necessary technology has been available for 70 years and has been steadily accumulating. What is needed is training of engineers and dissemination of available knowledge, e.g., the proper use, design and construction of "Australian" galvanized corrugated iron water tanks and their application to water storage and rain water collection, plus recent innovations using plastic and fibre glass instead of galvanized iron. How many Sanitary Engineers on the WHO program have even heard of these tanks now in successful use for 70 years let alone know how to build one or what they cost?

A similar point is made by a World Bank engineer:

> Much of the technology already exists but it probably could be improved. Good hand pumps could be developed and manufactured locally. Low cost methods of exploring for shallow groundwater and developing wells can be promoted. Wells can be dug, augured, driven, jet, bored, hand sludged, and even manually drilled in rock by presently known techniques. We need demonstrations of simple low-cost and easily operated treatment and distribution facilities...

The rationale for our conclusion that more appropriate technology is needed does not rest on the assumption that no technology is available. Rather it is the case that the technology can be improved, and that the improvements that have been made and attempted are often of the wrong sort. Too frequently external technical advice (or internal advice by foreign-trained engineers) tends to be too sophisticated. Technical alternatives are proposed which are too high in capital cost;

make insufficient use of local materials; neglect to make use of locally available labour which is often unemployed or under-employed; and demand too high a capacity for maintenance and supply of spare parts. Transfers of technology are made too directly without adequate attempts to adapt to local needs and requirements. Insufficient research is undertaken and what research there is does not always go far enough in adopting a realistic view of economic and social constraints.

When new ideas and more appropriate forms of technology are developed, these diffuse very slowly through the engineering profession. There is considerable resistance to changing professional practice. To recommend simple, cheap, and effective solutions is not glamorous or likely to attract professional rewards. There is also the danger of failure. If technology that has been well tried and successful elsewhere is applied and fails, then local circumstances or the local population afford plenty of possible explanations. If a highly-trained professional engineer recommends the innovative use of simple low-cost devices such as bamboo pipes for transport of water or coconut fibre for filtering, he may or may not be taking a larger risk, but the perceived consequence of failure can be much greater. To learn that an engineer built a fine modern water supply system that failed due to lack of local cooperation or failure to provide adequate maintenance is regretted but understandable. To learn that an engineer designed and built an "intermediate technology" system relying on local materials and local labour, and that this failed, is often seen as calling more into question the sagacity of the engineer and leaves less room for other explanations.

Even where "intermediate technology" is used, the results can be less than fully successful. The following report comes from a UNICEF-WHO enquiry into rural water supply programmes in India:

> The hand pump programme in Rajasthan has not been a notable success. None of the four hand pumps observed in the villages of Sapetia and Palari were in working order even though the installations were in some cases only a few weeks old. The first casualty was usually the steel pump handle, which could after some delay be repaired by welding. With the failure of the cylinder, however, for whatever reason, the pump is abandoned and the protective well cover is reopened with return to the old reliable bucket.
>
> The pumps furnished by UNICEF for this project are from a reliable English manufacturer, but they are of relatively light construction and were never intended for the heavy duty to which they are subjected at a public well in Rajasthan. During the emergency in Bihar and Uttar Pradesh last year [1968] a number of these pumps were transferred to that project. The report of the WHO consultant for the emergency well drilling project made note of the fact that the pumps were totally unsuitable and that failures occurred after one week of operation.
>
> With the long experience that India has had in hand pumps, including the development of indigenous heavy duty types, an occurence of this type is indeed surprising. It is, in fact, difficult to divine why imported pumps had to be used for this programme.[5]

In an earlier report on the IDRC study, a general conclusion about the frequent failure of technology was presented. This was questioned by

a number of commentators who sceptically asked for chapter and verse. It is difficult to provide hard evidence for the frank honesty of the above-quoted UNICEF-WHO report is rare. More commonly it is thought better not to expose failures too harshly in order to protect those involved. Understandable though this practice is, it does tend to encourage the perpetuation of past error. An engineer from the Republic of the Congo, Brazzaville, comments:

> In the light of our experience we feel that what the writers say on this point is, unfortunately, largely true: frequently pumps and other equipment are out of service and villages are deprived of water because a pipe is broken and spare parts or fuel are not available.

The Brazzaville engineer goes on to state:

> Nevertheless, in numerous other cases things are properly done. However, we are convinced that over-sophisticated technology should not be encouraged and wherever possible hand-operated equipment is preferable to automatic devices.

Confronted with the frequent failure of technology both sophisticated and intermediate, the response of field engineers is often to ascribe responsibility to local factors. In effect he is saying "the technology is alright if only people would use it properly." A Swedish engineer with considerable experience in East Africa writes:

> All the facts are already published; the technologies are already tested, the money is available (enough for the start at least), the needs are clearly illustrated, and the overall approach to be used is fairly well established.
>
> What is needed now is to get the politicians in the countries in question convinced of the needs, to push governments to allocate resources, to get close to the natives in rural areas, to start low-cost water supply development, to train people in villages for the running and maintenance of water supplies, and to meet slowly the demands of volume and quality of water.

There is no important disagreement with this opinion. It is clear, however, that the prescription of "what is needed now" cannot be met very quickly. Politicians are often not responsive to the needs of their less powerful constituents or to the weaker sectors of the country. Governments are not easily persuaded to allocate resources to less productive activities. Water supplies often are the responsibility of the weaker ministries. Contact with rural peoples is not easily achieved, and training and education is usually a slow process. The Swedish engineer is right, but if his diagnosis is the full story, then progress is likely to remain slow.

The argument for new and improved technology appropriate to the real needs rests on the grounds that it offers the only hope of rapid and dramatic improvement. What sorts of technology might this be? It is hoped that the Lausanne seminar will help identify the more important needs and possibilities.

The following suggestions are made on the basis of the study so far. Simple methods of storing water are needed that cost little to build, can use local materials or locally maufactured materials, and keep water free from contamination. This might be supplemented with compatible

methods of collecting water from roof or surface runoff.[6] The problems of decontaminating stored water, well drilling, spring development, and pipeline distribution have received little or no concerted alteration. The design of pumps susceptible to local manufacture and maintenance has had only a pitiful amount of support. The work done on an improved pump by AID/Batelle is an example of the sort of activity that is needed on a much larger scale.[7]

There have been innumerable suggestions for research to improve technology, some of which are reported in another background paper. The suggestions that we favor are those that point to the need for relatively unsophisticated, low-cost, labor-intensive, devices that can be constructed with local materials, labor, and skills, and are easy to operate and maintain.

Rather than expecting rural populations to acquire unfamiliar skills overnight, we see the challenge as one of adopting and developing technology to meet the needs and capabilities of the local populations.

User-Choice Systems

The second proposal seeks a fundamental change in the role of the expert. Instead of being the person who "knows best," the water supply technologist is asked to adopt the stance of advisor and assistant to people who confront a choice of how much risk they are willing to run at a price of other benefits foregone. The idea that there is a universally desirable standard of water quality for domestic use ignores the basic choice with which developing countries are faced. It is whether to supply a few rural people with safe water or many rural people with better and safer water. Everytime considerations of standards intended as a universal objective serve to prevent or delay possible improvement, the choice is being made that it is better to have no improvement or a delayed improvement, rather than one which will produce water which is judged in the view of the experts to be not safe enough.

Given the impressive array of technical expertise that can be brought to bear for the exploration of sources of water; for testing of their chemical, physical, and bacteriological properties; and the skills that are needed for the procurement, treatment, storage, and distribution of water to the consumer, it seems on the face of it incredible to suggest that the relatively uneducated, frequently illiterate populations of rural areas in developing countries can make better choices.

The choices may not be "better" in the sense that they are technically more sound. The quality of water supplied may not meet the sorts of standards that sanitary and public health engineers would like to provide, but if the system has the understanding and support of the local population, it at least has the prospect of continuing to function. A World Bank engineer comments:

> Over the past twenty-five years, great amounts of money have been provided through bilateral programs for rural water projects. The world is covered with the remains of such projects where they were provided without regard to the people's interest in having them and the mechanisms necessary to insure that the systems would be operated and maintained.

There is considerable disagreement among the experts on how this is to be achieved. Some advocate self-help schemes, and point to conspicu-

ous success. Others describe the failures of self-help with the villagers quietly drifting off and losing interest. Bank personnel tend to equate interest with willingness to pay. One such official asserts that "cash on the barrelhead" is the only reliable measure of local interest.

Reporting an experience in the rural water programmes in Latin America, David Donaldson of the Pan American Health Organization states:

> It has been found that a strong local participation is essential for the success of these programs. The full support of the community must be enlisted from the start. Local leaders must be identified and worked with. Too often it has been concluded that the "poorly educated" rural people lack the required skills to undertake the construction, operation, maintainance, and administration of their water system. But it has been shown time and time again that with proper guidance, community leaders can make meaningful choices, motivate others, and provide the necessary leadership that is a key ingredient for a successful rurban water project.[8]

Few would now disagree with this conclusion, especially in the larger villages in more densely settled areas of "rurban" population that Donaldson describes. For the smaller villages and less densely settled areas where piped supplies are not an immediate prospect, the same approach can be applied. What is needed in both cases is an array of technical choices that can be ordered in incremental steps of programme improvement. The community can then choose its own level of improvement at a cost and on a scale that it finds suitable. It can also progress to better levels at a speed corresponding to its own capacities.

A major obstacle to this common-sense approach is that it involves outside experts in the development of systems that may provide water that cannot be regarded as of sufficiently high standard in terms of quality or quantity or accessibility. If the role of the expert can be changed from that of the person who "knows best" to that of advisor and assistant in decision-making, then the way will become open to the creation of safer and better water supply for many millions of rural people who would otherwise have to wait for decades in the hope that one day they will be provided with safe water.

Step three involves the creation of a substantially new approach to rural water supply involving technological research and development, in conjunction with user-choice in a risk-benefit framework. These form the key ingredients of an expanded and coordinated programme designed to improve radically the rural water supply situation in developing countries. And because water supply is so intimately connected with sanitation similar improvements will necessarily follow in that area also. The study so far has devoted relatively less attention to sanitation than to water supply. The principal findings of the study also apply to sanitation, however, and there is a clear need in research and development as well as in implementation of programmes for the two to go hand in hand.

An Opportunity Perceived

If the conclusions tentatively reached in this investigation are valid, and for the reasons we suppose, then we have what amounts to an opportunity to create dramatic, even revolutionary, improvements in the well-being of rural peoples in the third world, through the provision

of improved domestic water supplies and sanitation. Although the complexity of the task at the operational level is great, there are good prospects for success. These rest on the knowledge that in many rural areas major changes are underway as a result of the success of the "green revolution." Increased crop yields and agricultural productivity are creating a breathing space in which the pressure of population on food supplies is temporarily alleviated. Small amounts of capital can now be accumulated in many places where this was previously impossible. The hope is that quick advantage can be taken of this situation to maintain and establish the forward momentum, especially in the provision of a basic infra-structure that will lay the basis for rural prosperity. A water supply and sanitation programme of the kind described here is one important component in that infra-structure development. There are also good prospects for success because much has already been accomplished and with the introduction of a few critical catalytic ingredients a real take-off point seems within reach.

The opportunity perceived is new; it has emerged slowly with the accumulation of knowledge, experience, and insight. This is so much the case that often those most closely involved with programmes to improve rural water supply and sanitation are unaware of the ways in which the situation has changed.

At close quarters the obstacles to rapid improvement can seem overwhelming, and attempts at dealing with them are rarely less than frustrating. Viewed in larger perspective, however, it can be seen that the efforts of the past 25 years have gone a long way towards putting the basic organizational structure for improving rural water supply and sanitation into place. Under the impetus and guidance of the World Health Organization, many countries have now initiated national programmes and policies for water supply and sanitation; the necessary manpower and machinery of government is being created to carry them out. The United Nations Children's Emergency Fund has developed a successful village well programme that complements the activities of WHO and the United Nations Development Programme which focus more heavily on major urban areas. International and interregional development banks are staffed with experienced personnel and a number of leading bilateral aid agencies have been working in the water supply and sanitation field for many years, with increasingly satisfying effect. A whole host of private organizations including foundations, voluntary relief and development associations, professional societies, consulting engineers, and research groups have vigorously tackled the problem and have steadily enlarged their capacities for constructive action in improving water supply conditions. A strong basis for future progress has thus already been laid.

Maximum advantage of these achievements can now be obtained by recognition of two critical insights that have emerged with better understanding of the development process. These insights refute two cherished myths of the conventional approach to rural water supply and sanitation. One is that all the technology that is needed is already available, and the other is that rural peoples are so wedded to the old ways of doing things that they fail to adopt new technologies even when it is clearly to their advantage to do so. Together these myths lead to the assertion that the major obstacle to progress is the resistance of rural peoples to the new technology that the experts know is good for them. The question needs to be stood on its head. Ask not how to induce people to adopt new technology, but how to create new technology that people will adopt.

There are two driving forces that give rise to this more hopeful diagnosis in rural water supply and sanitation. One is the notion that better and more appropriate forms of technology can be created and made available. The second is that given a choice to make from an array of such technological alternatives, rural people can and will select those that make the most sense in their circumstances.

Qualifications and caveats are in order. To suggest that better and more appropriate forms of technology can be created does not mean as has been noted above, that many useful devices do not exist. They are indeed abundant. But their profusion need not be used to conceal the possibility of their improvement and reworking into more appropriate forms. Nor is it necessary to assume, in recognizing the capacity of rural peoples to make wise choices for themselves, that this should be done without any external help or advice.

In both cases--technology and choice--it is a question of arriving at a judicious blending of the existing with the innovative. Water supply and sanitation are not the sorts of human enterprise in which the slate can be wiped clean and a fresh beginning made. On the other hand, if the possibility of change, even radical change, exists it should be quickly seized. An unthinking attachment to outmoded ideas can be no less strong among highly trained scientists and engineers than it is often assumed to be among the rural peoples of the third world.

To create the conditions necessary for more rapid advance requires not the rejection of the existing programmes, but rather their expansion and strengthening plus the creation of appropriate new technologies, and of a choice process that will involve the rural user. The focus is on what science and technology can do, recognizing that a wide range of skills are needed if the technology is to be applied successfully in a particular socio-economic, political, and environmental context.

This opportunity for rapid improvement in the well-being of rural peoples through better water supply and sanitation can easily be missed, and the best intentioned efforts are likely to fail unless a clearly defined path of advance is marked out. This study is directed at the provision of guidelines and a rationale based on an analysis of the problem.

Two Matters of Definition

So far reference has been made to "developing" countries and "rural" areas without any explanation of what is meant. For present purposes the category of developing countries refers to all the countries of Latin America, Africa, and most of those in Asia excluding the Soviet Union and Japan. Statistics from WHO quoted later refer to 90 developing countries, and these are listed in Appendix A. Unfortunately, data have not been assembled for all countries. The most notable omission is China.

The definition of rural varies widely. For the purpose of this report an exact definition is not required. Generally speaking, rural is taken to refer to populations engaged in agriculture and pastoralism together with the immediate associated service and ancillary personnel. Rural populations might be dispersed or concentrated into villages, sometimes quite large villages, the function of which is closely related to obtaining a livelihood from the soil. Insofar as the conclusions of this study, however, refer to the provision of improved water supply and sanitation through the development of technology appropriate to the needs of relatively poor people living in insubstantial buildings, then

it may be considered relevant not only to traditional village populations but also to those living in village-like settlements in the shanty-towns, bidonvilles, and bustees of the burgeoning tropical cities.

The national criteria for definition of rural areas as used in the World Health Organization statistics quoted below are summarized in Appendix B. Twenty countries used an upper population size limit to mark the boundary between urban and rural and this ranges from 1,000 to 10,000 with the most common figures chosen being 2,000 (7 countries) and 5,000 (6 countries). A further 45 countries used various sorts of administrative criteria for deciding when a place is no longer rural, and for 25 countries no data are available. Clearly these definitional questions alone mean that generalizations about rural populations in developing countries have to be treated with caution.

Some Significant Dimensions

Beyond the issue of specifying what is meant by the developing countries and "rural" populations, there are many other sources of variations that are significant for water supply and sanitation. Among the more important considerations is the level of economic development. It is not an accident that where the general level of income is higher, as in Latin America, the provision of rural water supply is also in a better state. This distinction also applies to areas of greater and lesser prosperity within countries. The obvious association between higher income levels and better water supply has led some to argue that improved water supplies are an essential requirement for economic growth. This is a very dubious proposition, even for urban areas and seems even less tenable when applied to rural areas. There is, of course, no doubt that better water supplies can contribute to greater social well-being in the broadest sense. It is alto true that industrial expansion and increased agricultural productivity in many developing countries both require more water. But for rural populations generally it has not been well demonstrated that improved water supplies do by themselves have a substantial effect on health. Even where this is the case studies of improvements in health have not been able to demonstrate in a convincing way any substantial measurable economic benefits from disease control. In a recent study in St. Lucia, for example, it was concluded that:

> "Our findings are that, on the whole, parasitic infection appears to cause few statistically significant adverse effects on agricultural labor productivity. The analysis does show some effect of schistosomal infection in daily labor productivity; however, even this effect is tempered by the finding that infected workers work more, so that their lower daily earnings are offset and weekly earnings are maintained. We do not argue that these parasites have no other consequences -- they may affect the quality and quantity of leisure time and relationships within the household, for example -- but we do not conclude that economic development is not being retarded importantly by their presence."9

It seems more reasonable to suppose therefore that improvement in rural water supply tends to occur in the wake of some rise in prosperity rather than as an essential prerequisite for such a rise. This does not mean

that there cannot be sound reasons for investing in rural water supply and sanitation improvements; only that to do so in the expectation of prompt and dramatic signs of resulting economic progress is to hope for rather too much.

2 Another source of variation is the form of rural settlement. When settlements are strongly nucleated the cost of providing services in a form accessible to all the members of the community is relatively lower. Dispersed rural settlements in which large distances separate individual dwellings are clearly more expensive to serve. Construction of pipe distribution systems for communities otherwise equal in size and wealth, but scattered rather than concentrated, is likely to be considerably delayed. This has led some governments to adopt a policy of deliberately trying to concentrate settlements, in for example the new ujamaa villages in Tanzania. Where settlements remain scattered or become so through a process of land reform as in parts of Latin America, technology is needed to provide water supply on an individual household basis.

An even more acute version of this difficulty is found in areas of nomadism and shifting cultivation. Where settlements are temporary, and likely to be abandoned after a period of a few years at most, expenditures on the construction of water supply facilities seems unwarranted. A desire to provide better amenities for such people has led governments to adopt sedentarization and settlement stabilization policies.

3 A third source of variation includes a number of factors that may be broadly grouped as environmental conditions. These extend to availability and reliability of surface and ground water sources; seasonality of moisture availability and rainfall regime; the character of the terrain, whether hilly or mountainous or flat. Where ground water is available close to the surface in easily penetrated rocks the rural water supply problems exists in the most readily soluble form as in Bangladesh, on the Ganges-Brahmaputra delta. Resort to surface water usually implies a greater danger of contamination. Ground water sources that are deeper or lie beneath hard crystalline rocks as in much of the Deccan Plateau in south India prove more difficult and costly to obtain. Climatic factors also affect the availability of water sources. Places on the fringe of the Atacama Desert in southern Peru and northern Chile have more in common in their water supply problems with places in northern Nigeria or in Rajasthan than with their South American neighbours in the Andean Mountains or the Amazon Basin.

4 Seasonal variability is another climatic factor of considerable significance. Where abundant water can be relied on to fall from the skies almost on a daily basis as in the tropical rainforests of the Congo Basin and in parts of Malaysia and Indonesia, there need be little concern for water storage against the possibility of a protracted dry spell. In places like the Sudan, however, the water environment is very different in the rainy season from the dry season and water supply programmes must take this into account. Something very similar obtains in the monsoon lands of south Asia where water supply systems have to be built with a late arrival of the monsoon, or even a complete failure, in mind.

Another important source of variation is the disease environment, which differed considerably between one part of the developing world and another. Cholera for example has been largely as Asian disease; it has only just recently made its appearance in Africa; and has not yet appeared in South America although there are considerable fears that this may happen soon.

A helpful classification of diseases related to water has been developed by Bradley[10] and is shown in Table 1. The classical water-borne diseases of typhoid and cholera can be reduced by improving water quality. What is most important to note, however, in connection with the approach presented in this investigation is that increasing availability of water alone, without improving quality at all, can reduce greatly the incidence of several water-washed infections. Depending on the nature of the disease environment the kind of water supply improvement that is most needed will differ. Bradley concludes:

> "Many diseases can certainly be reduced by improving domestic water supplies, but no good quantitative data on the degree of improvement needed are available. Also there are sufficient studies on record, careful ones, that have shown no benefit at all from improvement in village supplies that we should take warning. Probably more than just water is needed - a change in habits? health education? - it is not yet clear". 11

Table 1

A Classification of Diseases Related to Water

I	Water-borne	I(a)	Classical	typhoid, cholera
		I(b)	Non-classical	infectious hepatitis
II	Water-washed	II(a)	Intestinal	shigella dysentry
		II(b)	Cutaneous	yams, scabies
III	Water-based	I	Percutaneous	Schistosomiasis
		II	Ingested	Guinea-worm
IV	Diseases with water-related insect vectors			
		IV(a)	Water-breeding:	onchocerciosis, malaria
		IV(b)	Water-biting :	Gambian sleeping sickness

Source: Bradley

Improvements in health following the provision of safer water supplies may also be dependant upon actions taken to safeguard health in other ways, including food protection, waste disposal, personal hygeine and sanitary education. An effective user-choice system of the kind contemplated here could not therefore be confined solely to choices of the scale and type of improvement in water-supply. Other environmental health programmes need to be considered along with education and information-giving.

6 Social organization varies considerably from country to country, and this affects the ability to develop community water supply systems. Perhaps the most profound source of variation, however, and one that is least understood, is the way in which cultures relate themselves to water. Since water is such an essential requirement for life, it has been invested with all manner of meanings and significance in different cultures. Often it is regarded as having mystical significance. Almost all religions involve the use of water in rituals or ceremonies of various kinds. These associations of water with ideas of moral significance and codes of conduct mean that the relatively simple task of improving the water supply for a village can become complex beyond belief. It is in many instances not only a question of finding water and deploying the capital and technology and organizational skills to supply it to those in need: more often it requires an understanding of the role and significance of water in community and individual life at all levels. Water is not a commodity or public service like any other, and attempts to regard it as such invite failure and ridicule upon those who try.

1 2 3 4 5 6 Given the enormous range of variation in the levels of economic development; the pattern of rural settlement; the environmental conditions including hydrologic, geologic and climatic factors, the diseases prevalent; the social organizations; and the cultural, including religion, characteristic of different countries, it is clear that there can be very few valid generalizations about "the rural water supply problem in developing countries". For the purpose of planning a global strategy, however, or simply to improve the processes of financial and technical assistance it is important to have some understanding of the overall magnitude of the problem.

The Present Situation

A questionnaire survey distributed by the World Health Organization in 1971 is the only source of data about the global situation. Much more detailed and reliable data are available for some countries. The WHO questionnaire data in its current stage of analysis describes the situation for the 90 developing countries, listed in Appendix A. The total rural population of these countries has been estimated at 1.166 million in 1970 growing to 1,438 million in 1980. The rural population is over two-thirds of the population of the 90 countries as shown in Table 2.

The rural populations are described in terms of those having "reasonable access to safe water" or "adequately served". The definitions of these terms are crucial in understanding what the figures mean and how the problem is approached, and they are briefly discussed below.

From the data now available and shown in Table 3, it appears that only 12% of the rural population is "adequately served". In considering what is possible within the Second UN Development Decade 1970-80 the World Health Organization has set a target of attempting to double the percentage of those receiving "adequate" supplies. Many would say that the prospects of reaching such a figure are not high. By WHO estimates it will require the design, financing, construction, placing in operation and maintaining of new rural water systems to supply an

additional 20 million people each year. By the end of the decade it is hoped that 200 million additional people will have been served costing $1,600 million (US) for construction alone.

Table 2

Population Growth in Ninety Developing Countries

(in millions)

	1970		1980		Increase	
	No.	%	No.	%	No.	%
Rural	1,166	72	1,438	67	272	23
Urban	461	28	712	33	251	54
Total	1,627	100	2,150	100	523	32

(90 countries)

Source: World Health Organization.

Table 3

Water Supply Status and Goals

(population figures in millions)

	1970		1980		Increase 1970-80
	No.	%	No.	%	No.
Adequately served	140	12	357	25	217
Not adequately served	1026	88	1081	75	55
Total rural population	1166	100	1438	100	272

(90 countries)

Source: World Health Organization, Community Water Supply Programme, Progress Report by the Director General, 25th World Health Assembly 20th April 1972, Geneva

Despite the ambitiousness of the target it is expected that the number of those not served adequately will actually increase, from 1,026 million to 1,081 million. The increase is not large in relative terms and given the margin of error in the figures may well reflect a stable situation. What this means is that in spite of great efforts the magnitude of the problem remaining at the end of the decade will be about the same as it was at the beginning. It is true that as a result of the efforts of

many organizations and groups at local, national and international levels, some 217 people will be "adequately served" that otherwise would not be. But also the number of those not adequately served is expected to rise by 55 million. Extrapolation of the data for the 1980-90 decade under very optimistic assumptions on the rate of progress, does not significantly change the general picture.

This gloomy prognosis arises as a result of the definitions used in the WHO questionnaire. The definitions are as follows:
reasonable access "when the housewife does not have to spend a disproportionate part of the day in fetching the family's needs for water".
safe water "includes treated surface waters or untreated but uncontaminated water such as from: boreholes, protected springs and sanitary wells. Others of doubtful quality will be classified as unsafe".

Given the state of availability in many of the countries responding to the questionnaire, the definitions are necessarily vague. In consequence they permit a wide variety of interpretations. This was foreseen by WHO and is inevitable in this kind of enquiry. Essentially what constitutes "rural" and "reasonable access" and "safe water" is a function of the ideas prevailing in each country. It is clearly impossible to have a common interpretation of "reasonable access", and the difficulty is not much helped by resort to the phrase "disproportionate part of the day". In some places where supplies are generally accessible more than a few minutes might be considered disproportionate, while elsewhere several hours might be considered quite normal.

The definition of "safe" presents particular difficulties. Laboratories and trained manpower for the testing of water samples are generally not available to permit quality assessments of rural water supplies. People learn by experience that some water is good and other sources are dangerous, or are poor in taste. In some instances, at least, there is reason to believe that the person charged with the responsibility of completing the WHO questionnaire simply calculated the population of those communities where improved supplies had been provided by a central government department. All other supplies were then categorised as "unsafe". To some extent the WHO questionnaire encourages such a response. Only those surface waters that are treated are to be regarded as safe. Water from springs is not safe unless "protected", and water from wells is not safe unless they are "sanitary". This follows sound environmental health practice as far as water supplies are concerned of tending to assume guilt until innocence is proved. It is considered to be a far more serious error to classify as "safe" an "unsafe" water supply, than to classify a "safe" one as "unsafe". This view, coupled with the specification of WHO international standards for drinking water, fosters the notion that there are only two kinds of water - safe and unsafe. It also fosters the notion that there are only two kinds of water supply systems - the one that can with high confidence be described as "safe", and all the rest. This is probably not the intention, but it is the effect.

The ramifications of this view are considerable. It powerfully influences the strategy of national water supply programmes, and it persuades the thinking of public health engineers in their selection of water sources, and the design standards and criteria they use.

A consequence of the "safe" - "unsafe" and "adequate" - inadequate" categorization of water supplies and the specification of quality standards is to reinforce the tendency towards provision of the near perfect supply for a few while neglecting even minimal improvements for the vast bulk of the population.

Such an approach might be justified if it were indeed true that there are only two kinds of water. As it happens, the notion of "safe" water is a myth. The unpalatable truth is that with all water in public supply systems there is an element of risk. In the most highly developed countries it appears likely that viral infections such as hepatitis can be spread through public water supplies, and concern is increasingly being expressed about the possibilities of contamination by toxic substances released into the environment from industrial and agricultural activities. The use of water anywhere involves an element of risk. Much can be done, at a price, to reduce the level of risk. By how much it is decided to reduce the risk is a matter of judgement depending on an assessment of the consequences of taking the risk and the cost of reducing it.

In order to arrive at a more accurate diagnosis of the "rural water supply problem" it would be necessary to know how many people are exposed to some specified degrees of risk. A calculation of the amount of risk reduction to be gained by different kinds and degrees of improvement would then form a basis for choice of policy and of technology.

A beginning might be made if the simple classification of populations into "served adequately" and "not served adequately" could be broken down into a finer set of classes. All those not served adequately do not "enjoy" the same standards. Not all suffer from water-related diseases, and those that do suffer do so in different degrees. The distance which some have to walk to water is much greater in some cases than others. A division of those without "reasonable access to safe water" can be made into different degrees of access and different degrees of safety. This would give a more accurate picture of the situation, and help in determining research priorities.

Neither the data available nor the level of scientific understanding of the relationship of water use to health and well-being are sufficiently advanced, to permit a thorough-going application of risk-benefit analysis to water supply policy. This is not necessary, however, for the adoption of a risk-taking point of view. In subsequent discussions of technology, and of water quality and quantity, the approach adopted is to seek ways of increasing the benefits of water use at lowest cost while continuously reducing the level of risk. What it is hoped to achieve is not accessibility to safe water but greater access to safer water. The distinction is simple and crucial.

An Incremental Approach

The precise magnitude of the rural water supply problem is not known and probably never will be. It is clear, however, that many people (perhaps as many as 1,000 million), are now relying on water sources which are a significant threat to health, or yield insufficient quantity or are difficult of access, or a combination of these. Under the present policies of many national water supply programmes, villages will be left

to continue using unimproved traditional sources of water until the day when the experts and the technicians move in and a spanking new water supply system is built. For the present inhabitants of most third world villages that day will not come in their lifetime. It probably will not come in the lifetime of their children.

When it does come it is likely to find the villagers unprepared. Not used to using water out of a tap; not used to the idea of paying for water; unacquainted with the health benefits that can be gained; not used to the idea of having to repair and maintain a system in proper working order; not used to the sudden reduction in time normally spent in fetching water; unfamiliar with the taste of chlorinated water; for these, and a hundred and one similar reasons the provision of a new water supply system can come as a substantial psychic shock to a village community. Small wonder that when things go a little wrong the community may return with some relief to its traditional sources.

Rather than building a few first class water supply systems for the lucky or the influential, the strategy suggested here implies a process of gradual incremental improvements for a much larger group. In organizational terms it means a continuous programme of assistance to each village community helping the people to assess their situation and to choose a level of improvement appropriate to their needs and abilities.

In terms of technology it means presenting an array of choices and making those available in a form most suited to local circumstances. To this end the water supply system has been broken down into six separate components, namely pump, wells, treatment, conveyance, storage and distribution. For each of these system components the main choices now available are described together with a general assessment of their characteristics and suitability for use in rural areas in developing countries.

On the basis of this formulation it will be possible:

1. to develop the means and techniques whereby rural people can express a choice in the degree and type of water supply improvement that they wish to adopt;
2. for communities to take some initial steps in the direction of better water supply without being committed initially to a programme of heavy investment or expense;
3. at the same time it will permit village communities gradually to develop the capacity to operate water supply systems, and to appreciate their benefits;
4. to identify more clearly those areas in which technological research and development is needed to make the available choices more appropriate to the needs, and to indicate gaps where new technology or new scientific understanding are needed.

Ian Burton
UEA, Norwich
4 April, 1973

Notes

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11. Bradley, op cit, p.5

Appendix A

List of 90 developing countries in WHO Data on Water Supply (WHO, 1971)

Continent	Countries
Africa	Algeria, Botswana, Burundi, Cameroon, Central African Republic, the Congo, Dahomey, Egypt, Ethiopia, Gabon, Gambia, Ghana, Guinea, Ivory Coast, Kenya, Lesotho, Liberia, Libyan Arab Republic, Madagascar, Mali, Mauritania, Morocco, Niger, Nigeria, Senegal, Sierra Leone, Somalia, Sudan, Uganda, United Republic of Tanzania, Tunisia, Upper Volta, Zaire, Zambia
Asia	Afghanistan, Bahrain, Burma, Srilanka, Cyprus, India, Indonesia, Iran, Iraq, Jordan, Khmer Republic, Kuwait, Laos, Lebanon, Malaysia, Mongolia, Nepal, Pakistan, People's Democratic Republic of Yemen, Qater, Republic of Korea, Singapore, Saudi Arabia, Syria, Thailand, Turkey, Vietnam, Yemen
South America	Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Guyana, Paraguay, Peru, Uruguay, Venezuela
Central America	Barbados, Costa Rica, Cuba, Dominican Republic, El Salvador, Guatamela, Haiti, Honduras, Jamaica, Mexico, Nicaragua, Panama, Trinidad and Tobago

Appendix B

National Criteria for Definition of Rural Areas

Criteria \ Continent	Africa	Asia	South America	Central America	Oceania	Total
Population less than						
1,000	-	-	1	1	-	2
2,000	3	-	2	2	-	7
3,000	1	1	-	1	1	4
5,000	2	4	-	-	-	6
10,000	-	1	-	-	-	1
Total number with population size Criteria	6	6	3	4	1	20
Administrative	17	11	7	9	1	45
Data not available	12	11	-	1	1	25
Total number of countries	35	28	10	14	3	90

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NOTES ON RESEARCH RECOMMENDATIONS

This paper consists of extracts of research recommendations drawn from a variety of publications, conference reports and committees. No attempt has been made to systematize or to eliminate repetition.

"The most pressing problem is to develop better criteria for allocating scarce funds among competing projects in this sector. Progress toward this goal depends on developing better measures of economic benefits, which largely depend in turn on developing better data. The Bank is starting to carry out research to this end, and expects to intensify it. Other research objectives are to improve water demand analysis and fore-casting and to identify pricing policy options for water and for sewage."

IBRD World Bank Operations, Sectoral Programs and Policies, Washington DC, 1972, Water Supply and Sewage, p. 251

"For all practical purposes sanitary engineering research may be considered to be at a baseline level of near zero. A few very modest applied research projects have been started, largely with PAHO and United Nations Development Program assistance, in the last two years. But in relationship to the opportunities and needs the research effort has to be considered negligible. The important thing is that the potential is much improved. The establishment of graduate programs with full-time faculty and laboratory facilities makes research possible. In turn, research will produce the new designs, methods and innovations that will accelerate development in and attract support from the public agencies responsible for environmental facilities and services. The importance simply of fostering and developing the research point of view can hardly be over-emphasized here. Latin America is still largely using designs and methods developed for European and North American conditions rather than ones suited to its conditions and contributing in the fullest possible way to Latin American development. Sound, high quality indigenous teaching and research institutions are an absolute necessity for full economic and social development.

The Sanitary Engineering Center would be expected to play a key role in bringing about the improvement needed. As a multinational scientific and technological center it would strengthen national scientific and technological institutions. Most of these in the sanitary engineering field need supplementing; a number of new ones need to be created. The framework for support and for interchange of ideas and staff already exists in the Latin American training network which PAHO has developed with the Universities."

WHO Pan American Health Organization. Community Water Supply and Sewage Disposal Programs in Latin America and Caribbean Countries. ES Technical Series 5, June 1969. Annex D. Pan American Centre for Environmental Sciences and Engineering, page 4

"Experiment and research

A very important element of economic and social development is the increased importance of different forms of research, in particular in the field of science and technology. Recognising this fact, the government has approved the setting up of Scientific and Technological Research machinery to be responsible for a) the evaluation of expenditure and plans for applied and technological research within Tanzania, and b) the coordination of all research work including EA Working Party on Research.

Devplan in cooperation with other ministries is responsible for the formulation of a national research plan for 1970/74. The draft plan is to be produced by a working party representing the different interests in research matters. The aim is to present a draft plan in May 1970.

Another research activity within the field of water is under way within BRALUP - the preparation of a report entitled "Water Development in Tanzania: a critical review of research." The Report will cover all research carried out in National Programmes, River Basin and Large Area Surveys, Topic Oriented Research, and Impact studies. The presentation of the Report is scheduled for April 1970. Much of Tanzania is a marginal area with respect to water resources. Scarce and variable precipitation means problems for agriculture and cattle breeding, and difficulties with domestic supply. Basic research in hydrology and geology is needed for the knowledge of water availability. The desire to optimize the benefits from a water supply also require knowledge of the positive and negative social and ecoonomic changes that occur when water is supplied. These changes are complex, and the methodological approach must

- come in on all levels;
- be problem-oriented and try to identify the 'field of influence' on society
- be linked with the planning and implementation process and put the results into operational guidelines to WD & ID as an executing body.

The experiment and research section of WD & ID will not act as a research institution but rather as an initiator and as a body responsible for the transfer of research results into practical use. Among the very many research problems connected with rural water supply the following blocks of problems seems to be of the greatest interest for WD & ID for the time being:

The hydrological and geological aspects on water supply:

- what is the total amount of water available over the year in various parts of Tanzania?
- is there a cyclical returning period with little or no rain, and to what extent is this affecting water availability?
- what layers of the ground are water-carriers?
- how big is the salt-enrichment of the soil when a dam is constructed and how can it be avoided?
- what is the extent of soil erosion, considering type of soil, slope, humidity, etc.?
- are there any risks for the ground-water level to be lowered when public water supplies are installed?

The economic and social effects of improved water supplies:

- how could the effect of improved water supplies be measured?
- how and to what extent do improved water supplies improve the public health?
- what supplementary activities to water supply improvement are needed in the community: information on water use, training courses in home economics, care of children, needlework, cultivation of vegetables, dietary and food preparation and the like?

(Contd)

- are people willing to change their way of life and their attitudes towards government intervention in connection with water supply improvement?
- what is the real effect of the saving in time for the housewife in fetching water from the domestic point, and how does it affect the rural family's way of life?
- what supplementary inputs to water supply improvement are needed in a community in order to achieve economic development and how should adequate coordination be assured?
- what is the relationship between an increased consumption of water per capita and public health in various parts of Tanzania and under various climatic conditions?
- are there any changes in the quantity of consumption of water per capita after public water has been provided?
- is the hygienic standard depending upon the circumstances under which the water is obtained?
- how is permanent water regarded by nomadic or semi-nomadic people?
- what is the relationship between lack of water and seasonal migration, what is the effect of seasonal migration, and is provision of water the only means to stop this migration?
- what is the relationship between livestock breeding, water supply improvement, and soil erosion, what should be done in this matter, and who should be responsible for necessary actions?

Provision of water may, beside its social aim, be an agent or at least a catalyst for economic development. Little is known about these effects. It seems, however, probable that direct economic effects from a water supply are small, unless other conditions for development exist.

The economic development can hardly be achieved without functioning markets, channels for the flow of products and services, etc. Considering the scarce resources there seems to be an urgent need for research on these matters.

Risk for soil erosion must be considered when an area is supplied with water. As an example, a dam built for water supply can very soon be filled up with sediments as a result from over-grazing. The over-grazing also means that the thin layers of good soil is easily oxidized.

The adaption and introduction of various new techniques and working methods into the water supply improvement process:

- design of handpumps for local production;
- methods of rainwater catchment;
- design and methods of construction of wells for different parts of Tanzania and different sub-soil conditions;
- the need of and different methods for water treatment under different conditions and for different reasons;
- standardization of materials, construction elements & equipment;
- methods and means for chemical and bacteriological water analysis;
- methods and procedures for the change over to metric system."

The United Republic of Tanzania Ministry of Agriculture, Food and Cooperatives. Water Development & Irrigation Division. Tanzania - Rural Water Supply Development, Vol.1 Text, pp. 59-63

"Catchment Areas

Water from catchment areas which are influenced by industrial, agricultural and urban development, may be subject to rapid changes in quality with consequent serious effects on the health of the consumers. Research is needed on:

a) The effect of industrial, agricultural and urban development on water quality in catchment areas.

b) The protection of springs and wells for small communities.

Disinfection of Water Supplies

In many small communities it is not feasible to install complete water treatment plants and the communities must make use of water essentially in the form that it is taken from the source. There are many situations in which treatment by disinfection alone is adequate. There is a need for the study of new, simple and inexpensive procedures for the disinfection of water from wells used by small communities. A similar need exists for small water storage tanks.

Treatment of Rural and Semi-Rural Water-Supplies

To assure that water-supplies for small rural and semi-rural communities conform to the standards adopted, it is necessary to develop economically feasible and properly supervised treatment procedures and methods of assessment of quality. Research along the following lines would be desirable:

a) A study of disinfection techniques for rural wells using chlorine or bleaching powder and enabling residuals to be uniformly maintained for a fairly long period (e.g. a month) after the cartridge has been immersed in water.

b) A study of disinfection techniques for small water-supplies on a community basis, including the development of economical means of chlorination.

c) The development of indigenous coagulators and coagulent aids for more efficient coagulation of water-supplies.

d) The development of semi-rapid sand filter plants using a minimum of equipment and maintaining the efficiency of sand filters (suitable for small communities using proper water-supplies).

e) The development of upward flow filters; a study of the efficiency and suitability of reverse flow filters as against conventional rapid sand filters.

f) The development of new culture media for the detection of coliform organisms, using indigenous materials.

g) Methods of defluoridation of small water-supplies in areas of excessive fluoride content."

WHO International Standards for Drinking Water, Geneva 1963, pp. 201-202

"The Committee noted that a number of research and development projects have been initiated and assisted by WHO but that this activity is at present on a very modest scale. An expansion of the programme would be desirable.
It was felt that additional knowledge was required in certain areas, such as conservation and utilization of water sources, treatment, distribution, quality control and design criteria. As examples of specific studies considered necessary, the following were suggested:
1) Improvement in the design and maintenance of distribution systems, especially the development of devices and techniques for the detection and control of leakages.
2) Practical and economical methods of treatment utilizing locally availably materials, particularly in small-scale applications.
3) The development of design guide-lines and criteria applicable to water supply operations.
4) An examination of attitudes, traditions and taboos in relation to the acceptability by the community of piped and treated water supplies in rural areas.
The Committee felt that the whole question of research and development and related subjects warrants study in greater depth than could be undertaken in the limited time at its disposal."

WHO Technical Report Series No. 420, Geneva, 1969. Community Water Supply. p. 17

"Technology
a) Comparative research on construction, operation, and costs of waste-management plants.
b) Simplified systems for the collection, treatment, and disposal of wastes designed to make optimum use of local resources of men, materials, land, and funds.
c) Laboratory and field studies of new materials and methods of handling wastes.
d) Improved equipment, instruments and controls for the replacement of manpower in areas where labour is scarce.
e) Advanced processes for waste-water treatment so as to improve the quality of effluent. Such processes should remove nutrients, and other organic and inorganic substances, with high efficiency.
f) The prevention and reversal of eutrophication.
g) The hazards of the re-use of waste water and solids removed from it, with special emphasis on health aspects.
h) The compatibility of industrial wastes from manufacturing processes, and of wastes from product use, with domestic waste-water plants and with the environment.
i) The management of waste-water solids, and their integration with community and industrial solid wastes.
j) Economic studies, by systems analysis technique, of various combinations of unit processes for the collection, treatment, and disposal of wastes, of their incorporation into other waste systems, and of the eventual discharge of wastes to the land, sea or air. Due consideration should be given to the effects of reclamation and/or disposal of the liquid, gaseous, and solid residues, and of waste heat produced by treatment plants on the environment.

(Contd)

k) The use of wastes and residues, and of waste heat, for agricultural, horticultural and other purposes.
l) Improvement of equipment for reduction in size of solid wastes.
m) Improvement in the removal of pollutants from the waste gases given off by solid-waste handling installations.
n) Managemznt of individual waste constituents at their source by collection, treatment, and re-use or disposal, rather than disposal by mixing such wastes with heterogeneous refuse."

WHO Technical Report Series No. 367, Geneva, 1967. Treatment and Disposal of Wastes, p.24

'Rural water supply and sanitation is an important problem for India where only about 10% of the population is yet served with piped water supply. The problem is complicated by the need for extreme simplicity of the schemes, the need for funds and the lack of motivation among the rural population for either maintaining the schemes properly or paying for them. Several agencies are actively engaged in this field.
The efforts made by the various agencies in this field were appreciated by the conference, but it felt that proper implementation of the available findings in the field was not given due importance. A need for co-ordination between various agencies and research centres was emphasised. In this connection, it was suggested that concerted effort should be made to find out ways and means of implementing the rural sanitation programmes in such a way as to suit the existing conditions and the resources and attitudes of the rural population. In view of varied types in population density, living patterns, social customs, etc. the conference recommended that practical and effective demonstrations be undertaken for popularising community latrines, sew age disposal and general sanitation. Education in rural sanitation matters needed to be started at an early age and for this purpose some useful literature should find its way into the school text books also. Further, a special mention was made to find out the methods of financing and management of rural sanitation projects and the socio-economic aspects related to rural sanitation.
In allocating priorities for further investigations in rural sanitation, the conference suggested the following projects for investigation:
1. Improvements to hand pumps with a view to reducing the repairs and maintenance problems;
2. Suitable strainers for small diameter tube-wells in rural areas.
3. Suitable taps for use on public stand-posts so as to prevent water wastage.
4. Treatment units including domestic filters for water supply from the village water tanks and canals.
5. Design criteria for rural piped water supply schemes to take into account simultaneous demand effects both for intermittent and continuous supply.
6. Improvements in differential pressure chlorinators.
7. Cataloguing of water quality all over the country.
8. Water quality and related physiological effects in the case of communities consuming waters which fail to meet drinking water standards.
9. Bacteriological quality studies in piped water schemes for rural areas.

(Contd)

10. Desalination units for small community water supply in brackish water areas.
11. Prefabrication and standardisation for rural water supply components.
12. Rain water collection system
13. Latrine design with regard to geometry of pits, their lining and adequate superstructure.
14. Digestion of night soil for semi-urban and suburban areas.

The conference felt that priority should also be given to the following topics:
a) Co-ordination between various agencies and research centres.
b) Cost-benefit assessment for a rural community with the introduction of piped water.
c) Dissemination of information, training,manuals, pamphlets, etc. in local languages.
d) Methods of financing and management of rural sanitation projects.
e) Sociological studies related to rural sanitation."

Central Public Health Engineering Research Institute, Nagpur, India. pp. 30-33

"The most important recommendation is on the question of supplying well-drilling equipment to India. The expert team should report on the following major topics:
1) Suitability of the well-drilling proposed as a solution for the rural water supply problems of many of the so-called 'difficult and scarcity areas'.
6) Since the hand pump will be the backbone of a large segment of the rural water supply programme, the CPHEO should, from available Indian experience, establish the standards for a rugged pump that may be used on public well installations. Such action would avoid repetition of the Rajasthan hand pump experience."

UNICEF-WHO Joint Committee on Health Policy India Country Report. JC16/UNICEF-WHO/WP/69.1, Geneva 5-6 March 1969 pp. 29 and 30

"5. Design improvements should be introduced leading to economies both in construction and operation as well as to removal of pollution hazards".

UNICEF-WHO Joint Committee on Health Policy Pakistan Country Report. JC16/UNICEF-WHO/WP/69.6, Geneva 5-6 March 1969 p. 22

"3. A special study should be sponsored by SESP (Servicio Especial de Salud Publica) to determine whether there are any means of further reducing the per capita costs of piped water supply installations.
4. Greater emphasis should be placed on sanitary excreta disposal as either a parallel or follow-up programme to water supply. Particular attention should be paid to improving latrine design."

UNICEF-WHO Joint Committee on Health Policy Peru Country Report. JC16/UNICEF-WHO/WP/69.7, Geneva 5-6 March 1969 p. 8

"7. Gradual steps should be taken towards the introduction of some technical sophistication such as filtration where necessary, chlorination, fuel-saving designs and improved operating procedures."

UNICEF-WHO Joint Committee on Health Policy Kenya Country Report. JC16/UNICEF-WHO/WP/69.3, Geneva 5-6 March 1969 p. 18

"Priority areas for research

6. Ground water: the necessary research on inventories of water resources should be combined with research on water-saving techniques, specially reuse and recycling of water.

7. Desalination: this is a priority area for the acquisition of new knowledge because of new developments in this field, particularly as regards geothermal energy. The target of research should be the lowering of costs, which would make the use of desalinated water economically feasible for agricultural purposes.

Sectoral programmes

1. Water resources: research should be undertaken for application of new techniques to achieve a more efficient use of water, on nuclear desalination, on the use of geothermal energy. It is proposed to establish, in the field of desalination, up to 20 demonstration and pilot and other plants to test techniques, at an estimated cost of $40 million. Research should be carried out to devise and develop water-saving techniques and the review of processing methods and waste treatment in industries. It is estimated that R & D expenditure in this field should involve expenditures of at least $18 million."

OECD DD 227, DAS/SPR/71.3. Planning Group on Science & Technology for Developing Countries. Annex, pp. 5 & 8

"Identification of Research & Development Needs in Developing Countries

This topic was introduced by Dr Wilfredo I Reyes, Associate Professor of Public Health Engineering, Institute of Hygiene, University of Philippines, Manila, Philippines. Dr Reyes drew attention to the different approaches necessary in dealing with urban centres and fringe areas, and in areas of wide rainfall variation.

He stressed the importance of adequate data on the status of community water supplies, including activities, organization, legislation, patterns of utilization of water supply facilities, and development plans as a basic for defining research and development needs.

Discussion

Several participants emphasized that research and development institutions should have as a first obligation serving the national water supply research needs. The network of collaborating institutions through co-ordination of research undertakings could be mutually helpful in meeting the needs of individual countries. To facilitate this collaboration, a suggestion was made that the International Reference Centre undertake to stimulate the collaborating institutions to develop national research plans in their respective countries. This information might then be collated by the International Reference Centre, thus enabling the matching of research interests to achieve a coordinated programme. The preparation of a world-wide master plan for water supply research could possibly be evolved in this manner. After some discussion, this proposal was endorsed as a recommendation to WHO and the International Reference Centre.

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The need was agreed of finding ways of reducing not only capital costs, but also recurrent expenditure on operation and maintenance.

Consideration of the institutional base for research and development centres revealed some advantages and disadvantages of the university-based centre as related to the independent autonomous centre. It was pointed out that university-based institutions meet obstacles to the formation of realistic research and development programmes, find it difficult to maintain close contacts with operating agencies, and encounter many competing pressures for allocation of resources. On the other hand, universities were defended as sometimes possessing greater versatility, flexibility and resources of varied disciplines. It was pointed out that universities must relate to the society in which they exist if they are to maintain viability. Universities are helpful in cultivating interest in research among students, and offer many opportunities for individual research efforts to be carried out at little direct cost.

The point was made that there is enough work to be done to justify utilization of all available research and that universities and independent research centres have frequently been able to collaborate to their mutual advantage.

Research and development activities undertaken by institutions outside a country present problems unless the habits and customs of the user country are fully considered. Research workers based in other countries need to gain experience through association with the people and problems of the country utilizing their findings.

The financing of research and development centres is admitted to be a widespread problem, and several possible solutions were described. Financial support of research centres by the water supply industry has advantages in some instances, especially in achieving more effective application of research findings. Such support by industry is achieved in one country by basing membership fees on a percentage of water revenues, and in another by basing them upon volume of water produced.

Collaborating institutions could compare their own design criteria with those of nearby countries as a method of reviewing the validity and rationale of their own standards. Such outside comparison can be productive and useful.

Some research workers within the developing countries tend to accept without adaptation results of research carried out in industrialized countries. Research could profitably be undertaken in their own field installations under operational conditions.

Studies should be undertaken of public attitudes toward payment for water. There was a general consensus that the use of sociological and anthropological techniques could be helpful. Design practice might well take into account what rates people are willing or able to pay as opposed to design based upon agreed physical criteria, which may require unrealistic water rates to finance the water supply improvement. Pilot programmes of this nature are under way in Senegal and India.

The International Reference Centre might ultimately consider providing initial support in the form of "seed money" for projects undertaken by collaborating institutions. Although such financing might be small, it would have a value in demonstrating local competence. At this time, the International Reference Centre has no funds available for this purpose.

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The collaborating institutions should support the organization of professional societies within their countries, and internationally.
In recommending maximum concentrations of deleterious substances, e.g. lead, cadmium, selenium, in water, collaborating institutions should consider total body intake including air, food and other sources of exposure.
Seldom are technical problems met with in developing countries for which purely technical solutions do not already exist. What is more likely to be the case is that such solutions as found in the developed countries for similar problems are not applicable, either due to the high degree of sophistication involved or to the lack of foreign exchange for the importation of plant and equipment.
Another point which has to be borne in mind is that professional staff engaged in the provision of community water supplies in developing countries must re-orient their thinking and be ready to use what might be considered "unconventional" equipment and methods and to prescribe standards that are more suited to the reality of the situation. This problem is very real.

Identification of Research and Development Needs in Developed Countries

This item was introduced by Dr R G Allen, Director, The Water Research Association, Medmenham, Bucks, UK.
Acknowledging the prevailing limitations of resources for research and development, Dr Allen stated that is is necessary to identify problems and determine priorities. Instinct and opinion can be used for this selection but the choice should depend substantially on relating benefit-cost ratios, which are not easy to apply in this field.
Research and development programmes should be well planned with appropriate allocations to fundamental research, applied research, introduction and assimilation of results of applied research, formulation of standards, and training. Results must be timely and must respond to community desires, which do not always coincide with needs. Attention must be given to waterworks economics, finance, administration and management. The programme should follow a carefully prepared long-range plan.
The research and development institution should be organized to reflect the administrative structure of the water supply industry in the country, must strive to relate to the needs and desires of the user, and should seek to derive some revenue from those using the results of the programme.
Dr Allen suggested that an important function of research and development centres in developed countries is to assist their countries in providing aid to the developing countries. In this effort, one must guard against applying techniques developed in one country for use in others, but should develop methods best suited to conditions of the consumer locality.
WHO can assist in the establishment of research and development centres in the developing countries by:

1. Finding more efficient ways of promoting effective research in universities, recognizing the problem of continuity of research staff.
2. Developing guidelines for national governments about to establish or reorganize research operations in the water supply field, including preferred type of organization and size of effort.

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3. Promoting research into techniques useful to national governments which stimulate a national demand for better water supplies.

Discussion

Discussion of the needs of developing countries for water systems designed to match local conditions and resources brought out the importance of considering the availability of local labour, which factor might dictate the economy of labour-intensive design rather than equipment-intensive design. Consulting engineers have at times given inadequate consideration to local needs and operational problems, basing their work on design standards and practice more appropriate to their home countries. Research and development institutions have an obligation to assist in economic and engineering studies, and to work for the relation of design to the local situation. Sophisticated automation and mechanization of water treatment plant units should be avoided in most developing country situations.

Research undertaken in collaborating institutions within the developing countries should not ignore the relationship between water supply and waste water treatment. The developing countries should avoid the mistakes made by the industrialized countries during their earlier stage of development.

While most industrialized and developed countries have the resources to deal with research and development needs specific to their own countries, it would be of value to international organizations such as WHO, as well as to associations such as the IWSA, if areas where international action is indicated could be clearly defined. Another aspect of this question is that notwithstanding the fact that developing countries would want to encourage the use of local materials and techniques as much as possible, there would still be a need for importation of certain items (e.g. treatment chemicals, plastic pipes). In such situations, the experience of developed countries, particularly with regard to standards, toxicity, etc. would be of immense value, not only in assessing products that are imported, but also in establishing norms for production within the developing countries concerned.

Community water supply research should be undertaken within the context of total national water resources planning, and should be related to both long- and short-term planning."

WHO International Conference on Research and Development in Community Water Supply. Cavtat, Dubrovnik, Yugoslavia, 7-14 October 1970. Record of Proceedings. pp. 8-11

"3.2 Research and development needs suggested by Member States

Another area of concern indicated by the Member States was the need for research and development in a number of aspects of community water supply, ranging from research on simpler water treatment methods to desalination of brackish or sea water. The need for groundwater surveys was mentioned most often.

3.4 Summary of Recommendations

More attention must be given by both national and international agencies to the problem of meeting water supply needs in rural areas. Concepts of organization, design, construction and operation must be adapted to the needs and possibilities of the people to be served, using local materials and labour where possible and developing new materials and equipment. Research and development at the national and international level are urgently needed.

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4.1.2.1 The international reference centres and collaborating institutions

Community water supply

Twenty-eight institutions throughout the world have been designated as collaborating institutions within the WHO Community Water Supply Research and Development Programme, which centres on the WHO International Reference Centre for Community Water Supply at The Hague, Netherlands. During 1971 the Centre published a monthly Newsletter detailing research and development activities going on throughout the world in the field of community water supply.

In October 1970, an International Conference on Research and Development in Community Water Supply was convened in Yugoslavia under the joint sponsorship of the Governments of Yugoslavia and the United States of America and WHO. Thirty-three participants from 27 countries attended. Most of them were directors of the research institutes participating in WHO's research and development programme in community water supply. The purpose of the conference was to exchange information on current research, identify research and development needs, and explore ways of collaborating to meet the needs of the developing countries.

Wastes disposal

Forty-two institutions throughout the world have been designated as collaborating institutions in the wastes disposal research network. The WHO International Reference Centre at Dübendorf, Switzerland, has undertaken some activities in solid wastes disposal, but activities in the waste-water field are yet to commence. The Centre's newsletter, IRCWD News, is published quarterly.

4.1.2.2 Contractual research projects

Small water supply units

(a) Field testing of hand pumps: a number of different types of locally manufactured shallow-well hand pumps have been evaluated in India. These trials are now being extended to deep-well hand pumps. Extension of the project to French-speaking West Africa is under consideration.

(b) Extraction of safe water from "hafirs" in the savannah belt of the Sudan. These man-made ponds, with a capacity from 10,000 to 100,000m^3, collect rainwater and are often the only sources of water for the nomadic population in the summer months.

New water supply materials

(a) Toxicity of uPVC pipes used for conveyance of water: institutes in the United Kingdom and the Netherlands are investigating the process whereby stabilizers (such as lead) are leached out from pipes into the water.

(b) Toxicity of coagulant aids used in water treatment: this problem is being studied by the International Reference Centre for Community Water Supply in The Hague.

Disinfection of water with iodine

The International Reference Centre for Community Water Supply has developed an iodine crystal dosing device for use in wells in emergency situations. The kit has undergone first field trials, but must be refined and subjected to further field trials before it can go into production.

Removal of deleterious substances in water

The project undertaken in the United Kingdom is in two parts: i) the removal of heavy toxic metals, to study the efficiency of conventional treatment processes; ii) biological removal of sulfates and nitrates.

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Surveillance of drinking-water quality

Strenuous efforts are needed to ensure that the piped water supplies now in existence do in fact provide safe water. The University of North Carolina, USA, is investigating this complex question in a number of countries where the health and sanitation services are at various stages of development, and plans to outline practical surveillance mechanisms.

4.2.3 Research and development

Research and development, as well as training activities, will be looked upon as adjuncts to the process of transferring technology from the advanced to the developing countries. Innovative technology tailored to the needs of the developing countries will receive priority. The following subjects for study form part of the Long-Term Programme on Environmental Health, and the categories A2, A3, etc. refer to items in that Programme.

(1) Study of materials and skills available in countries at different stages of development, and evaluation of the effects on planning, design, construction and maintenance of water supply and waste-water disposal systems (A2, A3, A4);
(2) Development of new methods of water abstraction, pumping, treatment and distribution suited to the needs of developing countries (A2, A3, A4);
(3) Study and review of effects of deleterious substances (metals, chemicals, toxins, viruses, etc.) in water, and determination of the ADI of trace toxic substances (B3, B4);
(4) Study of the removal of toxic metals, organic chemicals, and nitrates, by existing and new methods of water treatment (B3, B4).

4.2.3.1 Guidelines, codes of practice, standards

The development of criteria, standards, guides for water and waste-water quality, and guidelines for preventive measures and control will also follow the long-term Programme in Environmental Health.

(1) Standards for drinking water (B3): it is expected that both the European Standards and the International Standards will be reviewed, and may be replaced by a single edition of WHO Standards;
(2) Guidelines for the control of deleterious substances in water (B4);
(3) Manual on standard methods of water and waste-water examination (B3);
(4) Guidelines on the collection, storage and retrieval of information for water supply and waste-water disposal (A1);
(5) Guidelines on the planning, programming, design, construction, management and operation of both urban and rural water supply and waste-water systems (A2, A3, A4);
(6) Criteria and guidelines on national policies, institutions and legislation for water supply and wastes disposal (A1, A2, A3);
(7) Criteria and guidelines for the evaluation of pre-investment projects (A1, A2, A3);
(8) Criteria and guidelines for the application of modern technologies to the execution of projects and operation of national and local programmes (A1, A2, A3)"

WHO - 25th World Health Assembly
Community Water Supply, WHA 25.35
24 May 1972, pp. 10-18

"Long-term planning in environmental health

Research Very little research work has been done in the Region in the field of environmental health. There is a considerable need for such research, particularly applied research, for development of methods and techniques best suited to African conditions. Research in the use of local materials is particularly necessary.
WHO-assisted centres for research, demonstration and training in public health engineering, due to be established by 1973, should meet this pressing need.

Research programmes should form an integral part of every long-term environmental health plan. Basic and applied research in the development of new methods and techniques, in order to develop realistic, logical and economic solutions to a number of environmental health problems affecting the Region is essential. Such research should deal with the availability and distribution of material resources, use of locally available materials, adaptation of techniques, apparatus and equipment to suit local conditions, and identification of problems with a view to developing adequate solutions.

WHO-assisted regional centres for research, demonstration and training in public health engineering are expected to be fully operational by 1975. However, countries should endeavour, within their possibilities and according to their needs, to set up their own research programmes, which would become operational by 1980. By 1990 environmental health reference centres should be established in every country, to ensure that the studies and research carried out in different countries are well coordinated and that information is readily available."

WHO Regional Office for Africa. Regional Committee for Africa, 22nd Session Conakry, 20-27 September 1972. Long-term planning in environmental health, pp. 14 & 34

"The use of local materials should be considered for all water supply projects. These materials should be simple, robust, easily maintained and produced at an economic price. To this end, it was advocated that considerable attention must be paid to applied investigations and research concerning materials, construction, equipment and treatment methods."

WHO Regional Office for Africa. Community Water Supply. Report on a seminar, Brazzaville 21-27 April 1971, p. 20

"Research in public health engineering

Research in public health engineering should form an integral part of the activities of the engineering agencies implementing a programme of this magnitude. Current design criteria for water and sewage and industrial wastes treatment plants are most often based on empirical formula obtained elsewhere. Constant research to find out modifications and new innovations in design suited to a different set of conditions in different localities should yield rich dividends and secure better economy and efficiency in plant design and operation."

WHO Inter-regional Seminar on Integration of Community Water Supplies into Planning Economic Development, Geneva 19-28 September, 1967. A Realistic National Water Supply Programme for Developing Countries, by S. Rajagopalan, p. 11

"General conclusions

*Excepting CPHERI, Nagpur, the Collaborating Institutions visited had no deliberate programme of research in community water supply although they all had fair to good facilities for such a programme and appropriate staff interest.

*There was a frequent lack of communication and cooperation between Collaborating Institutions and the operational agencies. Establishment of some formal link seems desirable.

*There is a pronounced shortage of ideas for useful research and development projects in community water supply. This may suggest an inadequate scanning of world literature, but it is clear that regular visits to Collaborating Institutions by experts well grounded in the broad field of community water supply research, is needed.

*It will be difficult to persuade Collaborating Institutions to formulate a forward programme for research in community water supply without positive and continuing interest displayed by WHO and the IRC. Such programmes, when received, should be subjected to constructive scrutiny and full backing should be offered in the subjects listed, by the IRC for relevant literature surveys and information retrieval.

There is a lack of knowledge of research already undertaken and in progress which the IRC should seek to remedy.

The technical audiences which can be brought together in developing countries to discuss ongoing research are not large and there is a tendency for work to be undertaken "in a vacuum". An adequate solution seems difficult to propose except by the provision of considerable travel expenditure. A partial solution may be found by using an appropriate form of publication put out by the IRC to permit a measure of discussion by correspondence."

WHO Community Water Supply Research & Development Programme. Visits to Designated Institutions - Report of a Consultant, Dr R G Allen, 30 June 1972, p. 23

"Despite the fact that biological filters have been operating successfully for more than 150 years, there are still certain features of their operation which are not fully understood. Thus, there are still areas on which general research is desirable.

More importantly, there is a call for research into the particular problems of different areas and varying qualities of raw water, and for development of simple devices and methods of construction suited to locally available skills and materials. In view of the possible economies in construction costs which could result from such studies, it is suggested that small pilot plants should be set up by collaborating institutions or by operating departments in those countries where biological filters could materially contribute to the solution of the problem of water supplies to rural areas and small communities.

Wherever there is a possibility that slow sand filters might be the most suitable choice for a large installation, it will nearly always pay to instal an experimental plant ahead of design and construction of the main works.

Some types of research study which can be made will include determining the best flow rate to suit various raw water sources; comparing the efficiency of different types and grading of sand; studying the effects of storage, sedimentation and primary filtration precautions against seasonal turbidity and determining the ideal capacity of a holding tank for this purpose; investigating what types of algae occur in natural waters, whether these

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are likely to become a nuisance, and, if so, what precautions should be taken to restrict their multiplication.
Among other problems, on which specific research is called for, and which may arise in certain areas or particular water conditions are the following:

a) Cladophoea. This green algae, which because of its branched form tends to interlace in a mat on the surface of the media, can cause difficulty in operation. Occasionally, sections of the mat will float to the surface, bringing with it part of the Schmutzdecke, thus reducing the efficiency of treatment. If not quickly removed, the mat will later sink, clogging a section of the filter completely. Periodical lowering of the water level will enable this mat to be removed as it forms.
b) Organisms, e.g. Nais, that may breed in the underdrains.
c) Excessive H_2S production. When conditions are conducive to a particularly vigorous bacterial population in bright sunlight, these same bacteria at night change over to a reducing action, during which sulphates are converted to H_2S. Concentrations of this may be lowered by aeration, but enough can remain in solution to impart a taste and odour to the water. In extreme cases, it may be necessary to provide a cover to the filter beds; cutting down the sunlight during the day slows down the multiplication of the bacteria causing this condition.

Under the heading of development will be the design and operation of simple control devices; the study and comparison of different methods of construction, including the costs of labour and materials; the preparation of standard details and designs adapted to local needs and conditions.
In addition to these "straightforward" studies, there may be a fruitful field for research into unconventional methods of construction and operation. Three examples may be quoted of experimental work of which we have heard. The first is in Africa, where water is drawn from a deep lake containing some particularly troublesome algae. As a remedy for this problem, trials are being undertaken of intermittent filter operation, the beds being drained in turn to a few centimetres below surface level to allow the sun to dry out the algae and thus prevent their multiplication. It remains to be seen how this will affect the biological life in the lower strata.
In other areas, beds are being operated unsubmerged, the raw water being sprayed on to a dry surface, with the water level being controlled within the bed. Obviously, the usual Schmutzdecke is not formed with this method of operation, but it is claimed that the additional oxygen absorbed by the sprayed water encourages a different form of biological activity.
In Scotland, upward flow biological filters are being tried out for small installations; the advantages of this method include the ability to back-wash the media by a simple manipulation of valves, thus obviating the necessity for scraping off the surface periodically. No Schmutzdecke, in its accepted definition, is formed, but equally no matting of algae on the surface can take place.
Other minor experiments include the incorporation of activated charcoal, either as a layer within the bed or as an additive to the raw water, to increase the colour-and odour-removing properties of biological filters.
A suggestion has been made that filter surfaces might be covered with light matting of hessian or of foam plastic on which the Schmutzdecke could form in order to facilitate cleaning and lengthen filter runs, but it is not known whether this has actually been tried out in practice.

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The World Health Organization, through its Community Water Supply Research and Development Programme, wishes to encourage experimental work on biological filters, particularly in developing countries, especially if this leads to increasing use of this safe, reliable and inexpensive method of improving water quality. Any individual or institution undertaking, or preparing to undertake, work in this field, and who wishes to be put in touch with other research workers or with previous experiments of similar nature, is invited to get in touch with the WHO International Reference Centre, 13 Parkweg, The Hague, Netherlands. Information on Professor Huisman's study of European installations and the theory of biological filtration generally is also available on enquiry, either to the International Reference Centre or to the Community Water Supply Unit, WHO, Geneva.

As stated earlier, it is hoped to compile a detailed publication on the subject, and this Organization would be most grateful for information, photographs, costings and operational experience (including details of any particular difficulties encountered), especially as regards small installations and filters in use in developing countries."

WHO Community Water Supply Research and Development Programme. Background paper. "Biological" or "slow sand" filters, pp. 22-24. WHO/CWS/RD/70.1

"The World Health Organization, recognizing the problem as it applies to both the developing and the more highly industrialized of its member countries, has initiated a study with two objectives in view.

Firstly, to determine in which countries standards, test procedures, and arrangements for the control and approval of suitable treatment chemicals exist, and by comparison and exchange of information to assist these countries to coordinate their respective efforts in this direction.

Secondly, to produce, as a guide for other countries, suggested specifications, standard tests and other data based upon the experience gained elsewhere, to enable them toecvolve their own national regulations if they so wish.

WHO gratefully acknowledges the assistance it has already received from the Department of Health, Education and Welfare of the Government of the USA, and from the Ministry of Housing and Local Government of UK. It is also appreciative of the background information on research in this field that has been provided by the Water Research Association of Great Britain, which has evolved a test procedure for the determination of acrylamide in polyelectrolytes, which might well form the basis of a standard test with wider application.

The Organization now requests information from any other government, research institution or individual that has undertaken (or is undertaking) work on these lines, and would be most grateful if such information could be communicated to the WHO International Reference Centre for Community Water Supply, 13 Parkweg, The Hague, Netherlands.

This information will be compiled, compared and supported by laboratory testing in the Netherlands, after which it will be incorporated into a document which will be available to all who are interested in the subject.

WHO Community Water Supply, Research and Development Programme. Background paper, Health Hazards of Coagulent Aids, p. 10. WHO/CWS/RD/70.2

"From a distance it seems likely that profitable areas of study might include:

1. Methods of reducing wastage and wasteful usage of water - this might include the development of plumbing fixtures and appurtenances that use smaller quantities of water.

2. Development of appropriate design criteria - most textbooks suggest 100 g/c/d (400 l/c/d) as a water consumption design criterion. Is this realistic to the real needs of a water system? If it is not, what should be the value?

3. Terms of financing - how realistic is the 20 year design life of a distribution system as it affects financing and amortization? Would a shorter period be more appropriate?

4. Local manufacturw of materials - foreign exchange is too valuable to spend on materials which could be manufactured in a developing country. What technology transfere is necessary for the production of materials and equipment for water supply? Can plastics be adopted to a greater extent for pipe, fittings, fixtures, etc.? Does locally manufactured wooden pipe have any place in water supply?

5. To what extent can rates of flow through water treatment plants be increased to meet increasing demands?

6. Is the slow sand filter a thing of the past or does it have a legitimate place in developing country water supplies?

7. Can chemicals for disinfection be made cheaply and easily in a developing country from locally available raw materials? (Foreign exchange, again).

8. Many rural water supplies could be tremendously improved merely by applying elimentary sanitary proceedures. How can the constraints of lack of knowledge, culture and social customs be overcome to achieve the improvements?"

WHO International Reference Centre
for Community Water Supply
Meeting of Directors of Collaborating
Institutions
Bilthoven, Netherlands, 9 - 13
April 1973
"Research needs in WHO member states"
Background Document No. 1.

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Lausanne Seminar
29 March - 1 June, 1973

IDRC
Rural Water Supply
and Sanitation
May 1973

Working Paper No. 8

A COMMENT ON WORKING PAPER No. 1

Working Paper No. 1 sets out two main lines of opportunity for rapid improvement of rural water supplies: technological development and user-choice systems in a risk-benefit framework. This note is a suggestion for a third class of activity: opportunistic synergism.

Such activity implies the conscious search for complimentary and cooperative synergistic activity to which rural water supply development can be linked in such a way that both RWSD and the activity are mutually enhanced for the greater well being of the population involved. Four kinds of activity are of special significance: 1) the search for non-traditional sponsors or initiators of RWSD; 2) the opportunistic use of complementary development activities, compaigns and idealogies; 3) the employment of unconventional manpower; and 4) the creation of alternative forms of technical education and assistance.

Examples of these might include:

Non-traditional initiators - football clubs, industries, travelling distributors, churches.

Complementary activities - agricultural development, political parties.

Unconventional manpower - army, prisoners, science teachers

Alternative assistance - science curriculum units based around water.

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Lausanne Seminar
29th May - 1st June, 1973

Working Paper No.11

IDRC
Rural Water Supply
and Sanitation

May, 1973

SERIES FILTRATION USING LOCAL FILTER MEDIA

by

Richard J. Frankel, Ph.D.*

A paper presented on 8 June 1972, at the International Affairs Session, 92nd Annual Conference of the American Water Works Association, Chicago, Illinois.

INTRODUCTION

In the developed countries where labor is expensive, and capital relatively plentiful, the technologies are understandably capital-intensive and labor-saving. Developing countries are characterized by shortage of capital and abundance of labor, the latter usually untrained. The indiscriminate use of labor-saving technologies can only lead to aggravation of the unemployment situation already one of the major social and economic problems facing the developing world. Development and introduction of "appropriate technologies" is of prime concern if the developing countries are ever to share the benefits of improved living standards. The term "appropriate technology" is used to convey the characteristics required of technical innovations in both the industrialized and developing countries; that is, technologies should be appropriate to the resource endowment of the society in which the technologies are being applied.[1/]

In Southeast Asia economic development is closely linked with improved social welfare of the massive rural population. The technological priorities appear to be transportation, community water supply and rural

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electrification. To emulate the developed nations in providing potable water to rural communities, many nations have imported conventional water treatment (coagulation, sedimentation, rapid-sand filtration and chlorination) as a panacea for their rural health and water ills. For several reasons this has proved to be a disillusioning experience. Capital costs are high and each plant must generally be tailored to a local set of conditions. This means that design and construction are time consuming and require well trained personnel. In Thailand operational difficulties in rural communities were found to be more numerous: laboratory equipment was not available for daily or weekly jar tests to determine proper chemical doses; operators were not sufficiently trained to perform or understand coagulation jar test results; chemical costs were expensive in rural areas and operators often tried to cut back on chemical use to reduce water treatment costs; chemicals ran short and ordering in advance or obtaining additional chemical deliveries on time was not always a simple task in distant communities; without proper dosages the chemical coagulation-sedimentation portions of the plant operated ineffectively with the result that turbidity loads were almost entirely handled by the rapid-sand filters; understanding of why or when to backwash the rapid-sand filter was generally not known; proper sizing of sand was often overlooked during construction in some areas; good sand was difficult to obtain; and lack of sufficient operating funds often curtailed use of chemicals and limited plant operation to 4-6 hours per day of discontinuous production. These difficulties leave village leaders and villagers alike feeling cheated and deceived when what they received was seemingly an out of place and unworkable technology. Thus a proven technology in the developed world

is not necessarily an easily exported commodity for the developing countries. The need for a new approach is evident even in the seemingly well proven area of conventional water treatment. This paper deals with a suggested approach for treatment of surface waters in Southeast Asia - an approach which has been under test for two years at the Asian Institute of Technology, Bangkok.

RESEARCH OBJECTIVES

The high levels of organic pollutants and colloidal particles found in surface waters of Southeast Asia contribute to the health hazards endemic in the region. The role of filtration in the total water use - reuse cycle is essential and research was carried out to develop a simple inexpensive filtering system, using local filter media, for efficient removal of undesirable contaminants from water sources. Primary concern was for removal of colloidal and suspended particulates and microorganisms.

Various potential filter media were studied using local materials, including pea gravel, charcoal, coconut husks and rice husks. Sand was used as a control media for comparison. Single and series filter systems were studied.

LABORATORY EXPERIMENTS AND DESIGN

A six month preliminary study was carried out in search of efficient filtering material. Filter media were sought for both a primary or roughing filter and a secondary or polishing filter. Criteria for selection were abundance, ease of preparation, storage ability, filtering efficiency, service life, and low cost. Emphasis was placed on the natural state and size in which such materials were found locally in order to avoid complicated methods of preparation and to take advantage of simplicity in design and operation of the filters.

Use of the local materials as filter media for treatment of surface waters was carried out in two stages: stage 1 at high-rate filtration and high turbidities in the range of 100 to 400 JTU (Jackson Turbidity units as measured by a Hach turbidimeter); and stage 2 at slow-rate filtration and turbidities of 15 to 40 JTU. Stage 1 was carried out to establish the effectiveness of the media as roughing filters - that is, to remove a considerable portion of influent turbidity for a sustained period of time at low head loss. Removal of other pollutants was considered secondary. In stage 2 testing, the prime objectives were to meet drinking water standards of clarity and to test the bacteriological removal efficiency of the filter media. When necessary, synthetic turbidity, in the form of kaolin clay, was added to the influent river or municipal water to insure a constant range of turbidity levels. Laboratory filters, each with a cross sectional area of 180 cm^2made of clear PVC sheets, were connected to operate in either series or in parallel. These are shown in Fig.1. One filter was always used as a control slow-sand filter with standard size distribution of sand as control medium. Influent waters to all the filters were fed from an overhead tank which was filled with river water or canal (klong) water pumped from storage tanks. The photograph shows the series of laboratory tests made using different depths of burnt rice husks. The further two filters at the left were control sand filters. Depth of the filter beds varied up to 100 cm, except for the 70 cm depth of sand accepted as the design parameter for slow-sand filters. All media were supported by 30 cm of graded gravel.

LABORATORY RESULTS

The Primary or Roughing Filter

The most successful filtering material found for the roughing

filter proved to be shredded coconut husks. A photograph of the shredded husks and other media is shown in Figure 2. The raw husks are found throughout Southeast Asia and have little market value, except in isolated areas where the husks are shredded for packing material. Cost of obtaining the raw husk is generally transport cost only. In Bangkok, shredded coconut husks were obtained from a coconut mill for 2.5 cents (US) per kilogram.

In Figure 3, (after Sevilla, 1971)[2/] the effectiveness of shredded coconut husk as a filter medium is shown during one test covering 440 hours of continuous operation. Significant increases in influent turbidity did not produce corresponding increases in effluent turbidity once the break-in period had been established. The removal efficiency of the medium was well over 98 percent. Penetration of influent turbidity was substantially deeper than with other media. Clogging started at the top layer but the particulate matter penetrated deeper into the bed as the filter run progressed. The shredded coconut husk filter appeared to operate in a manner similar to an ion exchange column. Once the exchange capacity of the upper portion of the bed had been exhausted, influent turbidity was removed in the lower portions of the bed. It appears also that the fiber contains a natural polymer which aids considerably in removing colloidal materials by adsorption. Head loss build up is slow and is proportional to the depth of penetration of colloidal and suspended materials.

At higher filtration rates, up to 2.5 m^3/m^2/hour, turbidity removal efficiencies ranged between 80 and 90 percent. An accumulated head loss of 1.2 meters was used as a limiting criterion for duration of all runs. In no case did a deterioration in effluent quality occur prior to reaching

the limiting head loss. In Figure 4 (after Jaksirinont, 1972)[3/] the efficiency of shredded coconut husk is shown for various depths of filter media. At the filtration rate of 1.25 m^3/m^2/hour, removal efficiencies were continuously above 90 percent. Duration of filter run increased directly with increasing depth. Effluent quality was improved with greater depth of medium during the first hours of filter operation. Differences in effluent quality diminished, however, as the duration of filter run increased. The effluent from the roughing filter showed turbidity levels of less than 10 JTU and quite often were less than 1.0 JTU. The filters were operated over a 12 week period.

Operation revealed that the media was complicated to clean because of the deep penetration of particles into the filter bed. The coconut husk fibers would require complex cleaning methods as well as large volumes of backwash water. Thus wasting of media after clogging was more practical than cleaning and would be more applicable in rural operation. No backwashing of the filter was carried out. The need for additional valves, piping, a backwash pump and storage water tank was thereby eliminated. The availability and low economic value of the medium also favored discarding the husks rather than cleaning them. Ideal operation would require the operator to replace the filter media about once per month when the head loss through the filter reached 1.0-1.3 meters.

The Secondary or Polishing Filter

A secondary filter medium was required to polish the water to WHO drinking water standards (for turbidity, color and odor) and to improve microorganism removal. The most successful filtering material found for the polishing filter was burnt rice husks. Raw rice husks were obtained from local rice mills. The husks, which represent the largest milling

byproduct of rice, comprise about 20 percent of the paddy weight, and can be obtained free of charge on payment of transport costs or at a nominal price ($1-2 per ton). Most of the rice husks are disposed of as waste, although a small amount is used as fuel by the mills. The raw rice husk was easily burnt (having a heat content of about 600 BTU/lb) to produce an ash. The burnt rice husk ash was about 90 percent silicon dioxide, 6-7 percent oxides of magnesium, aluminum, calcium and iron, and the remaining 3-4 percent organic matter (mostly carbon). The medium showed a low density of compaction over a wide range of moisture contents, had a specific gravity of 2.3, a very high surface area to volume ratio, adsorption properties similar to activated carbon, small pore size and high permeability and very low cohesion, making the ash very suitable as filter material.

A slow-sand filter rate was used in applying water to the filter to insure longer contact time between the remaining organic turbidity and microorganisms and the filter medium. The long contact time reduced the chlorine dosage required for final disinfection of the effluent and insured a sparkling clear effluent of the highest drinking water quality standards.

Performance of the control sand filter and the burnt rice husk is shown in Fig. 5 (after Sevilla, 1971) using raw water from the Chao Phya River with an influent turbidity of 25 to 85 JTU. Operation was stopped when the head loss reached 1.2 meters. Throughout the length of run effluent quality was excellent, with a residual turbidity less than 0.3 JTU. Penetration of the filter medium was superficial, most of the turbidity being removed in the upper 2-3 cm. Thus, ideal operation would require scraping off the upper 3 cm of the medium about once per

month. Because the burnt rice husks are plentiful and inexpensive, discarding the medium after use appears far more attractive than washing.

Numerous tests at filtration rates of 0.1 to 2.5 $m^3/m^2/hr$ were made comparing burnt rice husks with sand as filter media. The results are plotted in Fig. 6 (after Jaksirinont, 1972). In all tests a 25-35 percent longer filter run was achieved using the burnt rice husks without sacrificing effluent quality. Thus it appears that the burnt rice husks can be substituted very effectively for sand in water treatment filters operated at slow to medium filter rates, and thereby eliminate the sizing problem associated with sand.

Chlorination of Final Effluent

Bacteriological efficiency of the combined roughing and polishing filters was generally on the order of 99 percent, indicating that a chlorine dosage of 1 mg/l would be sufficient to insure microorganism - free and palatable drinking water to the village. Even without chlorination, microorganism levels were greatly reduced.

CONCLUSIONS

The use of local materials, such as shredded coconut husks and burnt rice husks, as filter media in a series filtration system appears to be a very attractive and appropriate technological alternative to conventional water treatment in rural communities of Southeast Asia. When followed by a minimum dosage of chlorine the system can produce a sparkling clear potable water.

Savings from using the new media in a series filtration system will be realized by the elimination of chemical coagulants, reduction in chlorine demand, simple design and construction of the filter units, lower labor requirements, a lower level of training required for the operator,

and considerably lower operation and maintenance costs.

The preliminary data are sufficiently attractive to warrent pilot-scale research. It appears that an inexpensive simple filtration system to provide potable water can now be made available to a large segment of Asia's population.

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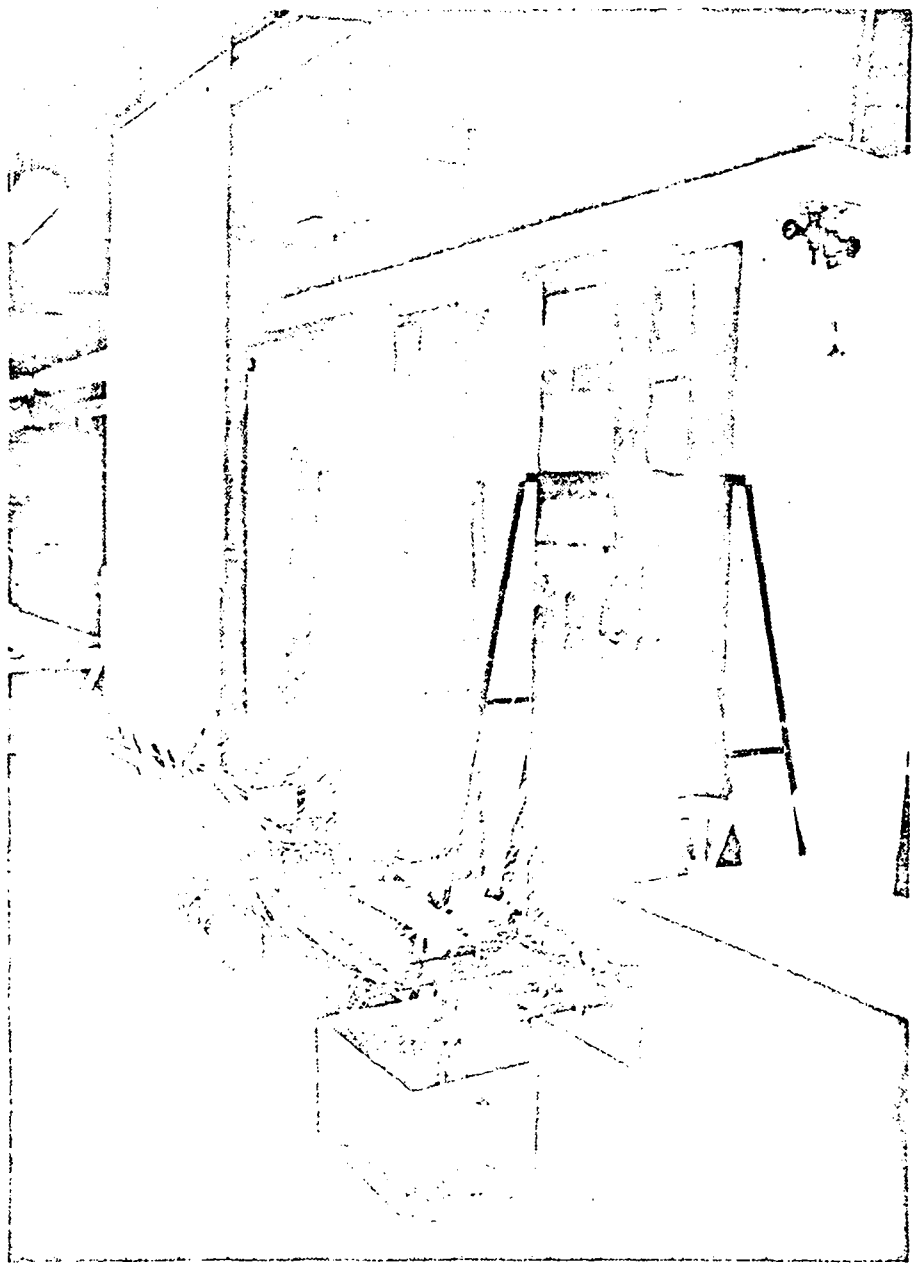

Fig. I Experimental Set-Up Showing Series Filters

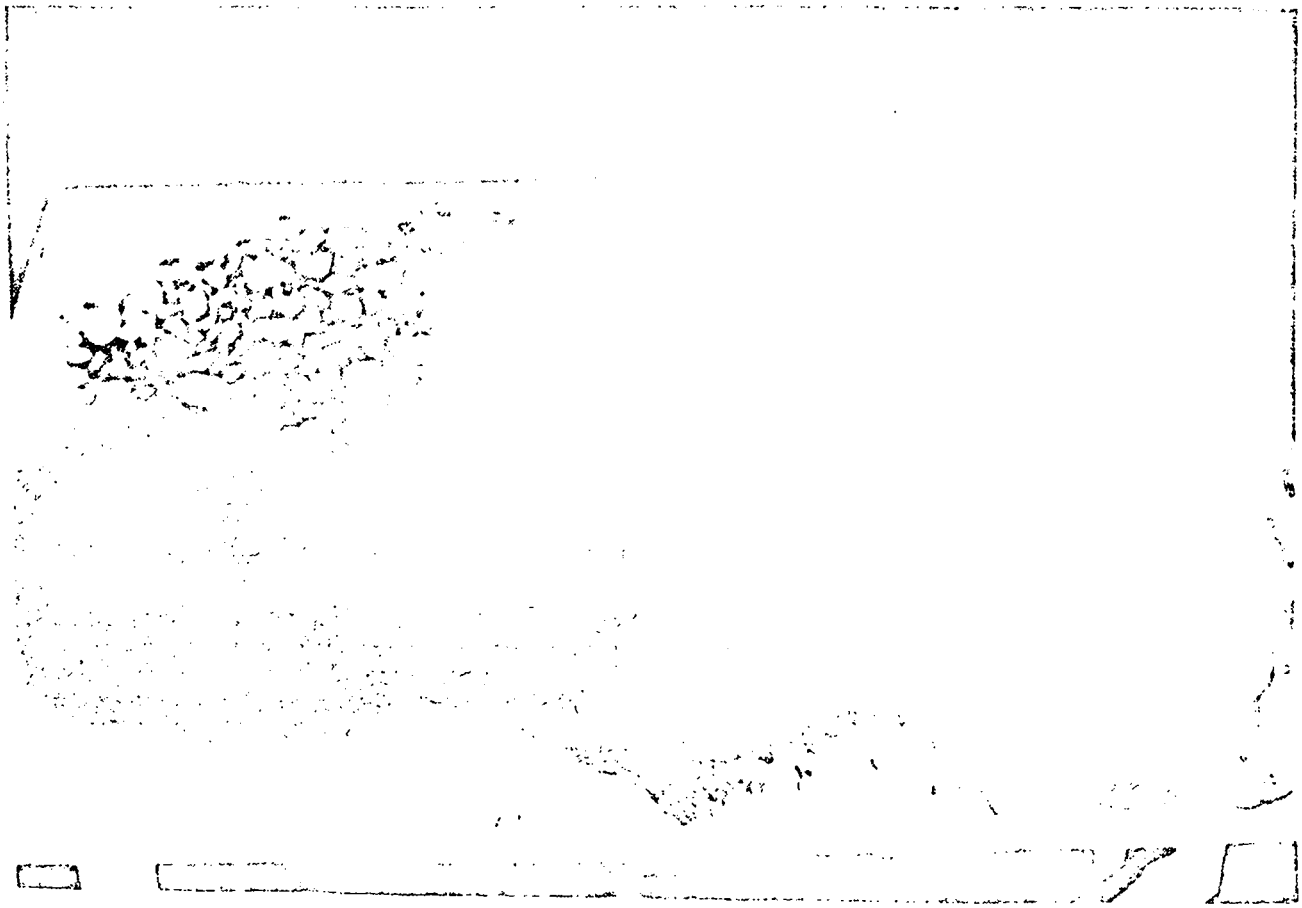

Fig. 2 Comparative Sizes of Filter Media
(from left to right 2nd. row: pea gravel, burnt rice husk, shredded coconut husk; 1st. row: sand, raw rice husk and unshredded coconut husk).

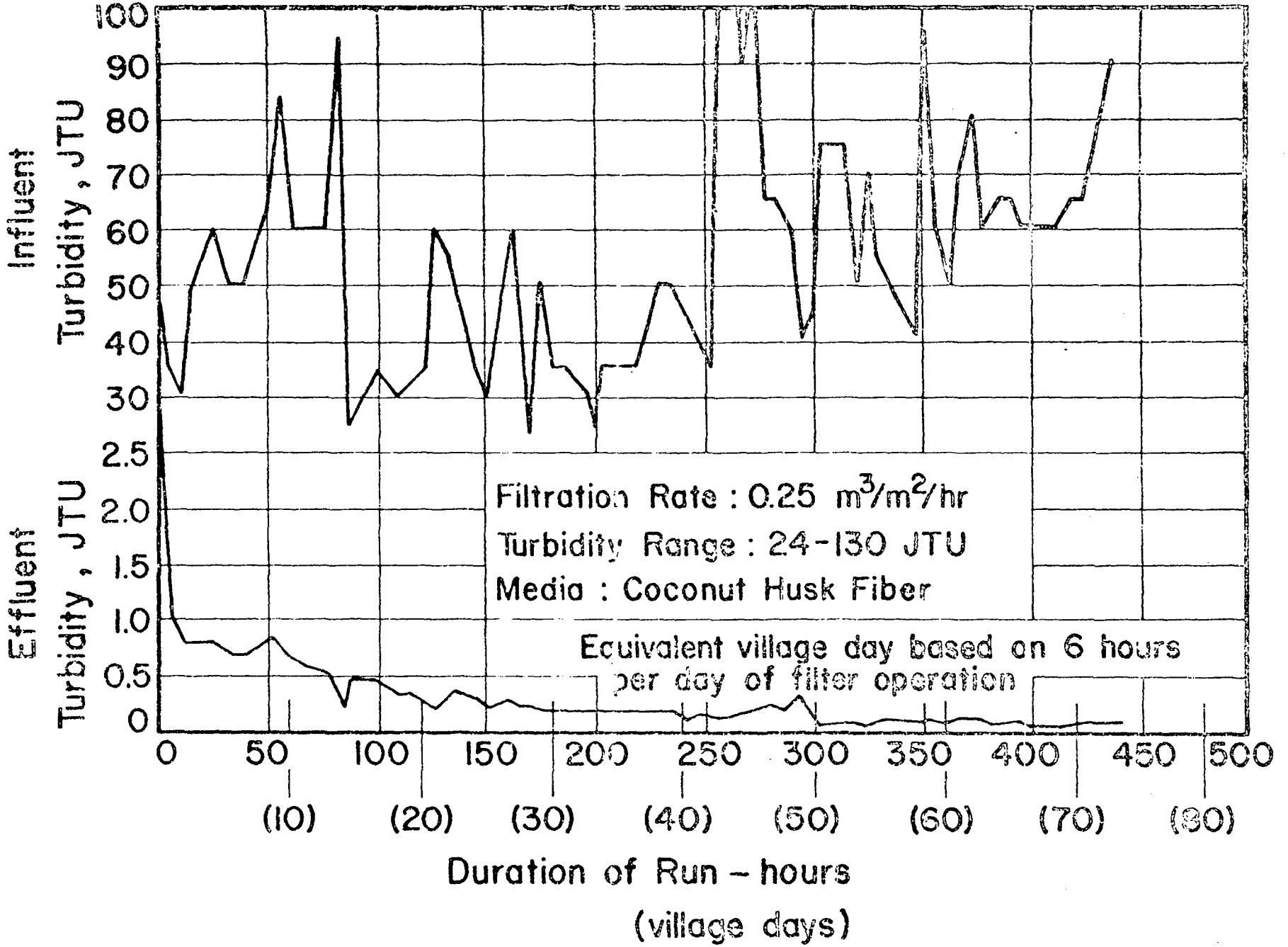

Fig. 3 Filter Performance of Coconut Husk Fiber at Slow Rate

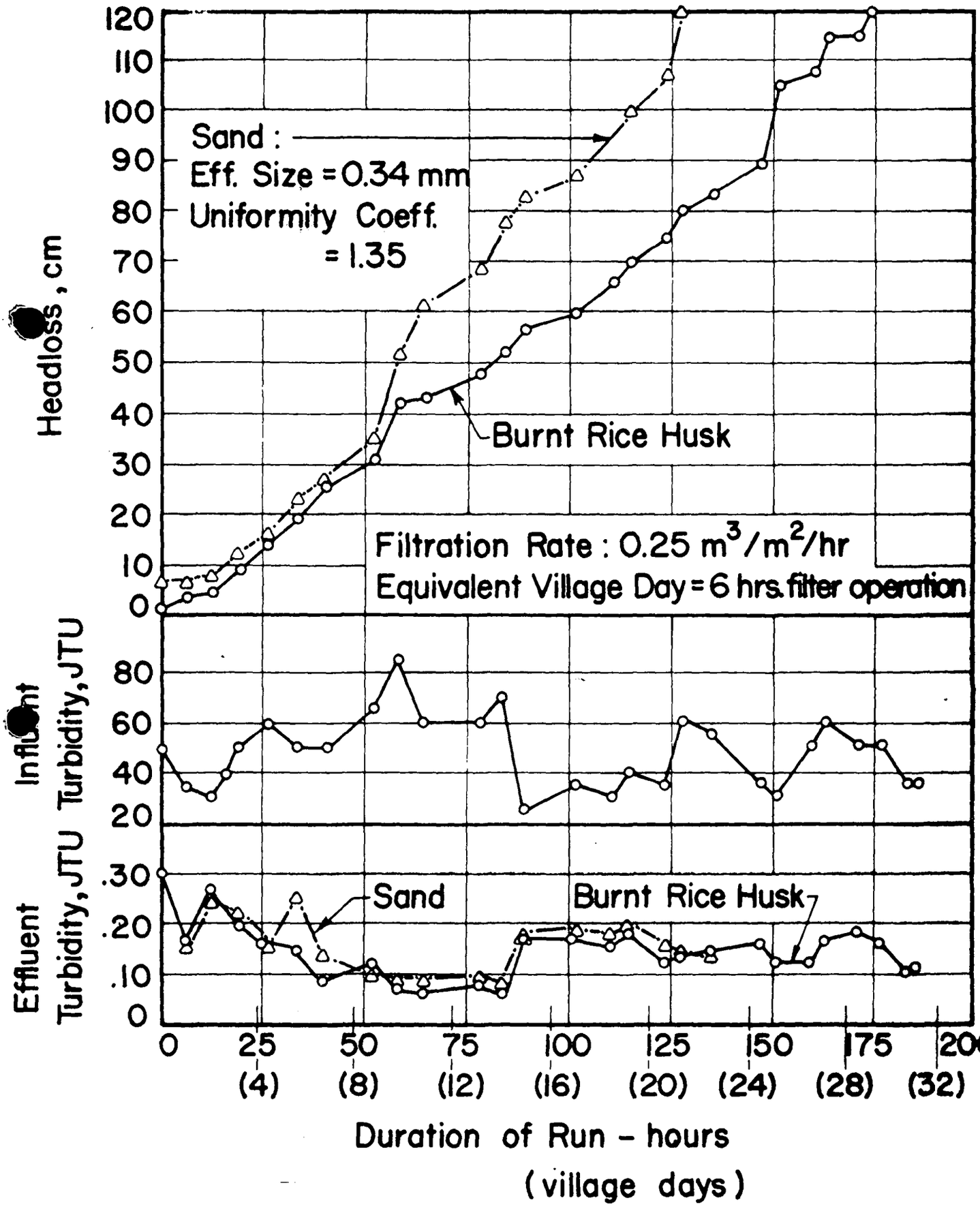

Fig. 5 Comparison of Sand and Burnt Rice Husk at the Same Filtration Rate and Influent Turbidity

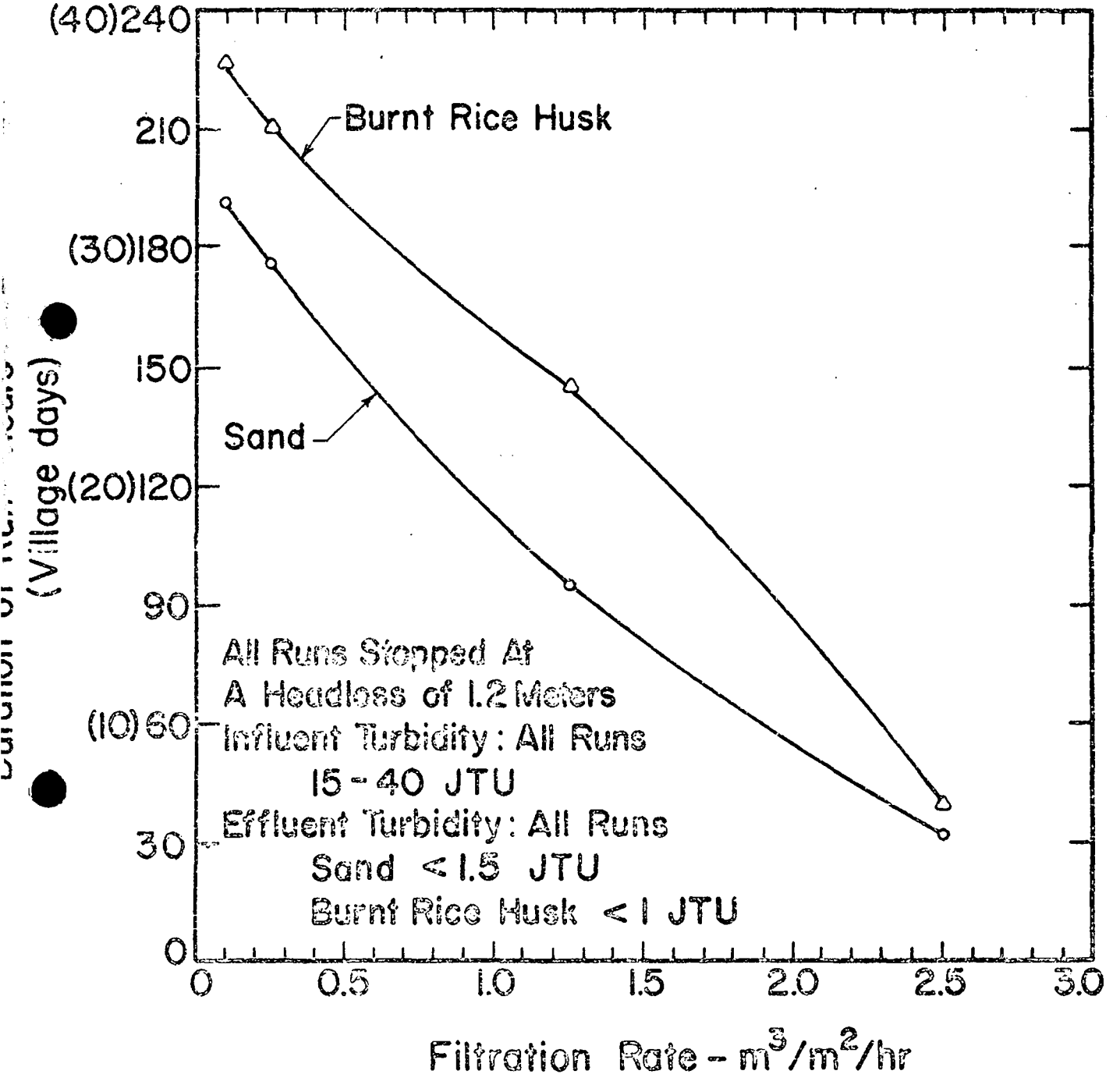

Fig. 6 Comparison of Sand and Burnt Rice Husk as Filter Media

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A SYSTEM APPROACH TO ASSESSMENT OF RURAL WATER SUPPLY PROGRAM EFFECTIVENESS

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ABSTRACT

Systems analysis was used to improve the methodology of impact evaluation by determining the role of resource constraints and complementary inputs in the development of the rural water supply program in Thailand. An impact evaluation was undertaken to analyse the effectiveness of the National Potable Water Project and to provide feedback to the government for improving the administrative, technical and operational aspects of the program. The methodology developed measured the social, economic and public health implications of the water projects towards achieving rural community development. The evaluation addressed the broad issues of whether the water systems have (1) had a positive effect on community attitudes towards the local and central governments; (2) fostered economic growth; and (3) had a significant positive effect on water use habits and on the overall level of community health. Data is being collected from some 165 village projects throughout Northeast Thailand.

INTRODUCTION

One of the fundamental problems facing developing countries throughout the world is that of providing water supply to rural communities. Scarce resources - budget, foreign exchange, skilled personnel and time - are the main reasons why this problem remains unsolved today and probably why it will continue to plague developing countries for the next several generations. These constraints require all countries to allocate their development resources in the most efficient, productive pattern possible.

Recent research at the Asian Institute of Technology (AIT) in Bangkok has explored several approches concerned with a particular way out of the dilemma: project and program evaluation, permitting the decision-maker to make maximum use of scarce resources by expanding his feedback loop of information based on the results of ongoing projects and development efforts.

The type of evaluation process chosen is called the ex-post evaluation or impact study, and is essential to developing countries in assessing the actual impact or output from development projects. Just as feasibility studies are necessary to evaluate the technical and economic acceptability of proposed projects, so are impact studies necessary to assess the economic and social effects of projects already undertaken. By comparing a completed project's actual impact with earlier predictions during the feasibility and planning phases, forecasting techniques can be improved. We can learn from impact studies where a particular project went wrong, why it did not produce the hoped for results. This will suggest corrective measures needed to vitalize a lagging project, or revisions to improve the composition of future projects of a similar nature. In addition, ideas for improving the technical aspects in both design and operation of the project will generally emerge. Successful projects present lessons as to what went right, providing insights for better selection and preparation of future efforts. This paper reports on the methodology developed to evaluate the effectiveness of Thailand's effort in providing potable water to rural communities and to demonstrate the improvements in impact evaluation made possible through application of systems engineering.

RURAL WATER SUPPLY IN THAILAND: A CASE STUDY

The Sanitary Engineering Division (SED) of the Department of Health is responsible for providing potable water to rural communities throughout Thailand. A regional Potable Water Project was started in 1966 as a major input to the development effort in the Northeast. By July 1972, about 165 potable water systems had been completed, serving some 357 communities with a total population of nearly 480,000. A map showing the general location of the projects is given in Fig. 1. Each project includes a treatment unit and a distribution system. The initial capital cost of these projects was approximately $3,600,000. In addition, considerable sums were spent in building-up and training a professional staff, purchasing and maintaining equipment, travel, village selection and administration of the program.

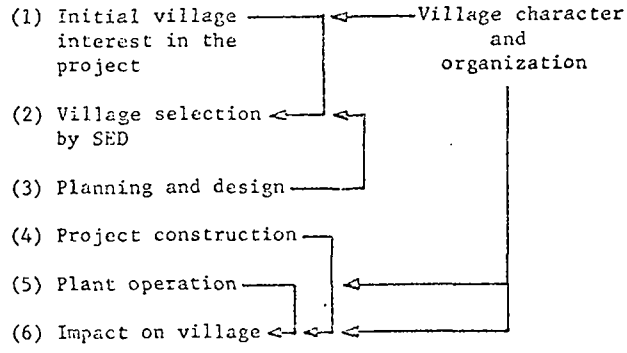
With an estimated 25,000 rural communities in Thailand still needing potable water supply systems, considerable future investment will be required if the program objective of eventually providing potable water to rural villagers throughout the Kingdom is to be realized. The Community Potable Water

Project has now been underway for 5 years. At this juncture, with major decisions pending as to the future scope of the Thai government's efforts in the potable water area, an evaluation of the overall effort in terms of its physical design and operational and administrative effectiveness was needed.

A comprehensive evaluation of existing plants and the overall water program was undertaken to provide information vital to improving the planning and decision making process. The investigation, financed by the Royal Thai Government and administered by SED through a contract with AIT, examined technical, operational and administrative factors related to the project's effectiveness. Objectives of the evaluation were to provide guidelines for design, construction, finance and administration of the potable water projects, operational guidance for management, information for training plant operators, and feedback on villager attitudes, water habits, water use and village development. Examples of the types of information needed to evaluate technical, operational and administrative effectiveness are given in Table 1. An equivalent of two man-years of labor was assigned to carry out the evaluation.

METHODOLOGY OF PROJECT EVALUATION

To insure that assessment of the Thai government's effort would be comprehensive, the entire potable water program was viewed from a systems approach. The official objectives of the program were first listed together with all measurable outputs from the program. Next complementary and hidden objectives were enumerated together with the factors affecting them. Several phases were delineated by a systems approach format and used to simplify interactions and identify variables affecting program success. Six of the project phases identified are shown below. The arrows indicate where feedback and interactions occur.



Within each phase all factors and individuals influencing decisions, including interactions between variables, were listed. Development of such lists required knowledge of agency regulations and guidelines, organizational and governmental hierarchies, financial constraints, trained personnel limitations, etc. Interviews with SED officials, personnel and advisory staff were arranged in order to obtain the needed information and data were also collected from SED files. In preparing the detailed lists discrepancies were found between agency regulations and practice, between professional guidelines and project realities. These discrepancies provided valuable insights into the actual operations of the program and highlighted potential weakpoints.

A detailed interaction flow-chart listing the factors that influence village selection is shown in Fig. 2. From this flow-chart the AIT researchers could more easily discern which factors were responsible for initial villager interest and what motivated participation of local government officials and SED. Selection criteria used to choose a specific village to receive a water project were identified. It was found that political influences far outweighed village water needs in ranking selection criteria. The influence of the village leaders on the next higher official in the line of communication shown in Fig. 2 was more important in getting village "A" a potable water project than the scarcity of drinking water was for getting village "B" a project.

During the planning and design phase, delineation of factors indicated that the agency focused on the question of how to most easily arrange village "A"'s water problem to fit into one of their known designs The approach provided expediency, simplicity and guaranteed the use of standard designs. However, differences between villages, such as geographic location, growth potential, water use, quality of water and availability of water source were minimized. Whether such differences should be secondary to simplifying agency tasks is a question this evaluation should answer. More flexibility in design criteria appears necessary if differences in village characteristics can offer cost savings.

COLLECTION OF FIELD DATA

In analyzing the operational phase of the program, the methodology chosen involved, first, visits to all completed water systems to assess their operations, obtain data on costs, maintenance program, level of operator training, frequency of breakdowns, reasons for breakdowns and breakdown duration, percentage of villagers using the system, complaints on water quality, and problems experienced by plant operators. These data were collected on card-coded forms, compiled on computer and analyzed by simple statistical methods. The output tables serve as updated inventory records for SED and provide valuable insights into maintenance program and village operator training needs.

As an example of the type of information obtained, Table 2 lists the recorded causes for plant shutdowns experienced during the last year. The list clearly illustrates the difficulties found in village plants - lack of funds to pay operators and maintain proper plant upkeep, poor training of operators and lack of understanding of how to repair broken parts, inability of operators to get spare parts, and the lack of a SED follow-up maintenance program.

Corrective action was initiated by SED this year partly as a result of the evaluation and a mainte-

nance program is underway incorporating present scheduling of visits to village plants by trained mechanics equipped with some spare parts. More detailed information collected this year will improve the development of the maintenance program and provide feedback for setting up an effective maintenance organization.

Initial contact with plant operators is continuing by use of questionnaires which the operators fill out each month and mail in pre-stamped, addressed envelopes to district headquarters. Thus the operator feels that he has re-established his contacts with SED, which otherwise were minimal after his training session. SED uses data collected on these forms as the basis for maintenance visits. The questionnaires, specifically designed for simple entry of data, are picked up by AIT evaluation researchers from the district offices. The data are transferred to forms for computer analysis; the monthly information collected from these 165 plants is now available in a data bank.

Based on initial data collected and tabulated by province, the second step was to select six typical village plants for an intensive plant operation and village impact study. These villages were chosen because of the water project's success or failure in technical operations and in obtaining continuing villager support. Intensive study of day-to-day operations is currently being made at these village plants. Plant output, water quality and operational problems are being tabulated. Interviews with villagers elicit their reactions, while AIT resident researchers are studying actual water use habits. Insights are being obtained into the following three questions: (1) Why were some plants successful and others not? (2) Why do villagers support the program in some villages but not in others? and (3) What factors associated with the water projects affect village water use behavior?

In one of these six selected villages, Ban Fang, where the water treatment plant is less than 12 months old, a comprehensive villager attitude and village status survey was conducted by AIT prior to the installation of the project. Results of the old survey shown in Table 3, are compared with Ban Phonsawang, a village of similar characteristics already having the advantage of a potable water project. This table indicates that water habits were very similar in both villages, sanitation practises were identical, the influence of the water project on water use was small; however, more frequent bathing, more water used for gardening, and an observed improvement in cleanliness in the households were apparent. A larger number of privies were also found in the village with the water system. A new survey of Ban Fang is now underway which will provide data over a three-year time period - data necessary to measure project impact and change.

INTERIM CONCLUSIONS ON PROJECT PLANNING AND EVALUATION

Success of the potable water system, both in providing clean water and in acting as a stimulant to broader community development, was found to depend to a large extent on three factors: (1) general compatibility of the system's technical design with local environmental conditions; (2) adequacy of administrative procedures adopted and (3) local operator efficiency. A deficiency in any one factor can result in system failure and public discontent. The evaluation study focused on these three factors, particularly on their relationship to success or failure of selected village water systems.

One of the principal conclusions from the impact study completed to date is that all projects in developing countries must be assessed (and designed) in a more comprehensive manner than has traditionally been the case. In particular, the concept of complementary inputs (other non-physical project inputs, such as villager education, operator training, etc.) needs to be emphasized if a development project is to attain the hoped-for impact. For example, it appears that provision of a community potable water system will not produce desired changes in village health and sanitation unless accompanied by a carefully-designed program of health education. The use of systems analysis in an impact evaluation will show whether or not these complementary inputs are missing from major infrastructure projects. Without them the changes in human behavior required to make the project work simply do not occur, or take place at a far slower rate than desirable.

Evaluation research in developing countries has been overly concerned with economic and technical aspects, neglecting the socio-political, psychological, institutional and administrative issues which in practice seem to determine project impact and effectiveness. Economic change is easier to measure than are changes in villager attitudes, rural behavior, or institutional performance. But since the latter are so often of overwhelming importance, they cannot be overlooked simply because they are difficult to handle, either conceptually or practically. Even though they cannot be readily quantified and placed in a single "rate of return" formula, the non-economic aspects of project evaluation must be explicitly included if these studies are to be of maximum value to decision-makers.

Finally, it has been observed in carrying out the evaluation study that the leadership group (operational personnel and decision-makers) should be directly involved in evaluation activities. These men must later use the results to alter program operations; if the leadership group is ignored or by-passed by researchers, they will react accordingly to the final report. The evaluation team must be certain to arrange periodic oral reports to learn of the specific concerns of the agency regarding the program under study. Such interaction will ensure that the research activities promote program change rather than report production.

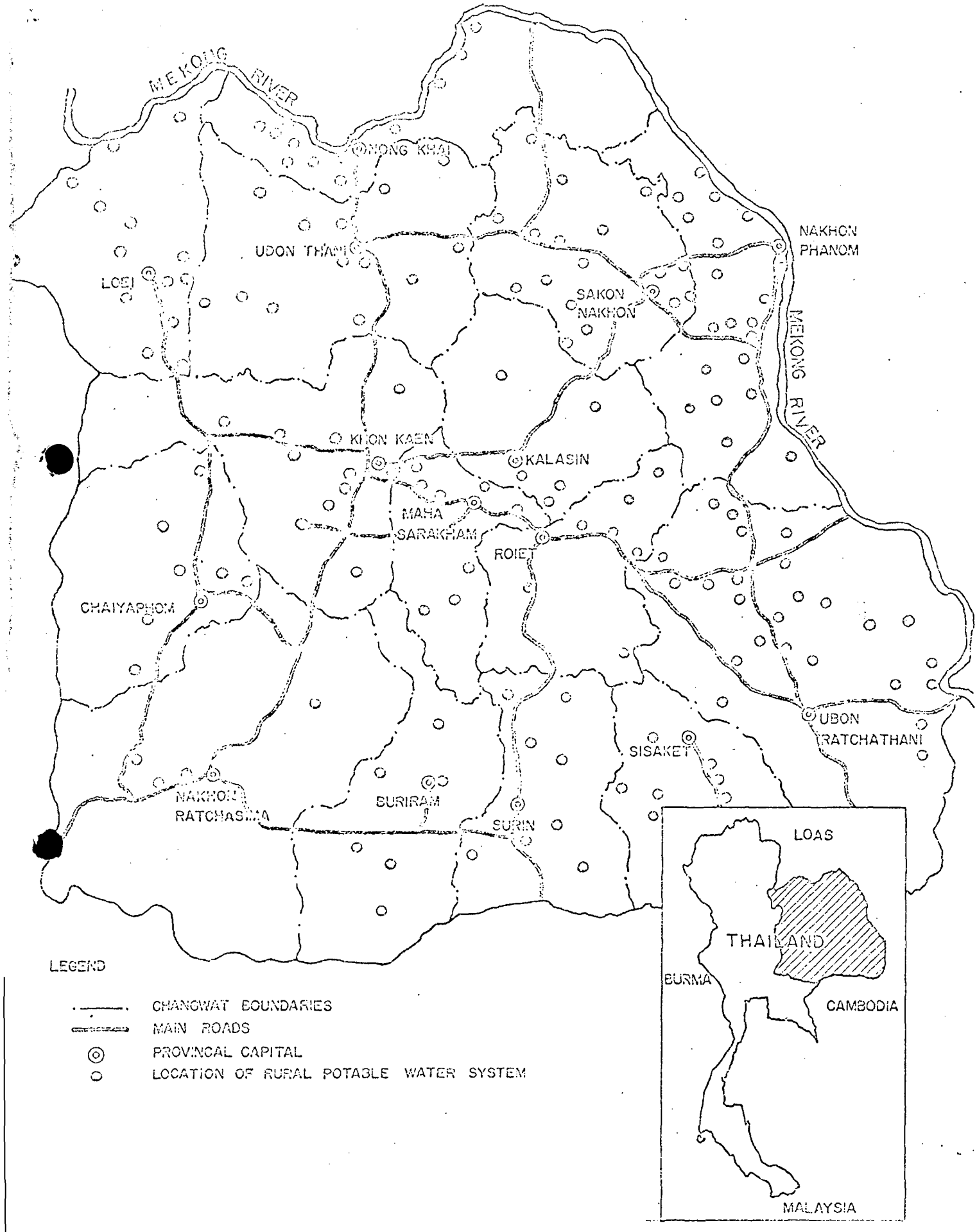
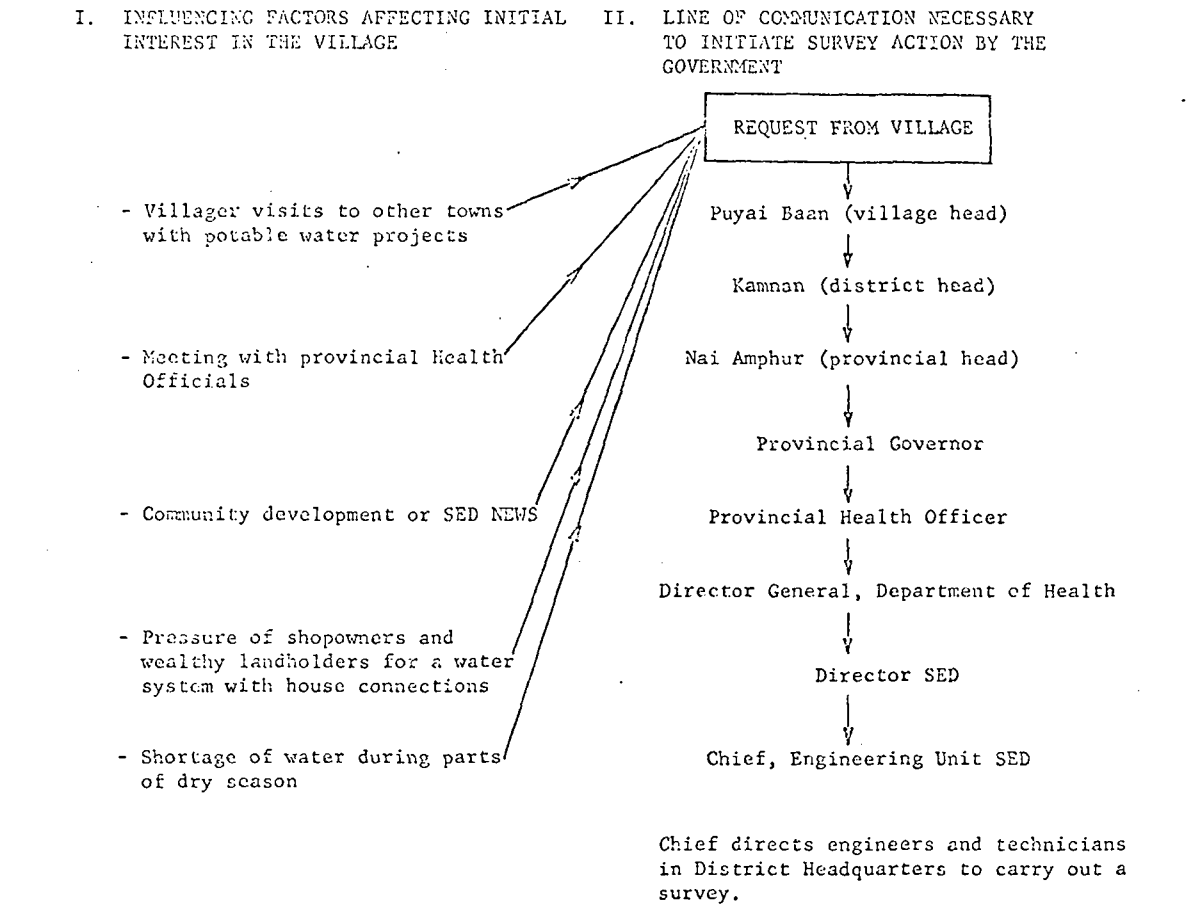


Fig. 1 –Map of Northeastern Thailand and General Location of Rural Potable Water Systems

Fig. 2 - Factors Affecting Selection Of A Thai Village To Receive Government Assistance For Construction Of A Potable Water Project



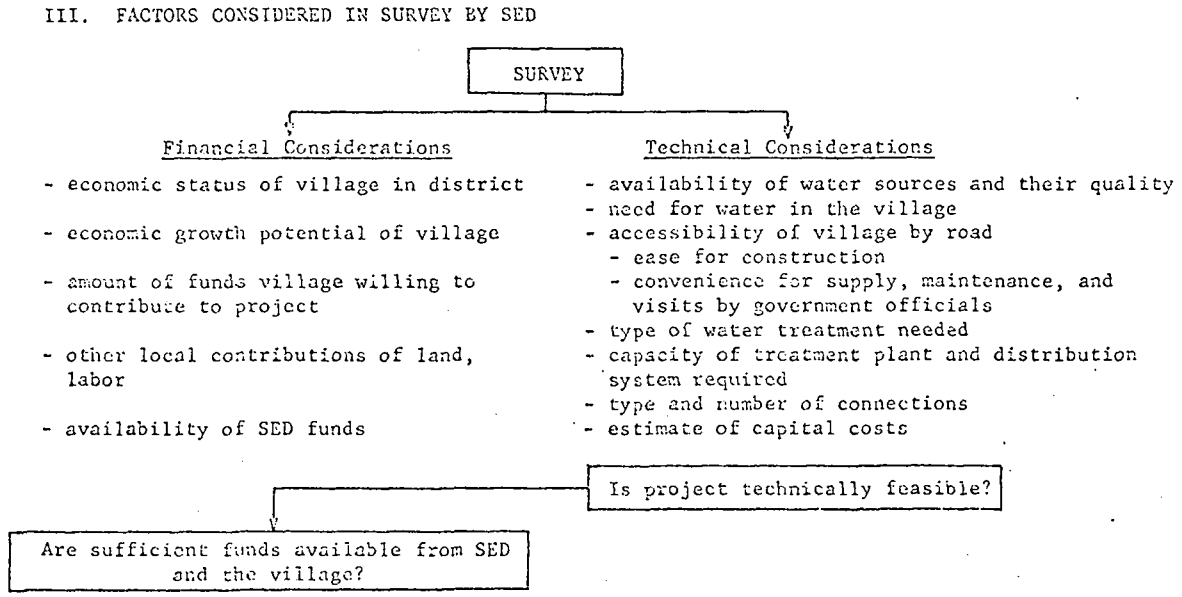


Fig. 2 - (Cont'd)

IV. POLITICAL CONSIDERATIONS INFLUENCING FINAL SELECTION BY SED

- political status of village in district
  - is the village in an advantageous position to receive a favor from government officials?
  - has the village received a development project previously?
  - number of government officials in the village
  - population
  - designated as a sanitary district?
- influence of political figures in line of communications (part II)
- insurgency potential of village
- other objectives of government's community development program
  - distribution of village projects within region, district
  - sequence and tie-in of project with other government development programs
- willingness of village leaders to contribute to project
- willingness of other villagers to contribute to project

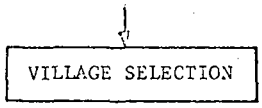


Table 1 - Factors Affecting the Efficiency of the Potable Water Project in Thailand

I. Technical Aspects

(1) Adequacy of preliminary studies
(2) Appropriateness of design criteria
(3) Water use - design standards versus actual use
(4) Technical design of the system
    (a) use of local village materials
    (b) use of imported items
    (c) suitability for construction under local conditions
    (d) suitability for operation under local conditions
    (e) maintenance considerations

II. Operational Aspects

(1) Selection of operating personnel
(2) Operator training and operator's salary
(3) Operating manuals
(4) Standard operating procedures
(5) Quality of service provided
(6) Operating records and reports
(7) Operating materials and supplies - gas and oil, chemicals, chlorine, etc.
(8) Maintenance procedures
(9) Maintenance supplies
(10) Operating and maintenance costs

III. Administrative Aspects

(1) Administrative procedures
    (a) project selection
    (b) project design
    (c) financial considerations
    (d) construction
    (e) operation

(2) Village administrative organization
    (a) appointment of representatives
    (b) collection of capital funds
    (c) collection of operating costs
    (d) rate making procedure
    (e) revenue disposition

(3) Administrative personnel
(4) Purchasing and warehousing procedures
(5) Construction bidding and supervision
(6) Charges for water service
    (a) water rates
    (b) other sources of revenue
    (c) collection of charges
    (d) disposition of revenue
(7) Procedures for system extensions
(8) Communications
(9) Public relations
(10) Villager education

Table 2 - List of Causes For Village Water Treatment Plant Shutdowns, Northeast Thailand, 1971-72 1/

	No. of plants
A. Economic Causes	
1) No financial support from the provincial government	1
2) Difficulties in collecting money from consumers	15
Because:	
- people poor	
- public fountains too far	
- villagers say that they go farming, don't use water	
- taps were broken	
- operator's work not efficient	
3) No salary for plant operator	13
4) Too little salary for plant operator; not enough to support family	10
5) Would like SED to give funds to pay for repairs, spare parts	3
6) No money to buy chemicals	14
Total	56
B. Technical Causes	
1) Inadequate raw water source	9
- water level too low	
2) Battery not charged	8
3) Pump broken	7
4) Quality of water not good (algae or salty taste problems)	2
5) Leakage of elevated tank	2
6) Inadequate pump power (not enough horse power)	4
7) Like to change benzine pump to diesel pump	12
8) No chlorinator	3
9) Public fountains broken	2
10) Like to change to electrical pump	3
11) Enlarge the elevated tank	2
12) Like to more floating intake pump to the bank, because the changing water levels affected intake	1
13) The filter rate is very slow; not adequate supply	3
14) Require main pipe to extent distribution system	13
15) Require repair tools	2
16) Require stand-by pump	1
Total	75
C. Education Causes	
1) Don't know how to mix chemicals and use	5
2) Like to know where to buy chemicals and other engine spare parts	8
3) Ask S.E.D. to tell the villagers of the reason for collection of water charges	4
4) Like S.E.D. to train operator once more	5
5) Require S.E.D. assistance	17
- where can locate an engineer or technician in case of problem	
- like S.E.D. to send engineer or technician to check the engine and operation of plant every month	
- how engineers, technicals can help improve plant operations or fix broken items	
6) Ask S.E.D. to educate the villagers of the advantage of potable water supply; in order to enlarge the number of consumers	4
Total	43
D. Management Problems	
1) Like S.E.D. to send officer to manage the water plant work instead of the village committee	5
2) Ask S.E.D. to issue operator identification; for convenience of getting chlorine from sanitary district offices	3
3) Village committee not faithful in collecting the water money	1
4) Don't like water plant to be village property	1
5) Operator left the work	1
6) Like to use metered system	6

(Continued).../

Table 2 - (Cont'd).

	No. of plants
7) Like to have S.E.D. technician stay at the plant permanently	2
8) Like to close all public fountains (so can collect more money)	2
9) Don't like to let the village head keep the collected water money; in case of engine problem, difficult to get money back	1
10) One operator cannot do all the work	1
11) Like to buy chemicals from S.E.D.	1
12) Like to have provincial officer collect the water money	2
13) S.E.D. sold operator an old spare part (instead of a new spare part)	1
Total	27

1/ Sixty-nine (69) plants out of 79 plants sampled (87%) experienced some difficulties in operation during the year. In some cases, several shutdowns of different causes were experienced at the same plant.

Table 3 - An Analysis of Water Habits, Sanitation and Health Conditions in Two Northeastern Thai Villages, 1971.

Factor	% of households in village	
	Ban Fang	Ban Phongsawang
1. Source of drinking water (dry season)		
- public shallow wells	98.0	100.0
- piped water	not available	exists but villagers do not drink it
- local surface sources	2.0	-
2. Boil drinking water everytime	4.0	3.0
3. Water used for washing		
- piped water	-	76.0
- shallow pond	100.0	18.0
- shallow well	-	6.0
4. Houses using above 200 l/day/family; %	34.0	52.9
5. Availability of privy	58.3	87.0
6. Washed hands before meal		
- often	46.0	41.0
- every time	39.0	34.8
7. Washed hands after going to toilet		
- often	42.0	45.5
- every time	32.0	30.2
8. Houses using water for gardening, watering trees; %	2.0	9.1
9. Houses storing more than 4 jars of water; %	25.5	33.4
10. Villagers taking more than 1 bath/day; %	68.0	92.4
11. Observed kitchen cleanliness		
- clean and rather clean	36.0	77.3
12. Often wash vegetables, fruit before eating	80.0	86.4
13. Eat meal with hands	73.6	60.9
14. Eat meat raw or not well cooked	53.7	57.2
15. After initial period of illness		
- but drugs themselves	43.9	62.1
- go to provincial Health Centre	11.4	3.0
- go to hospital, clinic	21.0	16.7
16. Incidence of water related sicknesses (within last year)		
Eye disease	6.9	5.7
Typhoid, Cholera	6.3	7.6
Kidney, bladder disease	13.8	11.3
Worm disease	3.1	4.7
Stomach or intestinal sicknesses	64.0	65.2
Skin diseases	8.2	7.6

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29 May - 1 June 1973
Working Paper no. 13

Draft May 1973

MEETING OF DIRECTORS OF INSTITUTIONS COLLABORATING WITH THE WHO INTERNATIONAL REFERENCE CENTRE FOR COMMUNITY WATER SUPPLY

Bilthoven, 9 - 13 April 1973

REPORT

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Summary

The present document forms the report of the Meeting of Directors of Institutions Collaborating with the WHO International Reference Centre for Community Water Supply and of representatives of bodies carrying out international programmes in this field. In chapter 2 a summary is given of activities of the latter bodies and of WHO.

In chapter 3 functions and activities of the Network for Community Water Supply are reviewed; in 3.4 specific methods concerning strengthening of the IRC, extension of the Network and improvement of communcation are mentioned, which were agreed upon by the Meeting.

Chapter 4 discusses some general aspects of problems of community water supply in industrialized and developing countries. In the 5th chapter 28 specific proposals for research and development and training programmes are listed, with an allocation of priority, given by the Meeting. Six projects - mentioned in chapter 6 - received a special priority: two on health aspects (water re-use and trace elements), two on rural water supply (slow sand filtration and transfer and adaptation of relevant technologies), one on the impact of community water supply and one comprehensive project on training programmes.

On the base of the outcome of the Meeting the WHO and IRC in consultation will take the initiative to start an international programme of action, to be carried out in collaboration within the international Network for Community Water Supply

Preface

A meeting of Directors of Institutions collaborating with the WHO International Reference Centre for Community Water Supply (IRC/CWS) was held at Bilthoven, Netherlands from 9 to 13 April 1973 at the National Institute for Public Health. Detailed planning and arrangements for the meeting were carried out by the IRC/CWS assisted by its host institute, the Government Institute for Drinking Water Supply at The Hague.

Mr. P. Santema, Director of the IRC/CWS opened the meeting and welcomed the participants. He expressed his appreciation to the Director of the National Institute for Public Health who had made the Conference rooms and other facilities available for the meeting and stressed the importance of this meeting, for the future expansion of the activities of the Reference Centre.
Mr. L.A. Orihuela, Chief Community Water Supply and Sanitation Unit, Division of Environmental Health, of the World Health Organization, welcomed the participants on behalf of Dr. B.H. Dieterich, Director of the Division. He thanked IRC's staff for the good work they had done in arranging the meeting and recognized that a number of the participants had travelled long distances with considerable personal inconvenience and expense. The interest thus shown was an encouraging indication of the prospects for success in the meeting and in overcoming the problems of community water supply.

The purpose of the meeting was to review and evaluate the work of the IRC/CWS and its associated institutions, to develop an administrative and operational strategy to overcome any weaknesses identified in the evaluation and to assess the needs in community water supply, with the allocation of appropriate priorities for implementation of research, development and training programmes.

The meeting was considered to be of considerable importance to the various organizations represented. The International Reference Centre is believed to have overcome most of its early problems and the view can be taken that the network of Collaborating Institutions of which it acts as the nexus, is now in operation. The meeting provided an opportunity for the establishment of a realistic policy outline within which future activities may be formulated.

An area of particular emphasis was the review of research needs. Many of the problems of water supply in developing countries might be solved by the application, adaptation or innovation of relatively simple technology. The task in this area, therefore, was to explore the ways and means by which information on such technology might be collected and disseminated in a useable form. This tacitly recognized unalterable relationships among research and development, the dissemination of information on research findings and the training of workers for research and its application to practice.

1. Introduction

Much progress in community water supply has been achieved since the establishment of WHO in 1948. However, much remains to be done. A recent study*) shows that in order to reach the water supply targets of the Second United Nations Development Decade some formidable obstacles will habe to be overcome. The target is to provide all urban dwellers with safe water supplies, 60% by house connections and 40% by public stand posts, and to provide reasonable access to safe water for 25% of the rural population. The target date for these achievements is 1980 and the estimated costs are $13,200. millions. The size of the task is almost incomprehensible.

Especially sensitive are those areas described as rural. Data concerning 1970 conditions indicated that only 12% of rural people had access to safe water. Population increase, however, far outstrips the planned rate of water supply development. Reaching the 1980 targets will produce an improvement in the percentage served but even so there will be 50 million more rural people without water than there were in 1970.

Developing countries are also being confronted with a host of problems arising from rapid urbanization. The migration of rural people to urban areas has resulted in the uncontrollable growth of most peri-urban settlements on the fringes of every city. These settlements are characterized by substandard housing and inadequate sanitary services. Frequently the basic essentials for sanitation - water supply, excreta disposal and refuse disposal - are totally lacking. This unplanned and uncontrolled fringe growth creates a critical hazard to the public health. The problems of water supply in developing countries are compounded by two major factors, which, although not unique to developing countries, are more intense than in industrialized countries. These factors are inadequate allocation of finances and shortages of skilled personnel. It is not surprising therefore that some of the common characteristics which apply to the basic sanitation services in developing countries include:

- absence of national environmental health programmes within health ministries,
- inadequate, or no, legislation, regulations, standards, criteria or codes of practice relating to water supply,

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*) Community Water Supply Programme. Progress Report by the Director General (1972) (WHO Document A25/29)

- incompetent administration and management of water supply programmes and facilities,
- unsatisfactory and unsound fiscal structures for financing of water supply projects,
- insufficient information on water resources and existing water systems,
- lack of interest in research and adaptation of technology to overcome local difficulties and to maximize the utilization of available resources.

2. International Programmes in the Community Water Supply Field

2.1 The WHO Community Water Supply Programme

Water supply forms an important element of the WHO programme in environmental health *).

Community Water Supply together with related activities for the improvement of basic sanitary services are considered to be an essential prerequisite for the prevention and control of communicable disease and the promotion of physical, mental, and social well being. The role of WHO is to provide direct assistance to governments in achieving national objectives, the collection and assessment of data on sanitary conditions, the preparation of documents for the dissemination of information and the stimulation of research and development activities. Assistance to governments takes a number of forms, the supply of experts to advise on and assist in programme implementation, the supply of fellowships, assistance toward the financing and staffing of institutions for the training of sanitation personnel are some of the most obvious forms of assistance. WHO works cooperatively with other international organizations and agencies, particularly when projects have an interdisciplinary character.

More specifically, WHO assigns, on request, experienced staff to work with national couterparts on the various tasks where assistance is needed. These assignments are frequently of a two year duration and the terms of reference are specific to the needs consistent with an overall programme. Within the subject of water supply, the most frequent assignments relate to national water supply programmes and the training of personnel. Technical and administrative support is supplied by WHO Regional Offices and WHO Headquarters. Large urban projects often attract assistance from international organizations such as the United Nations Development Program. On these projects, WHO acts as a contractor, supplying a project manager and retaining the technical services of an internationally selected consultant on a sub-contract basis. A fairly recent development within WHO is the conduct of sector studies wherein a team comprising technical, administrative and financial expertise will conduct a situation evaluation within a developing country. The comprehensive report which results provides government with the background information so essential

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*) Problems of the Human Environment, Offical Record of the World Health Organization, 1971, No. 193, Annex 13.

for decision making.

Data collection and assessment has a vital place in the WHO programme. At the country level it permits national country planning. On the global level it provides the basis on which WHO and other international organizations can establish priorities and allocate resources. This is especially important to donor countries within the international family who must allocate funds to bilateral as well as international aid programmes.

Training of technical personnel is accomplished by two main methods. The assignment of WHO staff to assist in the implementation of national programmes has already been mentioned. Most WHO sponsored projects include a training component wherein fellowships are provided for national staff who have already reached some level of accomplishment. Candidates for fellowships are selected by the national government and WHO attends to the detailed arrangements of travel, training programme and payment of stipend for the duration of the fellowships. Many hundreds of persons have received training in water supply under WHO auspices.

Research and development in water supply is conducted through the International Reference Centre for Community Water Supply and its affiliated network of Regional Reference Centres and Collaborating Institutions. The WHO financial support of this arrangement is minor - perhaps inadequate - the major cost of supporting the IRC/CWS is borne by the host government. The network serves to stimulate and catalyze research and development activities and to disseminate research findings and other information which is specific to developing country needs. In addition, contractual technical services agreements are made with collaborating institutions for the conduct of specific research projects. These projects aim at simplifying water supply facilities by the adaptation of existing technology, at the utilization of local materials and skills, at the collection and dissemination of scientific information and at the development of criteria and guidelines for water supply practice. The training of research workers is also included under the mantle of research and development. Many of the collaborating institutions have some form of training as an essential part of their ongoing activities and these provide an excellent opportunity for workers from developing countries to expand their knowledge and technique of research methodology.

The publications of WHO are another method whereby assistance and information are made available to developing countries. These publications are meant to supplement the many books and periodicals available through normal commercial sources and usually are oriented toward developing country situations. Several techniques are used for their initial preparation; the most common are preparation by an individual author under a contractual arrangement and the calling of a meeting of experts to discuss and prepare a report on a specific subject.

2.2 Activities of WHO Regional Offices

Regional Offices have the direct responsibility for all aspects of implementation of programmes at the country and inter-country level. Regions also cooperate on the implementation of inter-regional programmes and collaborate with Headquarters in these as well as in programmes that have global aspects. Water supply is a functional responsibility of the Regional Advisor in Environmental Health. In one region - the Eastern Mediterranean Region - there is a Regional Advisor in Community Water Supply.

The Regions have the authority to initiate research and commission the preparation of documents for publication. The European Region which was represented at the meeting,has published, for instance, European Standards for Drinking Water and has a number of research studies in progress. In this Region major emphasis is directed towards projects most directly related to pollution and pollution control.

The Region of the Americas is unique in that the Pan American Sanitary Bureau plays the dual role of Secretariat for the Pan American Health Organization and Regional Office for WHO. This structural arrangement is reflected in a high degree of internal dependance for most aspects of the Bureau's activity. Most of the programmes are directed toward Latin America and most of the publications are produced in the Spanish language. An important and unique departure within the region has been the establishment in 1968 of the Pan American Centre for Sanitary Engineering and Environmental Sciences (CEPIS) which was represented at the meeting by its Director. This Centre is at Lima, Peru and is financed by the Pan American Health Organization. The government of Peru provides an annual grant and, in addition, CEPIS earns fees

from governments within the Region who use its facilities. The Centre collaborates with the countries in the strengthening of their scientific and technical infrastructure, mainly by supporting research and training and education, improving the communications among scientific workers and other technical people and the provision of technical and scientific support. Special attention is being given to the development and application of more efficient methods of water treatment, to the technical improvement of laboratories for the control of water quality and water resources. Some written outputs of use also outside the Region, have been a series of manuals e.g. on treatment methods, on water meters, and many others.

2.3 Activities of other Organizations represented at the Meetin

1. African Development Bank (ADB)
   Abidjan, Ivory Coast.

   Since its inception in 1964, the Bank has given due importance to investments in the fields of water supply and sewage disposal. The Bank is promoting the advisability of long term planning by means of a master plan, and set an order of priority for implementation of the viable projects. Pre-investment studies include preparation of a master plan, feasability and preliminary engineering studies, in some cases also detailed engineering for the first phase of the master plan; they could also cover organization, management, financial and legal aspects for the water and sewerage undertakings. These studies can be financed out of the Banks ordinary resources on a loan basis or as a grant. Implementation of construction has been limited, the conventional terms of bank loans being a constraint.

   An agreement for establishing the African Development Fund, which should be operational by October 1973 and providing a possibility for granting soft loans, will increase the capability to deal with projects in environmental health of social character which could not support financing on conventional terms.

   The lack of qualified nationals to provide the required background information and statistics for the formulation of

bankable projects and take over the running facilities after construction, is very much felt. Training institutes in the developing countries should therefore be set up.

2. The National Institute of Public Health (RIV)
Bilthoven, The Netherlands.

This Institute has been founded by the Netherlands Government as a centre for the public health laboratory service. It has the task to direct the activities of the Ministry for Public Health and Environmental Hygiene to the detection, control and prevention of diseases caused by prominent noxious agents. It also takes an active part in relevant biomedical and environmental research projects, such as operating a nation wide surveillance system with regard to the hygienic properties of the environment (air, soil , water, noise).
For the surveillance of communicable diseases a network of 16 regional laboratories for public health is spread over the country.
The Institute has been designated by the government as the national institute of biological standards and reference preparations.
Toxicity testing and determination of residues of pesticides, etc. is one of the major activities of the institute.

3. The International Bank for Reconstruction and Development (IBRD), Water Supply Division I, Washington, D.C., U.S.A.

The World Bank is financing projects which assist economic development of developing countries. As the conventional terms of bank lending make these loans unattainable for many countries, the International Development Association (IDA) was established in 1960 to provide development capital at easier terms (soft loan). In the Water Supply and Sewerage sector, well justified rural water projects also merit Bank support, although in the past emphasis was on projects in urban areas where public health effects are greatest and economic criteria can be met. Bank assistance may include evaluation and help improve water and sewerage programs, strengthen institutions, improve project selection, preparation and execution and help finance the more important and complex programs.
In allocating scarce funds, better criteria and measures of economic benefits, should be developed; other research inte-

rests are to improve water demand analysis and forecasting and to identify pricing policy options.
Bank cooperation with the World Health Organization is in pre-investment studies for water and sewerage projects which are financed by the United Nations Development Program and for which WHO has been designated "Executing Agency".

4. The International Water Supply Association (IWSA)

The IWSA was created in 1947. Amongst its objectives are to secure concerted action in improving the knowledge of public water supplies, to secure a maximum exchange of information on research and on methods of supply of water, and to encourage better understanding between people engaged in the public supply of water. In furthering these objects the Association holds an International Water Supply Congress every 2-3 years. Until now 9 congresses were held, all in Europe, except the one in New York in 1972. The next congresses will take place in Brighton, U.K. (August 1974) and Amsterdam (1976). Two Standing Committees of the IWSA are of direct importance to the Network for Community Water Supply:
a. The Standing Committee on Education and Training of Waterworks Personnel (represented at the Meeting) was created in 1970; the objectives include the encouragement of an international exchange of information on education and training matters and the establishment of a bank of knowledge on this subject; the consideration of new developments in this field; and - lately - the stimulation of application of the existing knowledge and methods to developing countries. The first activities concerned the establishment of an international glossary of terms and a review of job descriptions, and the establishment of training needs in a number of countries.
b. The Standing Committee on Problems of Water Supplies in Developing Countries (not represented at the Meeting) in operation since September 1972, aims in general at the stimulation of dialogue between the Western countries and the developing countries on water supply matters and at the stimulation of scientific and technical assistance to water supplie in the latter countries.

5. University of Oklahoma Research Institute
Norman, Oklahoma, U.S.A.

In the Institute's Less Developed Countries' Water and Waste treatment program, an A.I.D. sponsored 3 years program on "Lower Cost Methods of Water and Waste treatment in less developed countries" is being undertaken. Most promising and applicable techniques and systems of providing and maintaining simple lower cost water and waste treatment facilities will be determined and verified by actual field demonstrations. For these practical field studies regional centres will be selected, capable to provide assistance to other locations in their respective region.

6. University of Toronto, Institute of Environmental Sciences and Engineering, Toronto, Canada.

A study is being undertaken of the present-state-of-the-art in rural water supply and sanitation in developing countries, with the support of the International Development Research Centre in Ottawa and in collaboration with the Organization for Economic Cooperation and Development.
Crucial points in the improvement of rural water supply and sanitation conditions in developing countries will be assessed and evaluated in order to arrive at a plan for increasing the rate of progress in this field. Critical issues to be further investigated are quantity (criteria in various countries under varying conditions) quality (what standards is it essential to meet) and technology (which is the most suitable that can be adopted on a broad scale).

7. U.S. Agency for International Development,
Washington, D.C., U.S.A.

The Agency was established in 1961 as an agency within the Department of State to carry out development assistance programs overseas designed to promote the economic and social modernization of developing countries. Most programs operate on the basis of bilateral agreements with the assisted countries in which the latter should take the active application step.

The programs comprise: 1. Technical Assistance through assignment of technical experts, participant training, research 2. Capital assistance 3. Commodity assistance 4. Sector assistance, 5. Supporting assistance.
Financing is provided as Development Loans or Development Grants (f.e. through the African Development Bank) for pre-investment studies.
Among the 450 projects underway around the world, 30 are concerned with water supply. Some 3000 relevant publications are being distributed to meet requests from the field. In the research sector the following subjects are being studied: Optimum size of small water supplies; Control of schistosomiasis; Development of a handpump; Lower cost methods of water and waste treatment.

8. Office of International Health, U.S.A. Department of Health, Education and Welfare, Washington, D.C., U.S.A.

The Assistant Secretary for Health in the Department directs activities of the Public Health Service; provides health policy direction for and coordinates all health and health-related programs in the Department, coordinates the health and health-related functions of the Department with those of other Federal agencies and provides advice and assistance on health matters to such agencies as requested; provides advice and technical support to international health organizations and has major staff responsibilities in the fields of health and and medicine, population dynamics, scientific affairs and international health activities.
The Office of International Health serves as the official contact with WHO, PAHO and other organizations for the U.S. Government on health matters. It is working closely with AID in different fields (population matters, environmental health, health planning), also in its research programs e.g. on lower cost methods of water and waste treatment.

9. The WHO International Reference Centre for Wastes Disposal, Dübendorf, Switzerland.

To foster the program of WHO in the wastes disposal field, the Federal Institute for Water Resources and Water Pollution Control (EAWAG) at Dübendorf was designated in 1968 as International Reference Centre for Wastes Disposal. Operation is

in cooperation with Regional Reference Centres (to date 1) and Collaborating Institutions (up to now 44) located all over the world. Through this network, coordination of research and development programs, exchange and dissemination of technical and scientific information are aimed at, finally assisting particularly developing countries, to construct their wastes disposal systems in a more efficient and more economic way. In its training function, the training of research and other personnel, preparation of guides, codes of practice, training manuals and courses and seminars for participants from developing countries are intended.

3. The WHO International Network for Community Water Supply

3.1. The International Reference Centre

Within the framework of the WHO-programme mentioned earlier, it is IRC's objective to consolidate efforts directed to the improvement and development of water supplies, in both industrialized and developing countries. In connection with the serious problems in the latter - as described above - a great deal of IRC's activities will apply to this category of countries, withi the context of the targets of the Second United Nations Development Decade.

The IRC endeavours to fulfil its objectives as the nexus of the worldwide network of Collaborating Institutions. The activities are carried out in cooperation with its host Institute, the Netherlands Government Institute for Water Supply, as well as many other organizations and institutions in and outside The Netherlands.

The targets of the IRC fall under three main headings:

1. Information exchange. The collection and dissemination of information on community water supply, including the transfer of knowledge to developing countries, and the preparation of codes of practice, training manuals and state-of-the-art papers.
2. Research and development. The inventory of research needs and institutional facilities, and the promotion and conduct of research and development in all aspects of community water supply.
3. Training. The training of scientific and technical workers and others by the planning and implementation of courses and the exchange of research workers.

It has already been proven that the International Reference Centr with its network of Collaborating Institutions, can deliver a valuable contribution to the improvement of lacks of communication existing all over the world, and through this can accelerate the activities leading to better water supply services. It provides an appropriate infrastructure to make possible the coordination of research and development and training programmes and to

assist in the transfer of existing technology from industrialized to developing countries. Yet a number of constraints has delayed the desirable increase of potentiality of the IRC. It is however expected that the present considerations of the organizational and financial structure of the IRC by the Dutch Government will result in a sound Centre that will be able to assist and take the lead in the implementation of programmes based on needs brought forward at the International Conference on Research and Development in Community Water Supply, in Dubrovnik in October 1970 and at the present Conference.

As one of IRC's activities so far, can be mentioned the Newsletter which appears to be a useful medium for the dissemination of information of general interest and for the exchange of news between IRC and the Collaborating Institutions as well as many other institutions and organizations. At present the Newsletter has a monthly circulation of approximately 2500 copies in English and 2200 copies in French. A provisional agreement was made with the Pan American Center for Sanitary Engineering and Environmental Sciences (CEPIS), Lima, Peru, concerning translation into Spanish and dissemination in Latin America. Apart from that more than 10 periodicals regularly quote items mentioned in the Newsletter.

Another regular series is the IRC-bulletins, giving reviews of institutional facilities, training programmes and research activities at Collaborating Institutions and other organizations. A general paper "Information on Collaborating Institutes" (1970) and four bulletins have been issued so far.

Bulletin no. 1: "Community Water Supply Research 1971" (1971)
Bulletin no. 2: "Training Courses in Community Water Supply" (1971)
Bulletin no. 3: "Community Water Supply Research 1972" (1972)
Bulletin no. 4: "The story of CPHERI" (1972).

In the IRC technical paper series in which scientific and technical information is being published was issued:
"Plastic Pipe in drinking water distribution practice" (1971), a bibliography, which will soonly be followed by a second paper on this subject: "Plastic Pipe Standardization". In preparation is a report of a meeting of a Consultant Group, convened by the IRC

(with WHO as sponsor) in February 1973 in The Hague on the toxicity of new water supply materials, under the title "Health Aspects relating to the use of uPVC pipes for Community Water Supply". Emanating from the same meeting a report will be published on "Health Aspects relating to the use of polyelectrolytes in Water Treatment for Community Water Supply". Representatives of 7 Collaborating Institutions, together with other experts took part in these meetings.
On behalf of WHO a study on disinfection of water in wells and village tanks using iodine dosing devices was carried out together with CPHERI, Nagpur, India and published upon in technical paper no. 2 'The suitability of iodine and iodine compounds as disinfectants for small water supplies" (1972).
Directed to water supply for small households is "The purification of water on a small scale" (1973, technical paper no. 3), a revised and updated version of R.N. Clark's article of 1956.

Within the activities of building up the IRC, falls the establishment of a documentation storage and retrieval system. A simple thesaurus for this purpose has been elaborated. The system is in the first place aiming at the provision of information concerning unpublished or hardly obtainable reports, papers and proceedings with respect to projects to be carried out and request received. This activity may ultimately result in an abstracting service and the publication of summarizing papers on special subjects. An example of collaborative activities of the Network in this field is a survey of the distribution of nitrates levels, about which through the support of the Collaborating Institutions many useful data were collected. Another example is the request of Prof. Burton, visiting Professor at the University of East Anglia, Norwich, U.K., who is carrying out a study of the present state-of-the-art in rural water supply and sanitation. Upon request to the IRC to support this study with expertise available in the Network many collaborating institutions cooperated to a great extent.
In a "Summary of the questionnaire on the relation river water - drinking water and on a water pollution index" was preliminary reported on a study concerning the set up of a "water pollution index" as a general criterion for the degree of pollution of rivers.

In a number of meetings IRC staffmembers played an active part, viz. the WHO Expert Meeting on Effluent Reuse: Methods of Wastewater Treatment and Health Safeguards (1971), Working Group of the IWSA Standing Committee on Education and Training of Water Works Personnel (1971) the first Session on Problems of Water Supplies in Developing Countries on the 9th IWSA Congress (1972), the Meeting of Directors of Institutions collaborating with the WHO International Reference Centre for Wastes Disposal (1972) and the WHO Meeting of Regional Advisers in Environmental Health (1973).
So far visits were paid to 9 Collaborating Institutions in India, Israel and Turkey (1971), Brazil, Italy and Venezuela (1972) and the United Kingdom (1973) and to SEARO (1971), AMRO and CEPIS (1972) and to several other insitutions, organizations and Conferences on the same journeys.

In the field of training the IRC forms a starting point for guests and visitors, who come to The Netherlands for field studies, orientation, short training programmes and visits to institutions. Programmes were prepared for French speaking postgraduate students of the Centre de Génie Sanitaire at Rabat, Morocco (1971 and 1972) and for several WHO-fellows. More than 30 experts and specialists from Collaborating and other Institutions paid brief visits to the IRC.

Apart from a continuation of the activities as mentioned above, the IRC sees as an important task for the near future to improve the position of the IRC and to strenghten the network. Current specific activities fall within the projects brought forward on the present meeting, which form a framework on which further planning can be based. Emphasis will be placed on problems in developing countries in general and on rural water supply studies in particular.

At present four staffmembers are working full time with the IRC, assisted by employees of the Government Institute for Water Supply. Steps are being taken to improve the position of the IRC as to personnel and budget. Deliberation has been opened with the Dutch Government on the formation of a "foundation IRC" which will enlarge possibilities of assistance from other bodies and organizations and increase the operational potentialities of the Centre.

3.2 Regional Reference Centres (RRC's)

It is believed that the designation of Regional Reference Centre for Community Water Supply will effect a more efficient way of operation of the Network, both in the establishment of contact the exchange of relevant information, the inventory of needs and the performance of research and development work directed to regional requirements.
Soonly the designation can be expected of the Pan American Centr. for Sanitary Engineering and Environmental Sciences (CEPIS) at Lima, Peru as RRC/CWS and of the Central Public Health Engineering Research Institute (CPHERI) at Nagpur, India as RRC/CWS and RRC/WD.

The functions and responsibilities of the RRC's will be similar to those of the IRC, but the scope will be restricted to a geographic region. In contacts on regional and local matters lines of communication will be from the IRC to the RRC's and from the RRC's to the CI's and national institutions, and vice verse. A specific example may be the application of existing expertise in Latin America concerning water supply in developing areas in other Regions. Communication on matters with worldwide significance (e.g. participation in projects) can be held between IRC and CI's directly.

3.3 The Collaborating Institutions

The tremendous task of the development and improvement of water supplies for millions can only be carried out in international cooperation. The network of Collaborating Institutions forms a framework through which the aid of research, educational and other institutions working in the field of community water supply is enlisted. It provides an appropriate infrastructure to make possible the coordination of research and development programmes, provide the means for an effective exchange and dissemination of technical and scientific information, promote education and training programmes and assist in the transfer of existing technology from industrialized countries to developing countries.

The International Network for Community Water Supply consists mainly of universities and research establishments. On the Conference on Research and Development in Community Water Supply, Dubrovnik 1970, a Collaborating Institution - formally designated as such by WHO - was defined as an institution that is already

engaged in research and development in community water supply or intends to undertake such activities and is prepared to collaborate in a world wide programme. At present the network consists of 31 institutions, 16 in developing countries and 15 in industrialized countries (see annex 3).
The functions of the Collaborating Institutions - for the first time discussed on the Dubrovnik Conference - were reviewed on the present meeting. It was thereby assumed that Collaborating Institutions are able to contribute to the international programme within their normal range of activities. The functions in the context of this programme could be described under the same three main headings as mentioned under functions of the IRC;

- Information exchange
- Research and development
- Education and training

Under information exchange would fall the preparation and exchange of annual reports and lists of available publications; periodic preparation of newsitems for IRC's Newsletter and transfer of requested information from their countries to the IRC; provision of information and reports related to projects carried out by the network, which are mentioned in IRC's annual reports; assisting governments in, and provision of national research and development programmes in their countries; and provision of information on institutional services, training programmes, conferences and seminars, and documentation facilities in their countries, on request by IRC.

One of the major inputs of Collaborating Institutions is of course the cooperation in research projects, to which will be further referred in later chapters. Particularly in the adaptation of findings to local situation and the transfer of that knowledge to bodies in their countries CI's can play an important role. Conduct of developmental investigations in respect of new methods of procedures could form another task.

In the training field the CI's have as a function to provide facilities for the training of research and other personnel, whereas the exchange of personnel within the network can in a large measure contribute to a strengthening of the network on the one hand and the education of personnel on the other hand. In the organization of local courses and seminars and the translation

into local languages of existing knowledge the CI's can play an important role. Another task in this field would be to make an inventory of training needs in their country.

Some thought is also to be given to establishing a "twinning" relationship between collaborating institutions to the effect to promote the direct exchange of workers between a developing and an industrialized country. Such an arrangement has double benefits in updating the technique and knowledge of developing country workers and at the same time sensitizing the industrialized country workers to developing country problems.

An activity which might have a great impact on community water supply programmes especially in developing countries could be the stimulation of professional society activities at the national level.

Although WHO or IRC have no financial resources for the support of the above mentioned activities, the provision of funds for certain specific undertakings under contractual technical services agreements may be possible. Upon request of the Government concerned, WHO may also be in a position to provide specialized consultants to a Collaborating Institution to advise on specific problems. In a further stage of its development the IRC might be able to mediate in other cases on request.

The activities of the Network will mainly be concerned with aspects of community water supply. It is felt however that a more integrated approach of sanitary problems, especially in developing countries, and cooperation between the activities of this Network and the Network for Wastes Disposal must be strived after. Further, seeing the large emphasis in water resources problems in developing countries, in a further future the Network might have to include such problems in its programme.

Note: A number of specific activities in international programmes are carried out by the Collaborating Institutions on an individual basis. On such programmes is reported in IRC's bulletin series as mentioned in chapter 3.3

3.4 Methods to improve the practical output of the systems

In order to improve the practical output of the system and to arrive at better communications both within the present network and with other bodies and institutions a number of recommendation

were put forward, which were endorsed by the meeting.

a) Strengthening of the IRC

- The Director of the Dutch Government Institute for Water Supply will request his Government to increase the input in the IRC to such an extent that at least a minimum base for continued activities is ascertained. Such a minimum base should include among other things at least 10 staffmembers Activities to have the IRC transformed into a foundation will be continued.
- WHO will consider possibilities to increase the contribution in financing IRC.
- Collaborating Institutions will consider possibilities to contribute financially in supporting IRC and inform the IRC accordingly.
- The CI's and especially the Government based institutions will consider whether it will be possible for them to detach one or more of their staffmembers for posting with the IRC for periods of 6 months or more. The salary and subsistence allowance and the funds for international travel will be provided by their institutions or Governments. Secondment will be on a voluntary basis and for a clear-cut programme of work. CI's will inform IRC accordingly.

b) Communication within the Network

- In addition to the existing criteria for the designation of an institution being a CI, the IRC - in agreement with the WHO - will formulate the specific tasks of a CI, and circulate these to the Network. Such a formulation will include the functioning as national focus, the routine duties (sending annual and/or quarterly reports, lists of publications, selected reports and state-of-the-art papers, lists of congresses, seminars, training courses, research projects etc.) and a number of specific tasks broadly defined and to be specified afterwards.
- Collaborating Institutions are to report to the IRC annually on their activities within the framework of the Network. IRC will prepare an annual review of the collaboration by the institutions in the Network, as of 1973.

- IRC will send preprinted forms for supplying information for the Newsletter (as of July 1973) and for the handling of requests. Reminders will be sent if the information is not coming forward.
- The CI's will nominate within three months after the meeting a staffmember with the specific task to act as a contact-person for the work of the CI within the network and inform the IRC accordingly.

c) Extension of the Network

- The WHO, together with the IRC will take the necessary steps for the extension of the network of CI's in additional countries. Before an institution is designated as a CI, the functions of a CI should be personally discussed by the management of the institute and staffmembers of WHO and IRC.
- The WHO in consultation with the IRC will take the necessary steps to make the designation of an institution as a CI known to the national government concerned, asking this government to assist as much as possible, so as to enable it to carry out its functions.
- Collaborating Institutions should extend the flow of information beyond the Network to executing agencies in their countries, if possible through a formalized system. If in a country more than one CI is operating, they should be in close contact.
- --WHO will consider the set up of additional Regional Reference Centres. Secondment of staff from CI's to such Centres should be considered.

It was a general consensus that initiatives should emerge from the IRC. The IRC should build up the framework further and on the base of periodical evaluations as to the output make the appropriate modifications. CI's should on the other hand sustain IRC's efforts as much as possible. They are to assist the IRC in enlarging the publicity of the Network, both within their Institutions and in their countries and they should make known in their countries /they act as a reference point on community water supply There was a general indication of the willingness of CI's to work towards achieving more effective collaboration in the future.

/that

It should be seriously considered however that the Network be periodically reviewed and that the CI's who are not able or willing to perform their duties properly, should be suggested to no longer form part of the Network.
Participants found great value in the contacts the Meeting provided and believed that further meetings of representatives of CI's should be convened at regular intervals.

4. The Nature of Present and Future Research and Development Programmes

4.1 Industrialized Countries

Most of the industriazlied countries have extensive installations for water extraction, treatment and distribution. For many countries the problem relates to ever increasing pollution and contamination of water sources. The vast number of complex chemical compounds commonly used in agriculture, in industry and in the home have forced research to investigate methods for the detection and removal of a wide variety of materials from raw water. Much effort is also being expended on determining the health effects associated with the use of water containing trace elements; in general there is a need for more research on toxicity of materials. Simultaneously there are public demands for reduced environmental pollution as a means of improving the quality life. This has had a tendency to bring waste water treatment and drinking water treatment closer together.

Within government institutions and universities in the industrialized countries there is a tendency to concentrate on long term fundamental research. Applied research or development is more rightly a function of industry and industry supporting institutions. Research and development has become extremely sophisticated and has resulted in some extremely sophisticated methods for water treatment. The industrialized countries can accomodate this however, since they have the wealth, the expertise, the infrastructure and the will to overcome the problems. There is a general feeling that some coordination of research activities in the industrialized countries is needed to avoid duplication of effort. Research should be more predictive, that is, it should be directed toward future problems in an attempt to prevent or curtail them. An example mentioned was the growing problem of disposal of sludges and residues from water treatment. Projects such as this should be studied and budgetary provisions should be made for the developmental work necessary to apply research findings to a practical situation.

4.2 Developing Countries

There are vast differences among developing countries in their stage of development, their financial resources, their pool of skilled manpower, their geographic, climatic, water resources and demographic conditions, and their priorities for community water

supply. The common feature in all developing countries is that there is intensive competition among various sectorial interests for the allocation of resources, both human and financial, within an overall development strategy. The health benefits of a good community water supply are different - perhaps impossible - to express in tangible quantitative terms. Research in water supply is even more difficult to evaluate quantitatively. Economic planners, therefore, often assign relatively low priorities to water supply and water supply research projects, notwithstanding the tremendous benefits to health that can result from improved sanitary services. Participants recognized the problem but no universally acceptably solution was forthcoming.

Clearly, the water supply needs of developing countries are colossal. The extent of the needs is elaborated in other sections as is the overall allocation of priority to urban areas. There are few problems of water supply in developing countries that cannot be solved with currently available technology, so technology, per se, is not an overwhelming constraint. The cost and the operation of modern and sophisticated systems does present a problem and research must be directed toward system simplification and cost reduction. Much care must be taken to ensure that systems are rugged and durable and that repairs and changes to the various elements of the systems can be made quickly and easily.

In reviewing the research and development needs for developing country water supplies, there was general agreement among the participants that:

- Research in developing countries should relate to the existing water supply needs and often does not require a high degree of sophistication;
- The identification of research needs is of high importance;
- Research will often be concerned with national problems and the operating and/or executing agencies should be involved;
- A strategy to make research findings applicable is needed;
- Projects must be bankable;
- In order to get projects running more emphasis must be put on institutional building;
- Low cost technology in community water supply is of high priority;
- Past water supply projects should be evaluated to provide feedback;

- Data collection is of prime importance;
- Research and development experience from industrialized countries should be applied but only after thorough consideration of the local conditions;
- Use of locally available materials and services should be encouraged to make the best use of available funds;
- There is a need for applicable water quality and quantity criteria for rural and urban supplies, adapted to local conditions;
- Attention must be given to social and economic factors to produce locally acceptable solutions and to make people want the supplies.

5. Identification of Specific Activities and Projects for Research and Development with Priority Allocation.

5.1 Introduction

A request for preliminary proposals for projects had been sent to all collaborating institutions well in advance of the meeting and in response to this a total of 63 proposals were submitted for consideration. Since the proposals covered a wide range of interests within the broad scope of community water supply, it was considered expeditious to subdivide them into subject headings for detailed evaluation by committees. The subject headings used were:

1. Health Aspects of Community Water Supply
2. Urban Water Supply
3. Rural Water Supply
4. Administration and Management
5. Training and Training Programmes
6. Dissemination of Information

A few projects were rejected. The basis for rejection was that the proposals had insufficient direct relationship with water supply and were more appropriately directed towards waste treatment or pollution control. Some projects were proposals for activities that are currently underway within the IRC and/or WHO. The content of rejected projects is to be made known to institutions and organizations which have a direct interest in, or are otherwise concerned with the subject matter.

There was a considerable opportunity for consolidation of project which had a similar character. Research on slow sand filters, for instance, was suggested in 6 separate proposals and participants recognized that the projects could be combined into one major proposal. As a result of committee evaluation and consolidation, 28 projects remained for consideration by plenary session of the meeting. These were allocated priorities for implementation in accordance with the following classification:

Priority A* - Special Priority
Priority A - Very High Priority
Priority B - High Priority
Priority C - Low Priority

Participants agreed unanimously that all of the retained projects were worthy, were needed and should be implemented. The priorities assigned were intended to indicate the areas where benefits from project implementation would have the most immediate and the most profound effect. It was further recognized that some of the special priority projects would have the most immediate impact on industrialized countries with longer term benefit to developing countries. These are identified in the priority listing by placing an I in parentheses after the priority allocation, e.g. A* (I). Those projects of greater importance to developing countries are identified with the letter D, e.g. A* (D). Project titles, priorities and the source of the proposals and project descriptions in a standardized format follow:

5.2 Index of Projects

No.	Title / Proposed by	Priority
	Health Aspects	
1.	Health Aspects of Water Reuse - Long term Health Effects of Consuming Renovated Water by: Hadassah Medical School, Israel Water Research Association, U.K.	A*
2.	A Rapid Method for the Quantitative Isolation of Viruses from Polluted Water. by: Hadassah Medical School, Israel	A
3.	Assembling of Information on Engineering Measures for Control of Schistosomiasis. by: Agency for International Development, U.S.A.	A
4.	Distribution Studies on Intestinal Indicators. by: University of Newcastle-upon-Tyne, U.K.	B
5.	Toxicological Evaluation of Bromine and its Derivations in Drinking Water. by: Hadassah Medical School, Israel	B
6.	Study of Water Quality in Arid and Semi-Arid Regions. by: CPHERI, India	B
7.	Study of the Health Effects of Trace Elements in Water.	A*(I)

No.	Title / Proposed by	Priority
8.	Effects of Modern Agricultural Inputs on Water Quality. by: CPHERI, India	C
9.	Comparison of the Health Effects of Desalinated and Saline Drinking Water in Arid Regions.	A
	2. Urban Water Supply	
10.	Optimization of Water Treatment Systems. by: University of Newcastle-upon-Tyne, U.K. IRC/CWS	A
11.	Coagulants and Coagulant Aids from Local Materials. by: CEPIS, Peru IRC/CWS	A
12.	Simplified Water Filtration. by: CEPIS, Peru	A
13.	A Study of the Mechanism and Prevention of Membrane Fouling in the Application of Reuse Osmosis in Water Treatment. by: Hadassah Medical School, Israel.	C
14.	Field Trials of Fixed Bed Chlorination of Water. by: WHO/CWSS	A
	3. Rural Water Supply	
15.	Slow Sand Filtration in Developing Countries. by: Asian Institute of Technology, Thailand CPHERI, India Middle-East Technical University, Turkey Univ. of Science and Technology, Ghana IRC/CWS	A*(D)
16.	Transfer and Adaptation of Relevant Technology from Industrialized Countries to Developing Countries. by: Water Research Association, U.K.	A*(D)

No.	Title / Proposed by	Priority
17.	Hand Pumps	A
	by: Agency for International Development	
	University of Science and Technology, Ghana.	A
18.	Development of Simple and Inexpensive Testing Methods for the Field Examination of Water.	B
	by: IRC/CWS	
	4. Administration and Management	
19.	Criteria for Rates and Tarriffs for Water Supply.	A
	by: Water Research Association, U.K.	
20.	Impact of Community Water Supply.	A*(D
	by: Univ. of Science and Technology, Ghana	
21.	Seminars on Administration and Management.	A
	by: IRC/CWS	
22.	The Determination of Unit and Total Consumption of Domestic Water - Present and Future Estimates with Emphasis on Alternatives to Reduce Wastage.	A
	by: CEPIS, Peru	
	Middle-East Technical University, Turkey	
	University of Oklahoma, U.S.A.	
	Water Research Association, U.K.	
	WHO/CWSS	
23.	Case Histories of Successful Water Supply in Developing Countries.	B
	by: Water Research Association, U.K.	
24.	Community Water Supply Projects in Evaluation.	C
	by: Asian Institute of Technology, Thailand.	
	5. Training and Training Programmes	
25.	Development and Implementation of Systematic Training Programmes in Community Water Supply on the base of Assessment of Manpower and Training Needs in Developing Countries.	A*(D)
	by: Asian Institute of Technology, Thailand	
	CEPIS, Peru	

No.	Title / Proposed by	Priority
	Water Research Association, U.K. WHO/CWSS IRC/CWS	
26.	Seminars on Urban and Rural Water Supply. by: IRC/CWS	A

6. Dissemination of Information

27. Review of field use of WHO technical publications related to Water Supply. B
    by: Water Research Association, U.K.

28. Selection, Translation and Distribution of Selected Technical Publications on Water Supply Subjects. A
    by: CEPIS, Peru.

5.3 Analysis of Projects with Priorities

	Total	A*	A*			A	B	C
			A*(D)	A*(I)	A*(I+D)			
Health Aspects	9	2	-	1	1	3	3	1
Urban Water Supply	5	-	-	-	-	4	-	1
Rural Water Supply	4	2	2	-	-	1	1	-
Administration and Management	6	1	1	-	-	3	1	1
Training	2	1	1	-	-	1	-	-
Dissemination of Information	2	-	-	-	-	1	1	-
Total	28	6	4	1	1	13	6	3

The allocation of 4 special priorities to projects directed to problems in developing countries reflects the general feeling at the meeting, that the role to be played by the network in these countries is more urgent than in industrialized countries. The allocation of two special priorities for rural water supply projects is in accordance with the emphasis the meeting wanted to put on this category.

That training projects - in spite of their importance - received only one special priority allocation, is due to the fact that one large general project is proposed, which in practice will consist of series of projects with different character in different regions. Dissemination of information, was regarded to be of prime importance, but main activities will fall in the several projects. On top of that information exchange is one of IRC's routine activities.

The total numbers of projects in the 6 different categories are no indication of the importance of the problems in those categories. The variety of numbers is largely due to the fact that the projects are not always of comparable scope.

5.4 Project descriptions

5.4.1 Health Aspects of Community Water Supply

NO. 1

Title of Project : Health Aspects of Water Reuse - Long Term Effects of Consuming Renovated Water.

Project Agency : One or more collaborating institutions.

Objectives of Project :

a. To evaluate experimentally the long term health effects of consuming renovated water produced by selected treatment processes which are under active consideration for potential water renovation programs for human consumption.

b. To concentrate, identify and test the acute and chronic toxic effects of specific residual organic micro-constituents found in renovated waste-water.

c. To evaluate long term health effects on humans consuming renovated water.

d. To establish the safe limits of concentration of organics in drinking water which has been renovated from waste-water or a polluted source.

Description of Project :

a. Identify the full range of contaminants possibly present in municipal waste-waters which might affect the safety of the public health and the palatability of the water, and the range of concentrations.

b. Determine the degree to which these contaminants are removed by various types and levels of treatment.

c. Determine the long range physiological effects of continued use of reclaimed water with various levels of treatment as the sole source of drinking water.

NO. 1 (Cont.)

d. Define the parameters, testing procedures and analytical methodology, and allowable limits which should be used to monitor reclaimed water for domestic use.

The proposed research plan involves the evaluation of the health effects of consuming renovated water by long term feeding experiments with laboratory animals. Municipal waste-water treated by three different processes will be studied. The processes will include a physical-chemical train; a combination of conventional biological treatment together with physical-chemical treatment as well as a full scale groun water recharge system under study for eventual local consumption.

Physiological, biological and neurological parameters will be studied on animals chronically fed with normal and concentrates of renovated waste-water. Residual organic pollutants remaining in renovated water will be concentrated and separated into fractions for identification and toxicological screening.

In the second phase of this study it is proposed to carry out a prospective health evaluation among a population group to be supplied with renovated water from the full scale water renovation project (Dan Region Project) studied experimentally during phase one.

Assistance Required : By WHO : **Financial support**

By IRC : **Coordination and publication of finding**

BY CI : **Project implementation**

Priority : **A* (Developing and Industrialized Countries)**

NO. 2

Title of Project : A Rapid Method for the Quantitative Isolation of Viruses from Polluted Water.

Project Agency : A qualified collaborating institution.

Objectives of Project :

a. To utilize the ability of the fluorescent antibodies to demonstrate the presence of viral antigens within infected tissue culture cells, long before the appearance of the cytopathic effects, and thus confirm the isolation of viruses from water sources in 12 - 24 hours.

b. To examine the different types of cells in tissue culture in order to select the most suitable for the development of the method.

c. To evaluate the reliability of poliovirus of vaccine strain origin as an indicator for enteric virus contamination in polluted water in the same way as E. coli is used as a bacterial indicator. The purpose is to simplify the use of the fluorescent antibody method proposed. This is based on the assumption that all major communities in advanced countries carry out year round vaccination against polio in almost all infants.

d. To test the method both under laboratory and field conditions, and to compare the new method with the existing ones.

Description of Project : The project will be carried out in three stages: (a) Research and development of the suggested method; (b) evaluation and testing under field conditions, and (c) enlarging the method to include other enteroviruses.

NO. 2 (Cont.)

During stage (a) different approaches will be tried and examined in order to obtain a practical method for the isolation of polio virus from water and their identification by fluorescent antibodies. The following material will be used:

Viruses

The 3 polio virus types which were isolated in our laboratory.

Tissue cultures

Primary monkey kidney cells; primary human amnion cells; cell lines such as vero- and Hela cell lines.

Fluorescent antibodies

Anti-polio antisera for the preparation of fluorescent antibodies will be prepared in rabbits. Labeling of the sera and staining techniques will be done according to the method described previously in previous publications. Each antiserum will be labeled separately, thus obtaining 3 specific labeled antisera: anti-polio I, II, III, respectively.

The different variables employed in virus isolation will each be thoroughly examined. The minimal time period required for the appearance of fluorescence antibody stained cells will be determined. Special attention will be paid to small virus doses of 1-3 PFU/tissue culture. The combination that will prove to be most suitable and rapid for each of the polio types separately, will also be examined with mixtures of the 3 types. Fluorescent antibodies will be used as separate and pooled labeled antisera.

NO. 2 (Cont.)

It is thus hoped to be able to develop a method which, under laboratory conditions, will prove to be a sure and rapid way of isolation, quantitation and identification of polioviruses in water.

The selected method will be tried and tested with water taken from different sources (raw sewage, various stages of treated sewage, renovated waste-water, lake and river water, sea water). The virus concentration method to be employed will be the phase separation method or methods for large volumes of water such as membrane filtration or insoluble polyelectrolytes.

Finally, the selected method will be tested under true field conditions and will be compared with other accepted methods.

Assistance Required : By WHO : Financial support

By IRC : Dissemination of findings

By CI : As specified above.

Priority : A

NO. 3

Title of Project : Assembling of Information on Engineering Measures for Control of Schistosomiasis.

Project agency : U.S. Agency for International Development (Office of Health, Tech. Assistance Bureau) Washington, D.C.

Objectives of Project : To prepare a manual presenting appropriate engineering measures contributing to the control of schistosomiasis. Manual to enable engineers to work effectively with other professionals in the design and operation of schistosomiasis control programs and to enable epidemiologists, planners, administrators and others to understand the role or potential role of engineers in control programs.

Duration of Project : Two years

Description of Project : Extend previous work to include actual examples, sketches and schematics of engineering facilities favorable to schistosomiasis control in the field.

Investigate how engineering measures may be institutionally implemented within agricultural and water resources development agencies.

Develop a manual of general hydraulic design aids incorporating the special schistosomiasis control information.

Assistance Required : By WHO : Constructive review of draft manuscript by Headquarter and Regional staffs; assistance in distributing final publication.

NO. 3 (Cont.)

By IRC : Supplying of information available in countries where water resource development activities have contributed to the prevalence of schistosomiasis.

By CI's: Coordination with USAID and/or WHO projects where planning or construction of water resource development projects is contemplated.

Priority : A

NO. 4

Title of Project : Distribution Studies on Intestinal Indicators

Project Agency : One or more collaborating institutions

Objectives of Project : To find the most useful indicators of faecal pollution for testing raw-water sources in tropical and subtropical countries.

Description of Project :
a. Collection and isolation of bacterial cultures from sewage, a variety of raw-waters and soil.
b. Detailed identification of cultures.
c. Evaluation of regional differences in composition of intestinal flora.
d. Preparation of recommendations for regional criteria and methods of examination of water sources.

Assistance Required :
By WHO : Financial support for staff to supervise arrangements for collection and transport of cultures.
By IRC : Assistance with organization for collection and with dissemination of findings.
By CI's: Assistance with collection of cultures and wherever possible with identification.

Priority : B

NO. 5

Title of Project : Toxicological Evaluation of Bromine and its Derivatives in Drinking Water.

Project Agency : A collaborating institution, such as the Hadassah Medical School of the Hebrew University Israel and related institutions.

Objectives of Project : To investigate the practicability of the use of bromine and its derivatives as disinfectants in drinking water to overcome the deficiencies of chlorine, i.e. chlorine's low effectiveness against viruses and low effectiveness when in the combined form.

Description of Project :

a. Examination of acute and sub-acute toxicity of bromine at concentrations effective for water disinfection.

b. Toxicological evaluation of bromine products such as bromide, bromamines and other possibl compounds and the water disinfection effectiveness of these compounds.

Assistance Required : By WHO : none

By IRC : none

By CI : implementation

Priority : B

NO. 6

Title of Project : Study of Water Quality in Arid and Semi-arid Regions.

Project Agency : One or more collaborating institutions.

Objectives of Project : In arid and semi-arid regions in many parts of the world, waters of high salinity and minerals are still being consumed for want of better sources. This process is likely to continue fo some more time until the economics favour the developing countries to bring in better water from longer distances. It is important to know the adverse health effects of such poor quality water on humans and cattle, to improve the water quality criteria and to develop standards The project envisages a correlation between unwanted elements and radicals such as fluorides and nitrates and trace metals with the bad effects on human and cattle health.

Description of Project : Some information about trace elements and radicals in excess of limits suggested for normal waters is already available. One or two regions where the conditions are acute will be surveyed for the water quality and health effects in that region.

Budgetary, manpower and time requirements:

Budget : $ 100,000

Manpower : One medical doctor,
Two scientists,
Four scientific assistants and other auxiliary manpower.

Time : 4 years

NO. 6 (Cont.)

Assistance Required : By WHO : Financial support
By IRC : Assistance with literature review and coordination

Priority : B

NO. 7

Title of Project	:	Study of the Health Effects of Trace Elements in Water.
Project Agency	:	A collaborating institution such as the Institute of Hygiene and Epidemiology, Prague.
Objective of Project	:	To evaluate present knowledge and to prepare experimental project.
Description of Project	:	a. Collection of the present publications from the whole world. b. Critical evaluation of the present knowledge
Assistance Required	:	By WHO : assistance in contacts with people interested in the problem, financial support for some visits. By IRC : assistance in collection of world literature.
Priority	:	A* (Industrialized Countries)

NO. 8

Title of Project : Effects of Modern Agricultural Inputs on Water Quality.

Project Agency : A collaborating institute such as CPHERI, Nagpur (India).

Objectives of Project : Modern agriculture involves inputs of fertilisers and pesticides designed to increase the yield of crops. The run off of the residues of these inputs into surface and ground waters is known to cause considerable adverse effects on the quality of the receiving waters or aquifers. Such waters cannot readily be used as source of raw water for drinking purposes nor can be easily purified to avoid such contaminants. The project envisages the measurement of fertilisers and pesticides into the receiving waters under various conditions of crops growing on fertilisers and pest control.

Description of Project : The project envisages collection of run off and percolated samples of water from fields wherein fertilisers and insecticides have been used for improving crop yield. Samples will be collected both at surface and under ground and analysed. Samples will be collected from fields receiving flood irrigation or limited irrigation for raising different types of crops in different seasons.

Budgetary, manpower and time requirements:

Budget : $ 50,000

Manpower : Two scientists,
Two scrientific assistants and other auxiliary staff.

Time : 3 years

NO. 8 (Cont.)

Assistance Required : By WHO : Financial support and coordination with FAO.

By IRC : Assistance in coordination with other institutions.

Priority : C

NO. 9

Title of Project : Comparison of the Health Effects of Desalinated and Undesalinated Drinking Water in Arid Regions

Project Agency : IRC and interested collaborating institutions.

Objectives of Project : With the increasing utilization of desalinated water in many parts of the world (e.g. Kuwait and Israel) it would be appropriate to determine the quality of desalinated water by various processes and to assess the effects on the health of consumers in contrast to the effects on those continuing to use highly mineralized ground water. The ultimate objectivewould be to establish desalinated water quality criteria and standards.

Description of Project :

a. Collection of available information and data on the quality of ground water and desalinated water in countries like Kuwait and Israel.
b. Carrying out surveys to determine the daily intake of liquids with respect to quantity and quality.
c. Initiating plans for future extensive epidemiological surveys of different sections of the population utilizing highly mineralized ground water as well as those depending on desalinated water.

Assistance Required : By WHO : Financial support

By IRC : Coordination of the activities of a number of institutions

Priority : A

5.4.2 Urban water supply

NO. 10

Title of Project : Optimization of Water-Treatment Systems.

Project Agencies : IRC/CWS and University of Newcastle-upon-Tyne

Objectives of Project : To help to reduce the costs of urban water treatment plants by refining the design criteria and finding the optimum combination of treatment units.

Description of Project :
a. Collection and collation of data on quantity and quality of water required.
b. Collection and collation of data relating influent and effluent qualities of the various treatment units and of whole systems related to design criteria, and to such operating parameters as efficiency, cost and maintenance.
c. Formulation of equations descr bing the operation of the various teatment units, including cost functions.
d. Development of an optimization model of a complete water-treatment system.

Assistance Required : By WHO : Salary of one research worker at IRC.

By CI's: Collection of data on treatment plant design and operation costs.

Time Required : 2 years

Priority : A

NO. 11

Title of Project : Coagulants and Coagulation Aids from Local Materials.

Project Agency : CEPIS, and other collaborating institutions such as Bandung Institute of Technology.

Objectives of Project : Study possibility of using low cost, locally available materials to replace more costly imported coagulants and polymers in water treatment.

Description of Project :

a. Developing a laboratory process for extracting ferric aluminum sulfate from wastes from bauxite mines.
b. Investigate production of ferric chloride on plant premises using iron or/and chlorine.
c. Investigate availability, cost, and effectiveness of natural polymers, such as starches, tuna syrup, alginates, as compared to standard polyelectrolytes.
d. Set up pilot plants for producing coagulants and coagulant aids and conduct tests of these materials in water treatment plants.

Time Required : 2 years

Estimate Funds Needed: US$100,000.

Assistance Required : By IRC : Information on preparation and use of such coagulant materials in other countries.

By CI's: Conduct laboratory and pilot scale production studies and tests of materials.

Priority : A

NO. 12

Title of Project : Simplified Water Filtration.

Project Agency : One or more collaborating Institutions.

Objectives of Project : To study most economical methods for filters with constant and declining rate avoiding the use of equipment difficult to maintain and repair in developing countries.

Description of Project : The efficiency of equally split flow filters in comparison with different designs of declining rate filters would be studied.

Design parameters such as total depth of filter box required, maximum water level variation that can be expected, control systems, etc., would be determined.

Economical comparisons between conventional filters and simplified filters would be made.

Assistance Required : By WHO : Financial support.

By IRC : Collaboration in the collection of bibliography and dissemination of the results obtained by this project.

By CI's: Development of the project, by itself or in collaboration with interested agencies. Preparation of progressive and final reports.

Priority : A

NO. 13

Title of Project : A Study of the Mechanism and Prevention of Membrane Fouling in the Application of Reverse Osmosis in Water Treatment.

Project Agency : A collaborating institution such as the Hadassah Medical School and institutions in industrialized countries.

Objectives of Project :

a. To develop methods - both chemical and physical - of reducing the effect of membrane fouling in the reverse osmosis treatment of water.

b. To estimate the economic impact of water treatment prior to reverse osmosis and the subsequent possible reduction of membrane fouling as compared with no pretreatment and an increased necessity for membrane cleaning and/or replacement.

Description of Project : Some work on membrane fouling and membrane cleaning is underway at various locations throughout the world. Examination of the present stage of knowledge is essential, but difficult, because there are few publications. Information from unpublished experiments will be sought.

Current membrane cleaning techniques will be critically examined with further testing on standarized raw water. New cleaning techniques will be investigated.

Costs of cleaning will be evaluated relative to the time-phased throughput in experimental systems for each quality of raw water used in the testing series. Estimates of cleaning costs and

NO. 13 (Cont.)

down-time will be developed for full scale systems. This procedure will permit a comparison of the effect of applying pretreatment processes to raw water prior to subjecting it to treatment by reverse osmosis.

Assistance Required : By WHO : none

By IRC : Assistance in developing communication channels with institutions undertaking or contemplating similar work.

By CI's: Project implementation.

Priority : C

NO. 14

Title of Project : Field Trials of Fixed Bed Chlorination of Water

Project Agency : Several collaborating institutions.

Objective of Project : Simplification of water chlorination procedures

Description of Project :
a. Field trials at various location and under various climate conditions of the "Fixed Bed Chlorination" technique.
b. Install a number of fixed bed chlorinators at locations near to a number of CI's and to monitor the results over a meaningful period.
c. Report the results individually to the IRC for correlation and analysis.

Assistance Required : By WHO : Financial support.

By IRC : Collection of detailed information on the experimental process, obtain materials not locally available, coordinate research activities and publish final report.

By CI's: Conduct field tests and report results.

Priority : A

5.4.3 Rural water supply

NO. 15

Title of Project : Slow Sand Filtration in Developing Countries.

Project Agency : WHO, IRC/CWS and a number of collaborating institutions in industrialized and in developin countries.

Objectives of Project : To encourage the use of slow sand filters for treatment of drinking water in developing countries and to develop design criteria appropriat for tropical and semitropical countries.

Description of Project :

a. Review of the literature on the subject, especially that relating to tropical and semi-tropical installations.
b. Investigate, as necessary, the operating performance of known installations, e.g. the Gezira region of the Sudan. Operating performance to be recorded relative to the variables of design, construction, operation climate, raw water quality etc.
c. Develop a standard design of an experimental filter for construction at a number of test sites. Develop a standardized experimental design procedure and reporting system.
d. Investigate the effects resulting from the use of locally available and less than optimum filter media.
e. Extend to a pilot plant basis at a restricte number of typical sites.
f. Prepare quidelines for design, standard designs and detailed directions for the operation of slow sand filters.
g. Investigate adjunct operations such as pretreatment and continuous removal of schmutzdecke.

NO. 15 (Cont.)

Assistance Required : By WHO : Financial and technical assistance for experiment design. Publication of guidelines, standard designs and directions for operation.

By IRC : Design of experiment, coordination of work, collation of results and preparation of report.

By CI's: Conduct of experiments and report of individual experimental results.

Priority : A* (Developing Countries)

NO. 16

Title of Project : Review and Application of Relevant Technologies

Project Agency : IRC/CWS in collaboration with a number of CI's in industrialized countries.

Objectives of Project : Identification of successful simple, low-cost technologies, used in industrialized and developing countries and to investigate the practicability of using such technology, particularly in rural areas.

Description of Project : Virtually all of the industrialized countries have water supply systems which contain elements that were installed fifty to one hundred years ago in accordance with what was then current technology. (In water plants of Civil and Military installations very often such system are still in use).

Similarly, European explorers and settlers of earlier years established basic water supply systems at various centres throughout Asia and Africa. Many of these systems may still be functional. These systems based on early technology were appropriate for the then current conditions of low cost labour and difficult problems of materials delivery and parts replacement. To some degree similar conditions obtain today in developing countries, especially as compared with industrialized countries. It is logical therefore to presuppose that systems which utilize locally producable materials and are both constructed and operated by labour intensive methods could be suitable for many current needs. Consequently in many developing countries such systems have already been developed.

This study would investigate systems and element of systems which have withstood the ravages of time and are still functional. The study could

NO. 16 (Cont.)

result in the production of guidelines for effective utilization of standard and simple technical solutions to water supply problems.

Assistance required : by WHO: Financial support for the individual studies within the project and pubulication of the guidelines.

by IRC: Literature review, coordination of the study and dissemination of data collected.

by CI's: a) On site investigation of water systems and water system elements that were installed by labour intensive methods and utilized locally produced materials.

b) Field trials

Priority : A* (Developing Countries)

NO. 17

Title of Project : Hand pumps.

Project Agency : Collaborating institutions from developing countries.

Objectives of Project : To develop a number of hand pumps adaptable for use in rural communities in the developing countries.

Description of Project : In a number of rural communities in developing countries where ground water consitutes the cheapest and safest source of water, hand pumps will continue to be used extensively. Such pumps are particularly useful in remote inaccessible communities where technical know-how is limited. Under such conditions hand pumps must be cheap, robust and easily maintained. A numbe of available hand pumps fail to meet these criteria. This project which is designed to evolve reliable hand pumps for rural communities will have the following facets:

a. Review of previous work on hand pumps.
b. Identification of major operation and maintenance problems with existing hand pumps
c. Design of appropriate hand pumps to overcome short-comings of existing pumps.
d. Field trials of new pumps.
e. Preparation of guidelines for local productio of the new hand pumps.

Assistance Required : By WHO :

By IRC : Literature Review

By CI's: Supply of information on experiences with available hand pumps.

Priority : A

NO. 18

Title of Project	:	Development of Simple and Inexpensive Testing Methods for Field Examination of Water.
Project Agency	:	IRC
Objectives of Project	:	Examination of water samples in the rural areas has to be undertaken frequently for which unsophisticated techniques, adequate for field requirements need to be developed.
Description of Project	:	Study of available literature and make availabl- a suitable kit together with instruction manual which may be sent to several CI's and have it tested in the field. This will meet two purposes: a. to check water quality b. to evaluate treatment efficiency Modify the kit to meet regional requirements and make the information available to countries concerned.
Assistance Required	:	Funds to IRC to sub-contract the preparation of the kit and the manual. CI's to be approached to test the kit in the field.
Priority	:	B

5.4.4. Administration and Management

NO. 19

Title of Project : Criteria for Rates and Tariffs for Water Supplies.

Project Agency : IRC and several collaborating institutions.

Objectives of Project : To inform one country of the practices and related circumstances in others.

Description of Project : To assemble, with the help of the collaborating institutions, information concerning the rates and tariffs for water supplies, particularly in developing countries and to analyse these data, relating them to particular circumstances.

Assistance Required : By WHO : Publication of report

By IRC : Collation of data received from CI's and preparation of report

By CI's: Collection of data and information

Priority : A

NO. 20

Title of Project : Impact of Community Water Supply.

Project Agency : A collaborating institution in a developing country.

Objectives of Project : To evaluate the impact of community water supply and sanitation projects on community health and on the socio-economic life in a community.

Description of Project :
a. Literature review on health and socio-economic impact of water and sanitation projects.
b. Preparation of a complete socio-economic and health survey of selected pilot study areas before and after introduction of community water supply and sanitation projects.
c. Planning and execution of community water supply and sanitation projects in selected pilot study areas.
d. Quantifying the benefits of introducing water supply systems.

Assistance Required : By WHO : Personnel, equipment and supplies for project

By IRC : Supply of available information

By CI's: Local information and experience on the impact of such projects

Priority : A* (Developing Countries)

NO. 21

Title of Project : Seminars on Administration and Management.

Project Agency : WHO

Objectives of Project : To give an opportunity for advanced training in administrative matters to managers and high officials of community water supply agencies.

Description of Project : During a five-year period special meetings would be held in the different WHO regions.

Special manuals and information material would be prepared for each meeting according to local situations and conditions.

Assistance Required : By WHO : Consultantship services, fellowships, visual aids and special grants.

By IRC : Information and reference material on administrative techniques applicable to the management of CWS

By CI's: Coordination with the WHO regional or country projects in the arrangements with the national agencies who are supporting such projects.

Priority : A

NO. 22

Title of Project : The determination of unit and total consumption of domestic water. Present and future estimates with emphasis on alternatives to reduce wastage

Project Agency : A number of collaborating institutions.

Objectives of Project :

a. To determine unit consumption figures and their characteristics for developing nations
b. To explore population forecasting techniques and unit consumption projections to providin a basis for estimating future water need.
c. To investigate various technical and social alternative use to reduce water requirements

Description of Project :

a. Gather and analyze from existing sources unit use of water and pertinent variables, e.g. social and technical. Primarily for developing countries.
b. Explore population technology applicable and suitable to water projection needs.
c. Explore technical and social alternatives of saving water.

Technological -
- plumbing systems, fixtures
- flow limiting devices and peak control
- innovative solutions

Sociological -
- modes of water use and alternates in households
- modes of water use and alternates in the community
- social acceptance and economic benefits

d. Impact of use of alternatives on future requirements. Costs and benefit -
to the individual;
to the community.

NO. 22 (Cont.)

e. Identification, if any, of pertinent differences between urban and rural location.

Assistance Required : By WHO :

By IRC : Organize a "twinning or pairing" relationship between developed and developing CI's, and different regions Coordination of activities.

By CI's: Project implementation

Priority : A

NO. 23

Title of Project : Case Histories of Successful Water Supply in Developing Countries.

Project Agency : Collaborating institutions with WHO guidance.

Objectives of Project : To make available histories of successful and unsuccessful water supply projects as examples to others.

Description of Project : The compilation of case histories of successful water supply projects, especially in the rural areas of developing countries, with especial emphasis on the benefits (socio-economic) which have accrued.

Assistance Required : By WHO : Publication of case-study reports

By IRC : Establishment of criteria for evaluating projects

By CI's: On-site evaluation of projects and preparation of individual case-studies

Priority : B

NO. 24

Title of Project : Community Water Supply Projects Evaluation.

Project Agency : A number of collaborating institutions.

Objectives of Project : To collect data on a routine basis from past water supply projects to provide a feedback of information on water demands, system design weaknesses and operational problems and community benefits resulting from the system.

Description of Project :
a. Plan data collection in relation to local conditions and select projects.
b. Collect data over a five-year period from different types of community and water suppl service (including no supply system).
c. Evaluate data on a continuous basis and prepare interim reports so that water supply development can take advantage of the information.
d. Prepare final project evaluation report and make recommendations.

Assistance Required :

By WHO : Provide budget to IRC

By IRC : Coordinate programme
Select CI's on basis of proposals presented
Administer budget
Assist in developing project data collection and project selection
Prepare joint report

By CI's: Prepare proposal for submission to IRC
Select projects and design data collection system
Collect and evaluate data
Prepare interim and final reports

Priority : C

5.4.5 Training and training programmes

NO. 25

Title of Project : Development and Implementation of systematic Training Programmes in Community Water Supply on the base of Assessment of Manpower and Training Needs in the Water Supply Field in Developing Countries.

Project Agency : IRC and CI's in developing countries.

Objectives of Project : To obtain an accurate assessment of the manpower situation in the water supply field in developing countries.

To identify critical areas such as existing capabilities, utilization of personnel, labour turnover, training programmes and training needs.

To make recommendations on specific plans and actions to meet the identified needs.

To develop specific training projects directed towards the needs identified by the manpower and training assessment to form programmes relevant to each level of employment.

Description of Project : The project would be carried out in interested countries with the cooperation of CI's and relevant agencies. Methods and techniques would be developed by IRC to undertake the study. The data gathered would be thoroughly analyzed to determine manpower and training needs and specific plans proposed for the manpower development programs.
Then specific training projects by IRC in collaboration with CI's and consultants as required to include training manuals and teaching aids would be prepared. CI's would organize pilot training projects in collaboration with water executing agencies in developing countries using the training materials supplied by IRC. Such collaboration would involve active participation

NO. 25 (Cont.)

of the management of the executing agency. CI's could continiously give assistance to executing agencies in carrying out their own training programmes on a face-out basis. Developed training projects would be made available to other countries by IRC.

Assistance Required : by WHO : Technical advice on planning, execution and appraisal of the project. Financial support of project.

by IRC : Development of guidelines for carrying out the project. Collaboration in the planning stage of the project and in the dissemination of results. Provision of literature and information on the subject and of training materials. Preparation and coordination of the specific training projects.

by CI's: Promotion of the activity. Coordination with the governments to participate in the project. Assistance during the execution of the study at country level. Compilation of the preliminary report with an appraisal of results, conclusions and recommendations. Collaboration on the revue and publication of the final documents. Assistance in the specific training projects as specified above.

By external organizations:

Technical advise (possible sources AWWA, IWSA, and other professional and training institutions).

Priority : A* (Developing Countries).

NO. 26

Title of Project : Seminars on Urban and Rural Water Supply.

Project Agency : WHO

Objectives of Project : To provide a forum for the exchange of ideas and experiences on urban and rural water supply with a view to developing new ideas for more effective operations.

Description of Project : Collaborating institutions would present papers on urban and rural sanitation practices in their countries. The venue for the seminars should be chosen with due regard for appropriate field visits. Efforts should be made to display relevant literature, diagrams and materials. If appropriate, the seminars may be travelling semina

Assistance Required : by WHO : Funds for sponsoring participants and for equipment and supplies.

by IRC : Assistance in collating information on existing urban and rural water supply practices.

by CI's: Information on existing urban and rural sanitation practices, and on proposed innovations.

These seminars should be followed by refresher courses for those involved in the planning and administration of water supply programmes.

Priority : A

5.4.6 Dissemination of Information

NO. 27

Title of Project : Review of Field Use of WHO Technical Publications Related to Water Supply.

Project Agency : IRC

Objectives of Project : To investigate how they were distributed and if the material is available for the interested agencies and individuals.

To see how the scientific and technical knowledge contained in the publications has been appreciated and used by the interested sectors.

Description of Project : The IRC will contact the collaborating institutions to determine the availability of the documents considered in the study and to inform about the usefulness of them for the interested agencies and individuals.

Assistance Required : By WHO :

By IRC :

By CI's:

Priority : B

NO. 28

Title of Project : Selection, Translation and Distribution of Selected Technical Publications on Water Supply Subjects.

Project Agency : WHO International Reference Center for Community Water Supply, interested collaborating institutions.

Objectives of Project : To translate the selected technical publications of major interest to students, professionals and other groups in developing countries.

To use the resources of the International Network for Community Water Supply to develop this project through a coordinated action.

Description of Project : Selection of textbooks of high interest; translation and distribution to the interested countries.

Selection of the best pamphlets, manuals and booklets produced by associations, agencies, etc. for distribution; translated whenever possible.

Review of periodicals and selection of papers containing information of high interest to the countries participating in the project. Translation and/or distribution of them whenever possible.

Assistance Required : By WHO : Technical advice on the planning, execution and appraisal of the project.

By IRC : Collaboration in the search and selection of material.

By CI's: Translation, printing and distribution.

Priority : A

6. Proposed programme

6.1 Projects

With regard to the specific activities and projects for research and development identified in chapter 5, participants concluded that elaboration in greater detail is needed before actual performance and manpower and costs involved can be considered.

Participants had also in mind the possibility of certain projects of a short-term nature being of interest to the UN Governing Council for Environmental Programmes which is establishing an Environment Fund to be "used for financing such programmes of general interest as regional and global monitoring assessment and data-collecting systems, including as appropriate, costs for national counterparts; improvement of environmental quality management; environmental research; information exchange and dissemination; public education and training; assistance for national, regional and global environmental institutions; promotion of environmental research and studies for the development of industrial and other technologies best suited to a policy of economic growth compatible with adequate environmental safeguards and such other programmes as the Governing Council may decide upon. In the implementation of such programmes due account should be taken of the special needs of developing countries;" 1)

Furthermore, on the UN Conference on the Human Environment priority areas have been designated for research on "water supply, sewerage and waste disposal systems adapted to local conditions particularly in semi-tropical, Arctic and sub-Arctic areas" (recommendation 4(c)(VII) and the World Health Organization has been designated as the principal agency responsible for this undertaking.

Particular reference can further be made to the recommendations 4-1(c)(1), 4-1(c)(v), 4-2, 9, 10 and 52-1(b) of the same Conference.

The Fund is expected to amount to 100 million dollars for the first five year period.

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1) United Nations General Assembly (1972) Report of the United Nations Conference on the Human Environment held at Stockholm, 5-16 June 1972 (document A/CONF.48/14) p. 64

Participants at the Meeting concluded that priority should be given to the following projects:

No. 1 Health aspects of water-reuse / Long term health effects of consuming renovated water
(of interest to both industrialized and developing countries).

No. 7 Study of the health effects of trace elements in water.
(of interest mainly to industrialized countries)

No. 15 Slow sand filtration in developing countries
(directed to developing regions)

No. 16 Transfer and adaptation of relevant technology from industrialized to developing countries.
(directed to developing countries, but also of interest to certain regions in industrialized countries).

No. 20 Impact of community water supply
(of interest to developing countries)

No. 25 Development and implementation of systematic training programmes in community water supply on the base of assessment of manpower and training needs in developing countries
(in the first place directed to developing countries, but certainly also of interest to many industrialized countries).

6.2 Role of the Network

It was suggested that IRC and WHO in consultation should develop the special priority proposals into comprehensive research projects with a view to their early implementation funded from the regular budget, the UN Environment Fund or any other agencies budget, as appropriate. It is considered IRC's task to see if additional agencies can be found willing to finance projects as discussed at the Meeting. Consequently IRC will take steps in this respect, if appropriate in consultation with WHO.
In due time, WHO, IRC and the Collaborating Institutions will have as a function to cooperate in the performance of these projects, as preliminary stated on the several proposals.

Participants identified 19 additional high priority projects which are listed in the report. IRC will consider further work o some of the proposals in the future; subject to availability of funds, WHO may be in a position to stimulate implementation of these projects through consultation with IRC and Collaborating Institutions. In addition, the Collaborating Institutions may be interested in referring to them when developing their own research and development proposals. The same goes for the low priority projects, elements of which may be used in future programmes of Collaborating Institutions. The content of the proposals, which did not have direct relationship with water supply and are consequently not mentioned in this report, will be transferred to appropriate organizations and institutions.
It was a general feeling of the Meeting that the International Network for Community Water Supply - after giving follow-up to the agreement mentioned in section 3.4 - provides the appropriate infrastructure to coordinate and implement programmes proposed at the Meeting, thus adding to the solution of crucial problems in water supply in the world of today.

MEETING OF DIRECTORS OF INSTITUTIONS COLLABORATING WITH THE WHO INTERNATIONAL REFERENCE CENTRE FOR COMMUNITY WATER SUPPLY

Bilthoven, Netherlands

9 - 13 April 1973

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ANNEX 2

MEETING OF DIRECTORS OF INSTITUTIONS COLLABORATING WITH THE WHO INTERNATIONAL REFERENCE CENTRE FOR COMMUNITY WATER SUPPLY

Bilthoven, Netherlands

9 - 13 April, 1973

Draft Agenda

1. Opening of the meeting
2. Election of Chairman, Vice-Chairman, appointment of Rapporteurs.
3. Adoption of the Agenda
4. Statement of Manager IRC
5. International Programmes in the Community Water Supply Field
   - 5.1 The WHO Community Water Supply Programme
   - 5.2 Activities of the WHO Regional Offices
   - 5.3 Activities of other Organizations represented in the meeting
6. The WHO International Reference Network for Community Water Supply
   - 6.1 Review of work of WHO International Reference Centre for Community Water Supply (IRC/CWS)
   - 6.2 Review of work of Collaborating Institutions (CI's)
7. Research needs in WHO Member States
   - 7.1 Nature of present and future research and development in industrialized countries
   - 7.2 Nature of present and future research and development in developing countries
8. Possible methods of strengthening and improving the practical outputs of the IRC/CWS/CI-network
9. Implication of the recommendations from the UN Conference on the Human Environment
10. Proposals on specific activities and projects for Research and Development
    - 10.1 Health Aspects of Community Water Supply
    - 10.2 Urban Water Supply
    - 10.3 Rural Water Supply
    - 10.4 Administration and Management
    - 10.5 Training and Training Programmes
    - 10.6 Dissemination of Information
11. Presentation of specific proposals with priority allocation
12. Formulation of proposed programme for future collaborative action with priority allocation and consideration of ways and means to achieve this programme.
13. Concluding Session.

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LAUSANNE SEMINAR
29 May - 1 June 1973

Working Paper no. 14

Functioning of the International Network for Community Water Supply *)

by

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March 1973.

*) Originally: Background Paper to Meeting of Directors of Institutions Collaborating with WHO International Reference Centre for Community Water Supply Bilthoven, the Netherlands, 9-13 April 1973

1. SOME HISTORY

In the first 25 years of WHO's existence numerous new and excellent ideas have sustained a tremendous amount of activities directed to WHO's objective: "the attainment by all peoples of the highest possible level of health". One of the excellent ideas has been the setting up of systems of International Reference Centres.

It is beyond doubt that one of the foremost methods to arrive at a high level of both public and environmental health, is the provision of safe and adequate water on as large a scale as possible. And so the WHO Community Water Supply Programme, launched in 1959 in pursuance of a resolution adopted by the Twelfth World Health Assembly, had as its objective to assist Member Governments in the provision of ample, continuous and safe water to as many people as possible, as quickly as practicable, in a convenient manner and at a price they can afford.
Within this over-all objective, the C.W.S. Research and Development Programme aims at enlisting the aid of research, educational and other institutions throughout the world, in the solution of practical problems connected with the provision and improvement of community water supplies in those countries, where lack of funds and shortage of trained personnel are obstacles to successful efforts.

The mechanism whereby it was hoped to achieve the objective of these programmes was through the organization of a network of Collaborating Institutions in both developing and industrialized countries. It was the renewed implementation of an existing system to have these programmes sustained by the setting up of a WHO International Reference Centre (IRC) for Community Water Supply, which, under the auspices of WHO, followed the example of many other International Reference Centres, established throughout the world during the last 20 years. This new IRC, set up in December 1968 at the Netherlands Government Institute for Drinking Water Supply in The Hague, was to not only form a pool of information, knowledge and expertise in the community water supply field, but also to act as the nexus of a world-wide operating network of Collaborating Institutions, of which a description of the criteria of selection was included in WHO document CWS/70.6 (see annex 1).

As such it was expected that - as the progress report to the Twenty-first World Health Assembly states - "a network of communications would be established between WHO Head Quarters, the International Reference, the national collaborating institutions and health ministrie and other national agencies responsible for the planning and operation of water supplies".

In its first annual report IRC laid down its duties, which were then seen as the stimulation of research and development as well as the coordination of research on drinking water supply throughout the world, with the assistance of the Collaborating Institutions, for the benefit of both developed and developing countries and the development of criteria for design and operation of water supply facilities. Broad terms of reference were meant as a guide to activities to be undertaken

The 4-years history of this network for Community Water Supply had one important mile-stone half-way: the International Conference on Research and Development in Community Water Supply, in Dubrovnik in October 1970. The period before this Conference was characterized by two years of laborious attempts of many, to get this promising network into operatio The Conference itself meant a new impuls to the activities of the network and produced a large amount of valuable and original, but unclassified ideas and suggestions.

Some 60 participants and observers from 31 countries attended the Conference, the purpose of which was to explore ways in which educational and research organizations can contribute to the practical solutions of water supply problems in their respective countries, and in particular to networks of overcoming the twin obstacles of inadequate finances and insufficient skilled staff; to discuss needs for research and development studies; and to plan for the establishment of the international network of Collaborating Institutions, linked by the IRC.

Discussions focussed amongst other things on the identification of specific tasks or functions that the Collaborating Institutions might undertake following the Conference. A questionnaire was circulated and ultimately a consensus was achieved on a number of possible activities. (See Record of Proceedings p. 21). As to the IRC it was realized that

it was a brand-new organization which could only reach its ultimate goals step-by-step and should evaluate the demands for its services, and could resolve many questions of operational detail by operational experience only.
More specifically: it was agreed that the first step should be to act as a liaison between the Collaborating and other Institutions and to make information accessible through an up-to-date collection system. IRC services would include the preparation of state-of-the-art and background papers, mutual testing of equipment and other findings, financial support, translation facilities, and even political "leverage". There was a consensus that a Newsletter, including all relevant information, should be published regularly. Other activities of the Centre would include coordination of research and development, publication of guidelines and criteria for the design of community water supplies and compilation of information on training activities within Collaborating Institutions and elsewhere.
On the base of this and earlier information IRC compiled a 5-years programme at the end of 1970, approved by its Advisory Board, in which a sheet of detailed activities was taken up. It was showed that a staff of 30 people would be necessary to carry out the manifold tasks.

The period after the impuls of the Conference saw the network coming into operation and the first modest results came gradually to light. New ideas were born at congresses, visits to institutions and at WHO-meetings, and new contacts with other bodies were made (see Annual Report 1972). The second mile-stone in the history of the network, the Bilthoven-meeting, will undoubtedly give a new acceleration to this vehicle , which bears the burden of urgent activities.

2. PRESENT CONSTRAINTS

A comparison between the needs brought forward at the Dubrovnik Conference and the activities performed until now, makes clear that the output of the network has been smaller than was expected at the initial stages. One constraint, of course familiar to all, is the restricted staff and budget with which the IRC itself had to operate and without doubt this has considerably affected the operational output of the whole network. There are reasons to believe however, that a gradual improvement of IRC's situation comes in sight.

Another constraint, for the Collaborating Institutions, and partly due to IRC's limited possibilities of support, may have been the lack of a sound definition of the aims of the network, the vaguely defined means of collaboration; ways of communication and specific activities of both IRC and Collaborating Institutions.

It has further been supposed that one of the properties of the Collaborating Institutions would be the functioning as focal point in the activities concerning water supply and sanitation in their countries and in the exchange of information between their countries and IRC or WHO. Or - as has been stated in the background paper to the meeting of Directors of Institutions collaborating with the IRC for Wastes Disposal in November 1972 - in order that the Collaborating Institutions be truly effective they must reach out to institutions, government departments and agencies within their area of influence to discover the problems, the needs, the research and the solutions that may be appropriate in countries where development is taking place.

But even if Collaborating Institutions play an important role in research and development in their country, it is extremely difficult for them to lay hands on the needed background information. It goes without saying on the other hand, that the collection of information relevant to these activities by the IRC alone can impossibly lead to good results. It is even worse - and this is often the case - when the Collaborating Institutions cannot really act as the representatives of research and development in their countries. Besides, with many countries the IRC holds at present no contacts.

Yet, the network has proven itself. It has been shown that the establishment of this sytem in the field of sanitary services must be regarded as a successful decision. The network can deliver a valuable contribution to the improvement of the lacks of communication existing all over the world, and through this accelerate the activities leading to better water supply services.
The network deserves to be further perfected now it is passing the age of childhood. It is worth better terms of reference, to have its communication channels further improved and to undergo an enlargement where necessary.

3. THE FUNCTIONS OF THE NETWORK

Through its contacts with the Member Countries, WHO has a good knowledge of general needs, problems to be solved and research to be undertaken. Programmes are being established on the base of this information and it is within this scope that IRC has formulated new terms of reference for its action in the future (see annex 2).
The activities fall under three main headings, and it is felt that the international collaboration of the institutions within the network would follow the same lines:

- Information exchange;
- Research and development;
- Education and training.

In the following it will be attempted to give some general ideas on specific activities which could be performed by the Collaborating Institutions.

Information exchange

- One of the problems to overcome is the fact that the Collaborating Institutions do not know which information is needed elsewhere and that IRC does not know what is available at the Institutions and vice versa. A great help would be the exchange of annual reports, and the provision of information and suggestions related to the actions performed, on own initiative and from both sides.
- A service which would also make the information exchange easier, would be the provision of lists of available publications and

reports, and the automatic supply of copies of new publications within the network.

- It needs no empahsis that the input of information for the Newsletter from the network has now been reduced to practically zero. Yet the impact of the Newsletter has been shown to be considerable and new approaches, such as regular sheets sent by IRC to the Institutions might help save the Newsletter from its undoing.
- Collaborating Institutions should actively form a link between bodies and agencies in their countries on the one hand, and Reference Centre(s) on the other hand, on the exchange of information and the handling of requests and questionnaires. The Institutions should not try to handle them all themselves, as more appropriate bodies in their countries might be available and delegation is needed in order to reduce the problems of lack of staff.
- The Institutions should search for relevant papers, reports and project descriptions in their countries and send those on own intitiative to the IRC, which can make them available to others through Newsletter, abstracting services and - ultimately - summarizing reviews. All Collaborating Institutions should be alert for information on new developments in the use of national resources, an item which is of high importance, therefore frequently discussed but about which hardly any information can be obtained. Transfer of such information to the IRC could result in world-wide application of usefly ideas.
- The provision of national research and development plans, if existing to the IRC, would be a great help in assisting countries without such plans.
- The representative of the Institution in the network should have contacts with individuals in his country which can advice on specific matters, organize events when necessary and lend a hand with the preparation of abstracts.
- Obviously the Institutions can play a role in the provision of data on institutional services, training programmes, conferences and seminars, and documentation facilities.
- In general the Institutions should keep the IRC abreast of all possible activities going on in their countries in the field of drinking water supplies, be it in the form of reports, periodic reviews, news messages, or even press-cuttings.

It should not be necessary to emphasize that only information made available, can be made further available and that only through mutual cooperation the Collaborating Institutions as well as the IRC can benefit from each others expertise and knowledge.

Research and development

One of the major inputs of many Collaborating Institutions would be the cooperation in research projects. New ideas will be discussed at length during the present meeting and only general remarks will be made here on improvement of the communication.

- Not only for the provision of information, but also in order to be able to have broad research projects carried out in their countries, without again entering the problem of the well-known limited staff, the Collaborating Institutions must maintain close liaison with the several (if existing) bodies in their countries working in the water supply field. Both research needs and potentialities can only be identified through close contacts. The IRC can only give impulses to broad research and development activities, if a proper impression exists of institutional services.
- IRC will need advice on research needs and specific problems to be solved. That means: for the benefit of the countries and not for individuals or private companies who at present seem to be able to find the IRC the easiest and from which most requests are received. The Institutions - it is again emphasized - will need to have close contacts with the operative organizations. Only on the base of information on every-day problems felt in the countries, and of suggestions from individuals working on the appropriate level, can IRC set priorities.
- In the near future IRC plans to undertake testing activities on existing simple and labour intensive technologies and low-cost devices. The assistance of the Institutions in such activities should be expected, both in the provision of testing facilities, the information on existing technologies and last but not least - development of effective systems for water supply based on local skill technology and available materials in their countries.
  Although such activities would be undertaken unpon request, own initiative would add to the impact of such work.

- Research-coordination cannot be performed from behind desks in Geneva or The Hague. Researchers in the countries should regularly be made aware of larger possibilities than just local cooperation. Public relations for the network's goals might be one of the tasks of the Collaborating Institutions.
- It will be clear that international cooperation means international travel. In the budgets for research projects attention has to be paid to this aspect (and to connected training courses). The Institutions would have to emphasize this point in their own country.

One remark may be made, which was already brought forward on earlier occasions: the integrated approach of sanitary problems in developing countries, and cooperation between the activities of the now existing and further to be founded networks. Research undertaken in Collaborating Institutions within the developing countries, should not ignore the relationship between water supply, waste water treatment solid wastes disposal and further disciplines. The developing countries should avoid the mistakes made by the industrialized countries during their earlier stages of development.

Further, seeing the large emphasis on water resources problems, both in Dubrovnik and in the recent WHO questionnaire, one cannot help but wonder if research, information exchange and training in this field should not be part of the network's activities.

Education and training

One of the basic constraints in the development of water supplies in developing countries might be the lack of motivation. Motiviation is needed as an important stimulans to get things done. Governments must be persuaded that not only water supply is needed, but that it can be designed, constructed, operated and paid for successfully. In Latin America an enormous leap forward has been made. The motivation was high One of the most important tasks of the network and especially of the Collaborating Institutions in developing countries might be the triggering of motivations. Education and training are the activities which lead to it.

- Brochures, articles, speeches, lectures, motion pictures, radio and television coverage, together with visitor centres, guided tours, open days and visits to pilot plants assist in improving public

acceptance and cooperation in reaching project goals. Collaborating Institutions in developing countries might undertake and trigger those activities. It would be the tasks of the IRC, assisted by Collaborating Institutions in industrialized countries to sustain these efforts.

- Seminars are not difficult to organize, especially on a local level, and the impact on decision-makers might be considerable. Seminars and short courses for the management level might add to the availability of leaders. On the other hand courses on the spot for the operational level are highly needed in many developing countries. In the organization of all these events the Collaborating Institutions in both developing and industrialized countries could play and important role, which might go beyond the Institution's task defined, but would greatly help to improve the present water supply situation. It would be IRC's task to supply information, handbooks, training manuals and on specific requests for help, IRC could establish activities in these matters.
- On the other hand, IRC plans to start travelling "snow-ball" courses, based on training experience in West-European and Latin-American countries and applied to the needs of the countries concerned. Unpon request, Institutions will be supposed to house such courses, to assist in the organization and the compilation of manuals.
- Especially Collaborating Institutions in the Latin-American countries could be of great help in assisting in the translation of Spanish manuals for the benefit of colleagues in the other countries.
- Preparation and translation of hand-books and manuals into local languages could be one of the activities of Collaborating Institutions. Exchange of such documents within the network would add to the usefulness.

4. EXTENSION OF THE NETWORK

External extension

The network should be expanded to countries in which no Collaborating Institutions have been nominated yet. One look at the map will reveal that the network is unevenly spread over the world. As large as possible a geographical spreading should be strived after and Collaborating Institutions could now have an important input by suggesting

institutions they think appropriate.
A sound approach would be if a WHO or Reference Centre staffmember, assisted by representatives of the countries concerned, would visit the countries, in order to obtain a clear picture of institutional services, before an institution would be nominated. Existing procedures for the designation of Collaborating Institutions (as stated in WHO Manual X.7) in no way restrict such an approach. It should be emphasized that not only to representation of the country but also to institutional potentiality attention must be given.

Now University and Research Institutions make up the lion's share of the Collaborating Institutions within the network as a result of the early stages when the network was thought to be more directed to research than to application, as it is now. Undoubtedly there is a role to be played by health ministries and national agencies responsible for planning and operation of water supplies, as has been stated in the earlier mentioned progress report to the Twenty-first World Health Assembly.

Internal extension

WHO's document CWS/70.6 (Community Water Supply Research Development Programme) states: "It is considered absolutely essential that institutions collaborating in the programme should maintain a close liaison with the government departments responsible for the construction, operation and surveillance of water supplies in the country, so that the results of any research and development work carried out may be translated into practical action, and implemented as appropriate, as early as possible". Indeed, in order to arrive at an optimum operation of the network, the Collaborating Institutions should maintain such contacts, action as liaison between their country's interest and the international scene.

As has been discussed already, an appropriate system, assuring an effective flow of information between IRC and the various countries, would consist of the IRC on one side and the national Collaborating Institutions representing the countries on the other side, if possible interlinked by Regional Reference Centres. These national Collaborating Institutions would represent their countries in all possible activities in the water supply field: information exchange, research and appli-

cation of knowledge and training and education. IRC would form the nexus between these national Collaborating Institutions which would take care of contacts with institutions and agencies in their country. This would avoid time-consuming efforts to find the proper contacts enabling the interchange of the enormous amount of existing, developing and applied information in the countries by international bodies.

The national Collaborating Institutions should of course not necessarily be involved themselves in the whole range of activities but at least be aware of, and have close contacts with institutional services and practical application. An additional number of institutions per country should in fact assist the Collaborating Institutions as official part of the system. The Collaborating Institution (the most suitable one of the Institutions in a country) would then link the thus established national network of assisting institutions, universities and agencies with the IRC (or Regional Reference Centre).
If desired the national Collaborating Institutions could just restrict themselves to establishment of lines of communcations between the assisting institutions and the IRC's and RRC's after which direct contacts can be held. In general the national Collaborating Institution would act as representative of its country's interest in the IRC-network.

The described system is actually already in operation in some countries and no doubt it forms a useful addition to the already existing link between WHO and the countries through Governments and WHO Regional Offices.
Additional advantage of the suggested extension of the system is that also better contacts within the countries are established.
It would be well possible that in the system, institutions would be involved which do not have opportunities yet to actively cooperate. Also for these institutions which are only on the receiving side, a necessity of collaboration is present. The role of the International Reference Centre in assisting these Collaborating Institutions would be primarily to enable them to develop and improve liaison with more established organizations and to strengthen the international resources available to them. It may however not be the case that a country is represented by one institution which is not able to play and active role.

It should be added that in order to arrive at a sound cooperation, the Collaborating Institutions would have to nominate a person who would be responsible for the contacts within the countries and with the Reference Centres. Another organizational point: the establishment of twin or cooperation relationships between strong and weak institutions (e.g. in industrialized and developing countries respectively) has often been discussed, but not yet been carried out. It needs serious thought if such a system could be promoted by the IRC.

Many more suggestions to improve communications could be given and any idea will be welcome. Constructive and active collaboration means action on own initiative, and only if periodic thought is given to the role of international collaboration, the Institutions themselves will be able to find that they gain by it.

If this Conference will prove to be another mile-stone in furthering the coordination and strengthening of the community water supply network, then again an important step has been taken on the road leading to water for all.

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The main criteria of selection of collaborating institutions (WHO document CWS/70.6: "Community Water Supply Research and Development Programme"):

a) Each institution should already be active in the study of water supply problems, and should be staffed and equipped to continue such studies. Alternatively an institution, active in research in other fields, which wishes to extend its programme to cover water supply subjects would be considered.

b) It should be concerned with the identification and practical solution of such problems within its own country, and should maintain a close contact with the operative organizations responsible for implementation of water supply programmes.

c) It should be prepared to co-operate with similar institutions in other countries, and to pass on results of work which may be of interest to other institutions engaged upon similar problems.

d) It should be willing to support the national community water supply programme in any appropriate way, such as publicising technical material, education of the public, encouragement of the water supply profession, assistance to training programmes, sponsoring of seminars and other meetings.

These conditions apply more especially to collaborating institutions within developing countries. Similar institutions in the more highly industrialized countries will also be invited to collaborate; in the case of these, the following criteria will apply:

a) Each institution should already be active in the study of water supply problems, and should be staffed and equipped to continue such studies.

b) It should be interested in water supply problems overseas, particularly those arising in developing countries, and should be prepared upon request, to study and advise upon the solution of such problems as lie within its specialized field.

c) It should be prepared, when requested, to support the efforts of other collaborating institutions by exchange of information, making available the results of relevant research, accepting fellows for training and widening of experience, and generally to promote the over all aims of the programme.

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TERMS OF REFERENCE IRC/CWS

- to build up and maintain a reference library on problems of both urban and rural water supplies, to disseminate the available information through newsletters, a documentation storage and retrieval system and state-of-the-art publications, with an emphasis on the transfer of information to developing countries, and to establish a data bank on programmes and facilities in the water supply field.

- to integrate the expertise available in collaborating institutions, to assist these institutions in both national and wider scoped programmes and activities in community water supply, and to undertake cooperative liaison activities concerning the inventory of needs and resources of water supplies, coordination of research and use of institutional facilities.

- to promote, initiate, conduct and coordinate research and research projects in cooperation with WHO and collaborating institutions and other bodies and organizations and to organize and actively participate in meetings and conferences concerning research in water supply.

- to evaluate and test available information and technology and to develop guidelines and design criteria on the planning, design, construction, operation and management of urban and rural water supplies (in the first instance) with an emphasis on the use of locally available skills and materials applicable in developing countries, the development and evaluation of appropriate technologies and interim measures for rural water supply and emergency situations.

- to sustain the development of standards on the quality of drinking water and guidelines on the control of deleterious substances, and to promote, conduct and coordinate studies and meetings on effects and removal of these substances.

- to promote, organize and evaluate training courses and seminars concerning planning, design, construction, operation and management of water supplies for scientific and technical personnel working in the water supply field, to organize fellowships and exchanges, and to promote educational programmes, first of all in and to the benefit of developing countries.

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Rural Water Supply
and Sanitation

Emanuel Idelovitch
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INTERDISCIPLINARY TRAINING OF NATIONAL ENGINEERS AND TECHNICIANS FOR THE IMPLEMENTATION OF RURAL WATER SUPPLY PROGRAMMES

1. Foreword

The limited availability of adequately trained personnel has been repeatedly identified as one of the major constraints in improving the water supply situation in rural areas of developing countries; however, the specific problems encountered at each level of training have seldom been precisely identified. Consequently, only few initiatives have been taken with the purpose of producing a radical change in the existing training programmes for sanitary engineers and technicians, or for creating new frameworks, better adapted to the needs of rural areas of developing countries.

The aim of this paper is to identify some limitations in the training of personnel for rural water supply systems in developing countries, and to make suggestions for improvement, mainly in the field of manpower required for the design, construction, operation and maintenance of simple water supply works.

2. Manpower requirements and availability

The manpower required for the implementation of rural water supply programmes consists of several categories and levels corresponding to the various stages of the programme, which can be grouped as follows:

1. Top professionals such as engineers, economists or social scientists, required at the stage of general planning of the national and regional programmes, who are in charge of policies, priorities, resource-allocation, etc.

2. Qualified personnel needed for the planning, design and construction of the various water supply systems, comprising geologists, hydrologists, civil and sanitary engineers, technicians, draughtsmen, etc.

3. Staff needed for the operation, maintenance and administration of the systems, which include a limited number of engineers; intermediate-level professionals who must be qualified technicians such as health inspectors, sanitarians, superintendents or plant operators; and skilled workmen such as pump mechanics, plumbers, masons, etc.

The first group mentioned above generally consists of a few individuals, highly specialized and deeply motivated, who already exist or are now growing, in most - if not all - the developing countries. Besides international organisations such as the World Health Organisation and the World Bank provide their assistance particularly at this stage of general planning by means of sectorial studies, evaluation missions and short-term consultants (1).

Within the second group mentioned above, the engineering personnel needed for the design and construction of water supply systems is generally supplied by the Engineering Department at National Universities or by international degree courses organised by European or American universities. In some cases post-graduate courses in sanitary engineering are specifically designed for participants from developing countries. In addition, companies of foreign consultants or contractors, sponsored by government aid programmes or bank loans as well as volunteer organizations and salaried individuals, also provide highly trained professionals for the planning, design and construction of water supply systems.

The last group - that of intermediate level professionals - is normally provided by public health colleges and technical schools, which train public health inspectors or plant technicians, and by on-job training schemes provided by national institutes dealing with water supply and sanitation.

This paper does not deal with the training of the first group described above (the top level staff) which does not appear to be a critical factor and for which formal training schemes can hardly be devised. It is believed that, if improvements are achieved in the approach to training of the other two groups and if increased importance is attached to rural water supply, the growth of high-class professionals to deal with the problems of the sector will be implicitly accelerated.

3. Training of Engineers

The major problems in the field of engineering training, which seem to hinder the prospects for achieving a more rapid improvement of the rural water supply situation, appear to be the following:

1. The lack of sufficient national sanitary engineers in general.
2. The lack of national sanitary engineers actually working in the government entity in charge of rural water supply.
3. The lack of motivation for national engineers to work in remote, underdeveloped parts of the country.
4. The lack of adequate training, specifically adapted to the problem of water supply in rural areas.

Not all the constraints apply to all developing countries; in most cases one, or a combination of two, constraints applies; in very few most fortunate cases, none of these constraints obtains. In Kenya, for example, where there is a faculty of sanitary engineering at the University of Nairobi, only one Kenyan engineer has been recruited to work with the Water Development Department of the Ministry of Agriculture, the main government body dealing with community water supply, during the three-year period 1968-1971. The reasons have been identified in the

Sectorial Study for Community and Rural Water Supply which is being carried out by WHO (2). They are the insufficient output of the University of Nairobi as compared with the needs of an ambitious urban and rural water programme, and the deficient policy for staff recruitments of the Water Development Department, i.e. constraints 1. and 2. above.

Regarding constraints 1. and 2, very little can be suggested beyond the standard prescriptions such as "more importance should be attached to the training of national sanitary engineers to help solving the problems of rural areas" and "suitable policies and incentives should be introduced to attract more engineers to government entities working in the field of rural water supply". Despite the few individuals who are striving in many countries to apply these ideas, rapid changes cannot be expected to occur. The output of a university is a matter decided on the basis of many other factors than just water supply, and it is difficult to prove the increased economic benefits resulting from multiplying the trained personnel available by increasing the resources allocated to it. (In fact, if the training is not adequate to the needs of the country, the opposite might be true). The policy of a government entity, as well as the level of salaries and general conditions of work of the employees, is something that cannot be changed overnight either.

Nor is the third constraint - the lack of motivation of engineers to work in rural areas - one that can be easily removed. If courses in sanitary engineering included some lectures on the socio-economic conditions of the country and on the problems of rural development in general, and if international courses included presentation of more rural case studies from the countries of origin of the participants, the graduates would have probably been more aware of the problems of the rural population in their countries, and in some cases they might even be more willing to make some personal sacrifice in order to help solve their country's problems. However, this would not bring "masses" of engineers to the field, for construction and operation of simple water supply systems for small villages or disperse settlements. It is believed that this constraint should be rather accepted and the question to be asked is not only "how can more engineers be attracted to the field of rural water supply?" but mainly "must engineers be the ones who design, construct and operate village water systems?" This is discussed in more detail in the following section.

The last constraint listed on the previous page - the lack of specific training in rural water supply and sanitation - is perhaps the most universal one and the one for which it is easier to suggest and introduce improvements. The emphasis in most sanitary engineering courses seems to be on the more sophisticated "urban" water supply. The technological alternatives and the design criteria advocated are generally those used for urban areas. Little reference, if any at all, is made to the specific problems of the rural population. Simple technologies such as hand-dug wells, rainfall catchment, or animal-driven pumps, are considered too "simple" to have to be formally instructed. As a result they remain the privilege of skilled craftsmen, while engineers generally ignore them. As a result, the graduates of the engineering schools are not "equipped" to compete with the problems posed by the majority of the local population. As one official in a developing country sharply expressed it: "our engineers are good to be

shipped to Europe, since they were taught to solve Europe's problems and not our country's".

This limitation is well reflected in text books available for rural water supply too. While extensive literature is available on well drilling methods, for example, only limited information is available on methods of construction of protected hand dug wells. Detailed manuals are available for various types of mechanical pumps, but there is little information compiled on hand pumps. The best textbook available covering all aspects of rural water supply, including some simple technologies, is still Wagner & Lanoix's Water Supply for Rural Areas and Small Communities published by WHO in 1959. Water supply for livestock - a subject closely related to domestic water supply in rural areas of developing countries - is generally neglected, yet one of the major problems in areas of nomadic population is how to construct sanitary, dual-purpose systems for human and animal consumption.

Three of the most popular post-graduate courses in sanitary engineering which have been attracting students from a large number of developing countries are those held at the University of North Carolina (USA), the Delft Technological University (Netherlands) and the University of Newcastle-upon-Tyne (Great Britain).

The University of North Carolina instituted in 1962 an International Program in Sanitary Engineering Design (IPSED), sponsored by the US Agency for International Development (AID) which is conducted by the Department of Environmental Sciences and Engineering, School of Public Health, at Chapel Hill (3). Participants are requested to hold an engineering degree and to have some experience in sanitary engineering. At the end of the course, they receive a Certificate of Achievement. The program does not lead to any higher degree, but credit can be received for the taught courses. It lasts one academic year, consisting of three phases: the Academic, the Municipal, and the Design. In the Academic phase, formal courses are taught in subjects such as the design of hydraulic structures, ground water hydrology, water resources planning in developing countries. In the Municipal phase, participants are assigned to one month's residence at a Municipal water works for operating and management experience. In the Design phase, participants are individually assigned to the offices of an international consulting engineering firm specialising in water and waste water projects. During the seven-year period 1962-1968, 87 engineers from 34 countries have participated in the Program (4), i.e. an average output of about 12 participants per year.

The Delft Technological University offers a one-year International Course in Sanitary Engineering, attended by an average of 20 students per year. Participants who pass the required examination are awarded a Diploma in Sanitary Engineering; those who do not take examinations are awarded a Certificate of Attendance, and can devote more time to professional activities. From a list of about 30 subjects taught at this course, only one is related directly to rural water supply. The major assignments during the three terms of this course in 1969-1970 were design and computation of water distribution and waste water collection networks; design of water purification plants and of waste treatment plants; water quality management projects (5). The requirements for the Diploma degree consisted of written examinations in

hydraulics, statistics, hydrology, reports on laboratory work in chemistry and microbiology, problems on ground water flow and hydrology, design assignments on networks for water distribution and sewage collection.

The University of Newcastle-upon-Tyne has been providing since 1950 a 12-month full-time post-graduate course in Public Health Engineering, leading to the award of an MSc in Applied Sciences, or a 9-month course for a Diploma in Public Health Engineering. The subjects taught include unit processes and operation, biological engineering, public health and environmental sanitation, hydraulics and pipeline engineering, plant design, water management, statistics, laboratory course (6).

A review of the curricula of these courses, as well as the opinion of some engineers from developing countries who participated in them and are now working in rural water supply, indicate that, while the programmes are greatly valued and held at a high level, the emphasis is, in general, on the sophisticated urban systems, while very little is done in relation with the specific problems of rural areas.

A remarkable initiative has been taken in 1972 by the Department of Civil Engineering, Loughborough University of Technology (Great Britain) which has held a one week seminar/short course on "public health engineering in developing countries". A similar course, followed by a two-day conference, will be held in September 1973 on "environmental health engineering in hot climates and developing countries". The programme of the course includes subjects such as low-cost water treatment for rural areas, low-cost sanitation for rural areas, social and cultural barriers to environmental health development, etc. Such courses have to be multiplied and expanded.

The following suggestions are made for the training of engineers:

1. Courses in sanitary engineering held at national universities in developing countries and international courses designed for participants from developing countries should deal more emphatically with the problems of rural water supply and sanitation in rural areas, since a certain proportion of the graduates will have to work in this field.

2. Short courses, seminars and conferences dealing with specific problems of rural areas in developing countries should be organized in order to enable exchange of knowledge and ideas between engineers from developing countries, research workers from universities and research institutes, engineers from consulting engineering firms and personnel of international organizations dealing with rural water supply and sanitation.

3. Initiative should be taken for setting up a suitable framework for the development of a course in "public health engineering for rural areas in developing countries".

   In the first stage the course could last 2-3 months, and then, if successful, it could be extended to a full year. Such a course should combine lecture and seminar work with practical field work in rural areas. It could be held in a developing country which has

an important program for rural water supply and sanitation or there could be a combination between part-time in a developed country where it might be easier to concentrate high level, experienced teaching staff, and part-time field work in a developing country.

4. Training of Technicians

Experience in many developing countries has shown beyond any doubt that a major reason for the failure of rural water supply systems has been the lack of follow-up after the construction was completed. New systems were handed over to local authorities but, mainly due to lack of trained personnel, their operation and maintenance has been ignored or carried out inadequately and, as a result, the systems were out of order after a short while.

As more people in rural areas are being supplied with improved water supplies, more systems will have to be operated and maintained. If simple technology is to be introduced on a larger scale, the problems of operation and maintenance will certainly be reduced, but they will not be totally eliminated.

Thus there is a great need for setting up a suitable framework for the training of intermediate level staff who should operate, maintain, and administer small water supply systems. Such qualified personnel could also be trained for the design and construction of simple water supply and excreta disposal systems, and for the general understanding of other rural sanitation problems such as food sanitation, solid waste disposal, hygiene education, etc. The suggested course should be inter-disciplinary in its character, including study of the technical aspects of the problem (design criteria and technological choices), as well as its social, medical, financial and administrative aspects.

In some countries, e.g. Kenya, Ethiopia, training in the construction of small water supply systems is included in the training programme of Public Health Inspectors, who become actively involved in the construction and O & M of small water supply systems for schools, hospitals, health centres and villages.

What is needed is a comprehensive programme for training "sanitary technicians" which should combine a minimum of theoretical background with a maximum of practical field work that could be carried out in conjunction with a pilot project for simple technology in rural areas. Such a programme should be established in a developing country which presents environmental conditions and problems typical for many other countries, and should be designed for participants from various countries.

A thought which has occurred during my recent trip to Africa was that such a course could be incorporated into the new National Institute of Public Health planned to be set up at the Kenyatta National Hospital, Nairobi, Kenya. This is a project now in the stage of searching appropriate financing and its scope has not been exactly established yet. Another idea would be to set up in the first stage a pilot course for a limited number of people before extending it to an official national framework. In this case, Ethiopia could be a suitable place due to its

variety of ecological conditions and the existence of several integrated rural development projects being carried out, which attach great importance to the water supply problems. A third possibility would be to develop such a pilot course within an existing school such as the Weija School in Ghana, which is run by the Ghana Water and Sewerage Corporation and is training technicians for the O & M of water supply systems. A grant from the Canadian government is now under negotiation for the extension of this school and the construction of additional facilities.

Such programmes as those suggested in this paper for engineers and technicians have to be initiated and sponsored by an international organization, but must have the support of the national institutes dealing with rural water supply in developing countries.

It is believed that a more rapid progress in rural water supply and sanitation will not be possible unless some radical measures are undertaken in the field of training for the specific purposes of rural areas in developing countries. At a stage when many countries are embarking on large scale programmes for improvement of the rural water supply situation, when international organizations give the sector a greater emphasis than in the past, it appears most logical to evaluate the available training facilities and to make the necessary adjustments.

Notes

(1) Two reports now under preparation by WHO and IBRD will provide comprehensive information mainly on aspects related to planning and policies of rural water supply programmes.

WHO: "General guidelines for the Preparation of National Rural Water Supply Programmes" by W. E. Wood, Preliminary Draft, Feb. 1973

IBRD: "Village water supply in developing countries, Problems and Policies", by Robert J. Saunders, Professor and Chairman, Department of Economics, Kent State University. Preliminary Draft, March 1973.

(2) Government of Kenya, Sectorial Study and National Programming for Community and Rural Water Supply, Sewerage and Water Pollution Control; Report No. 2, "Recommendations on National Programme for Community Water Supply Development", WHO Brazzaville, May 1972.

(3) IPSED (International Program in Sanitary Engineering Design): "Water Works Engineering", Department of Environmental Sciences and Engineering, School of Public Health, University of North Carolina, Chapel Hill (leaflet).

(4) Op. Cit., page 3

(5) Delft Technological University: "International Courses in Hydraulic and Sanitary Engineering - Handbook 1969-1970, Sanitary Engineering II", Delft, Netherlands.

(6) University of Newcastle-upon-Tyne, School of Advanced Studies in Applied Science: "Post-graduate Courses in Public Health Engineering", Department of Civil Engineering (leaflet).

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RURAL WATER SUPPLY AND SANITATION SEMINAR
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SOME THEORETICAL AND PRACTICAL CONSIDERATIONS ON RURAL WATER SUPPLY AND SANITATION FOR VILLAGES OF DEVELOPING COUNTRIE

CONTENTS

Ecole Polytechnique Fédérale de Lausanne
GENIE DE L'ENVIRONNEMENT
Professeur Y. Maystre

N° 1

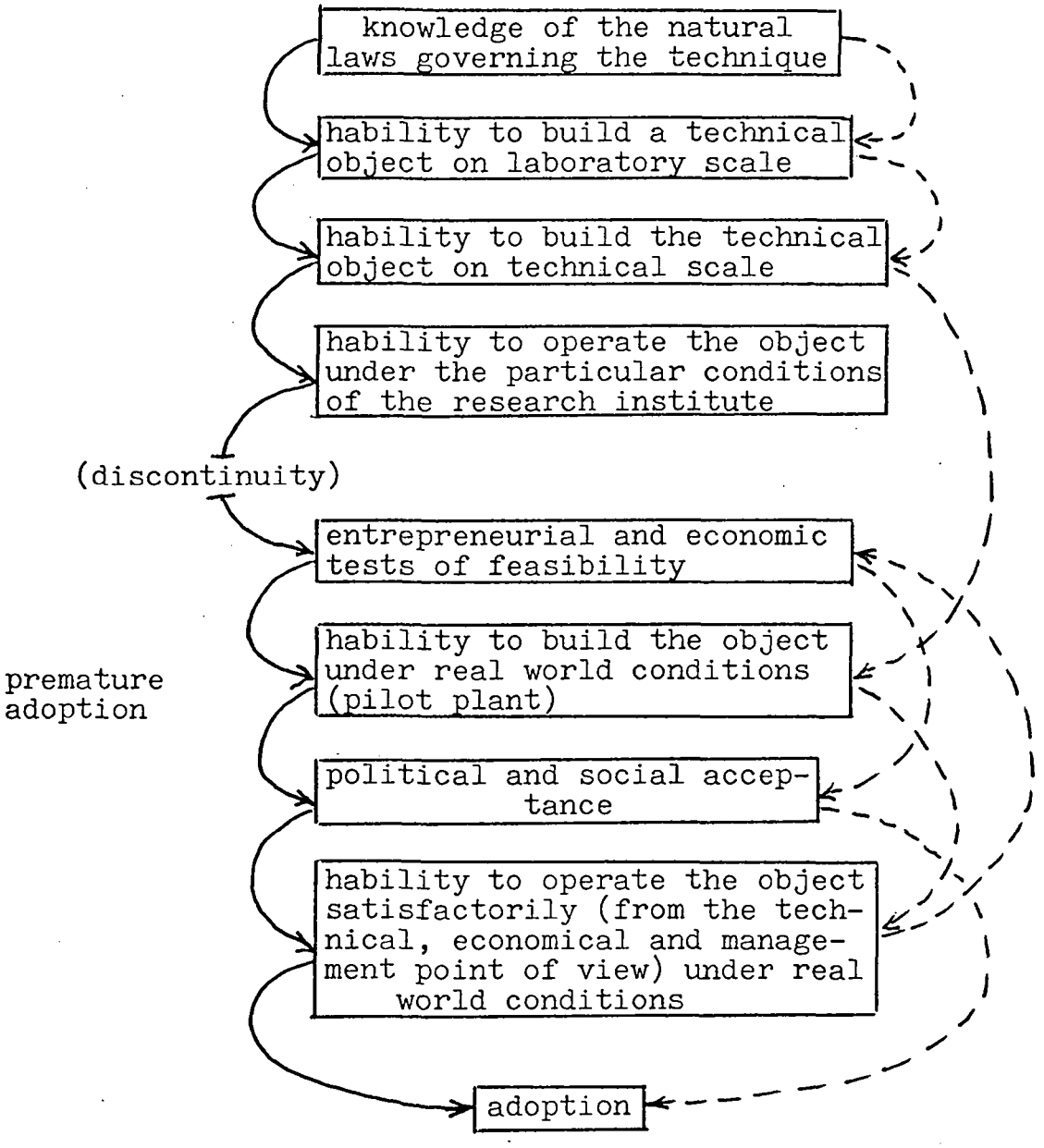
RURAL WATER SUPPLY AND SANITATION: SOME COMMENTS FROM INDIA

1. chlorination generally deficient on small water supply networks.
2. the villages lack of appropriate personnel: maintenance and operation should be handed over to a regional (State) service.
3. a larger service offers more possibilities of promotion.
4. the present tendency is for centralized water supplies with a distribution system for some ten villages (total population 10 to 40 thousand). Individual or group wells tend to be abandonned.
5. pumping by hand requires too much effort from the women who already work hard in the fields.
6. the most striking argument for a motivation is not always the scientifically most correct: motivation for latrines for health reasons is too low; but for privacy reasons and because of snakes in the fields, the motivation is high.
7. religions all contain some behaviour rules connected with health: systematic research is needed in this direction to revitalize the traditionnal health codes.
8. urgent needs for technical manuals in local language, easy, practical and with many illustrations.
9. water shortage inflicts intermittent water supplies on distribution systems: raises the problem of the individual storage between supplies.
10. arrangements around wells and foutains always insufficient: women make laundry, children wash (two water consuming activities) so as to have less water to carry home.
11. How much is reasonable to expect from the family income for water supply ? About 5% (on 700 Rs/family/year). Amounts to about 7 Rs/capita/year. Important for financial planification.
12. Low sense for common property: what is public belongs to nobody. If a child is seen braking down the tap of a fountain with a stone, nobody will tell.
13. the delusion of official statistics: the State constructs a great number of new water supply systems, but everywhere the water at the tap is contaminated.
14. people are not crazy about latrines: they feel these replace old nuisances by new ones (bad smells, clogging). So, why pay for it?
15. Mr Rotkar, from Amravati division of the public health engineering dept. mentions a case where water supply has brought on a 10 times reduction of typhoid and cholera. He prepares a report on the case for end of 1973.
16. Engineers of PHE have no contact with the sanitary inspectors of the Health centers.
17. The medical doctors are not yet persuaded of the preventive action of a good water supply: in one village, the local public doctor confessed he never checked the chorine content of the water.
18. Any training program will fail if the chances of promotion in the profession are not clear to the students: see the failure of the program for rural mechanics: they were offered no future and the class had to close after 2 years.

THE "CHALLENGE-AND-RESPONSE" FATE OF A TECHNICAL INNOVATION;

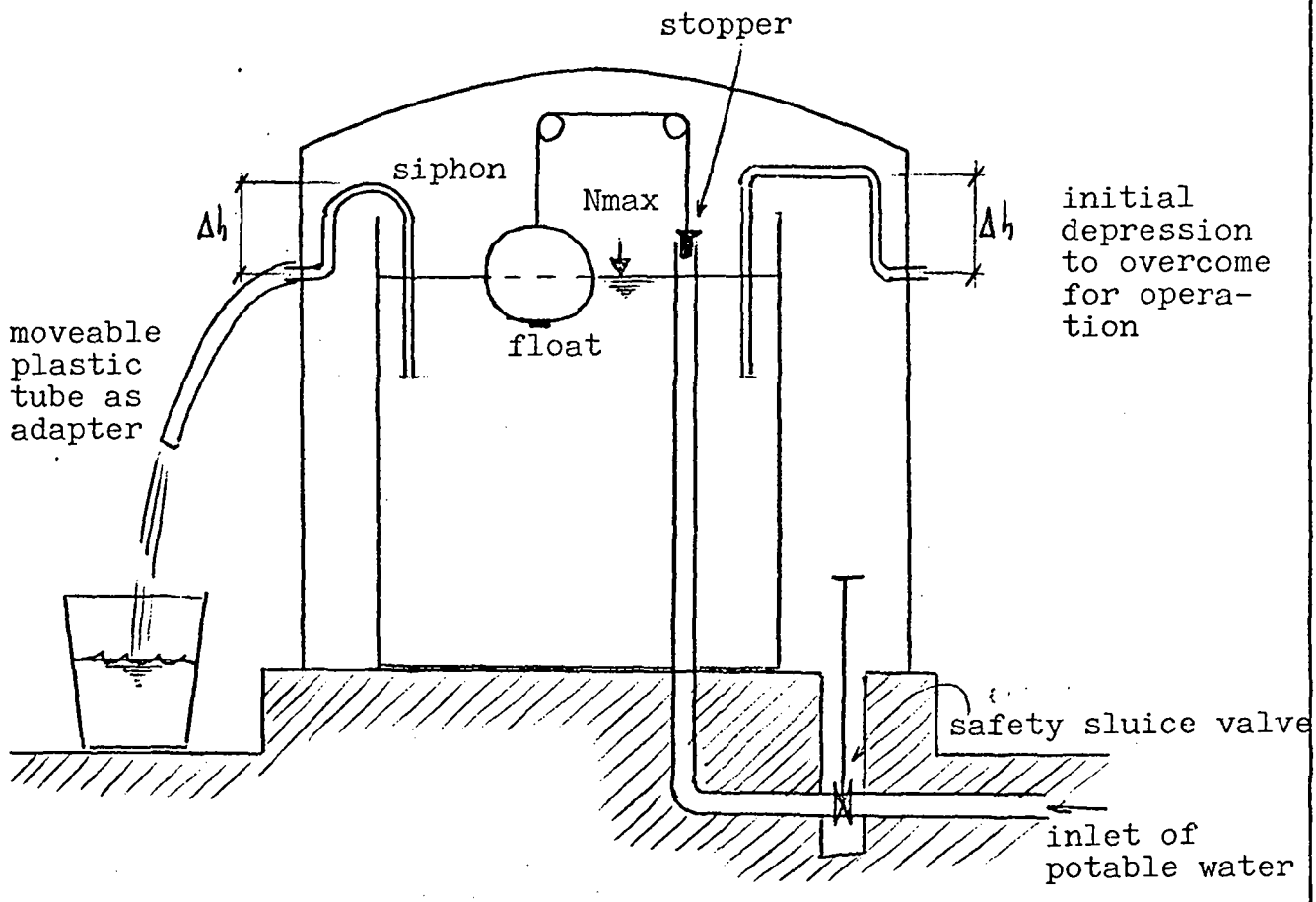
how it works with research institutes isolated from real world conditions

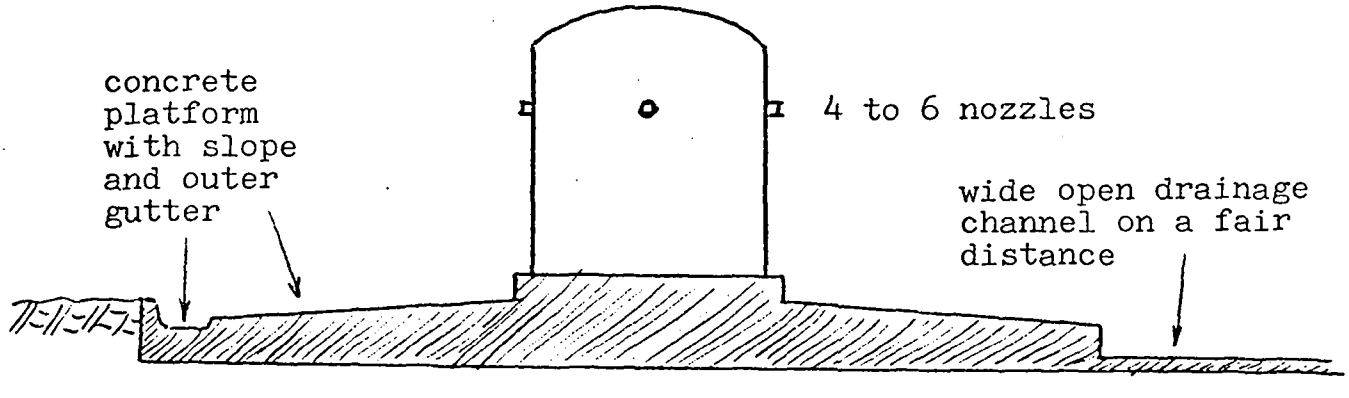
how it works with research done under real world conditions (like a fish in the water!)

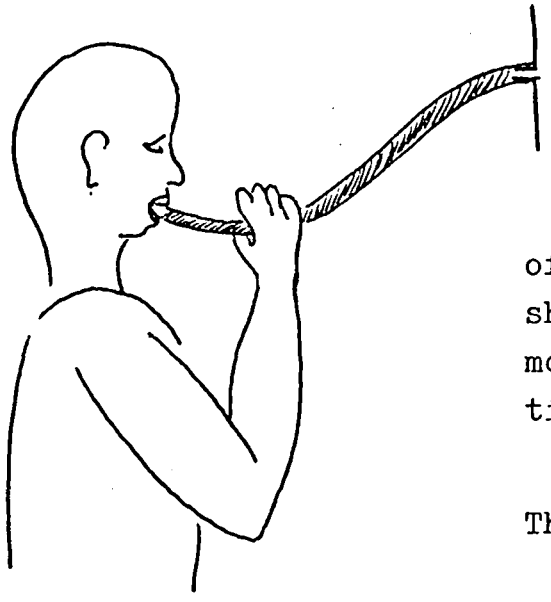


premature adoption of a technique, with insufficient testing of resistance to operation and maintenance troubles, leads to the stillstand of expensive equipment, disillution of the people, worse health conditions, only a few years after adoption. See handpumps, standpipes, latrines...

The public fountain with built-in siphons and no external moveable part.







A technological problem with social content:
THE PUBLIC FOUNTAIN

The problem: avoid wastage of water with the help of a shutting device having no external moving part and which can practically not be broken or stolen.

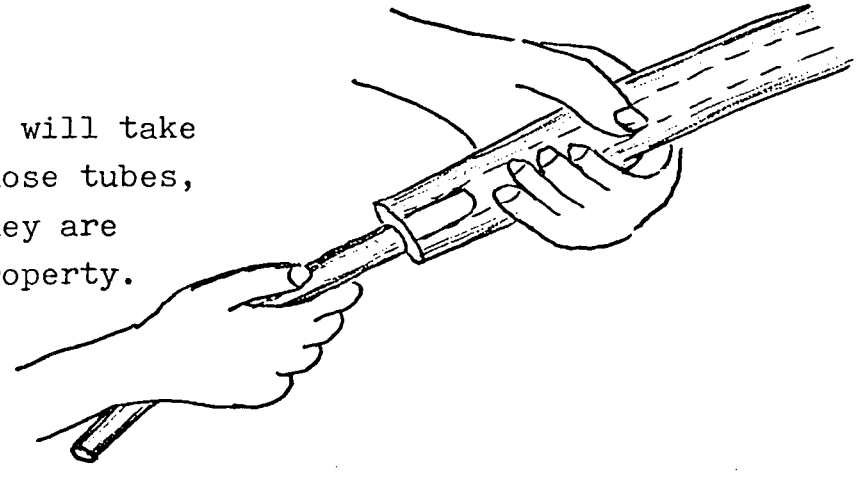
The answer: the siphon.
see page 3

The method of use in Bangui (CAR): a plastic tube, individually owned. A quick suck creates the vacuum Δh, then the water flows. The flow is stopped when the tube is pulled out.

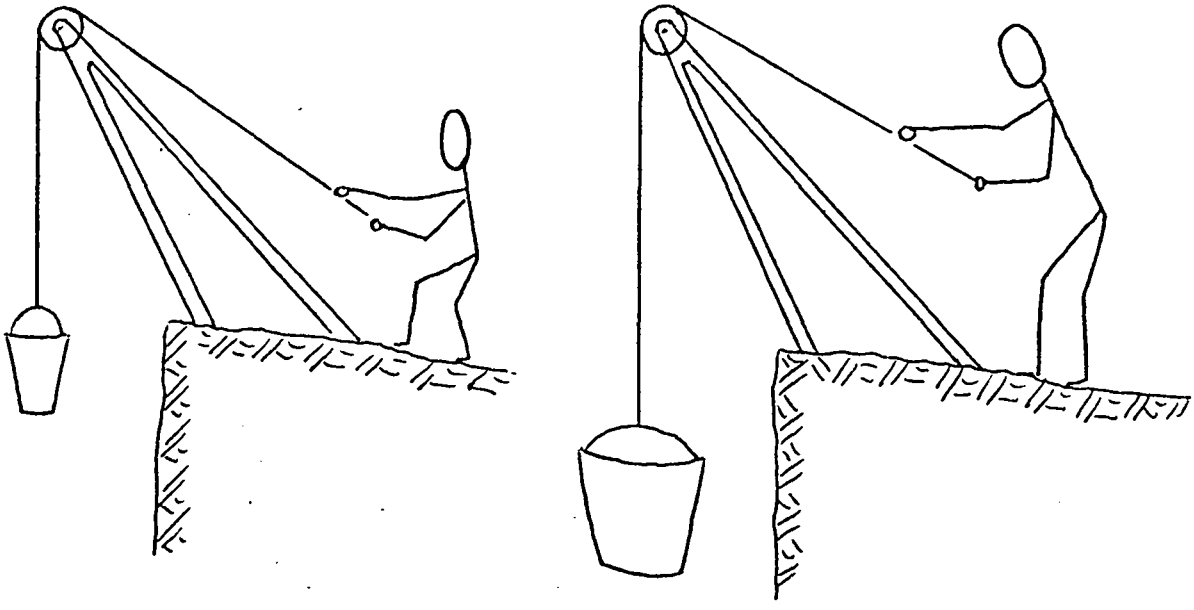
The social barrier as an objection from the people of Nerpinglai (Maharashtra, India): it is task of the woman to fetch the water, but her husband will not touch what she has put into her mouth. Even for a short while.

New problem: how to create the vacuum Δh without suck.
Suggested answer: two plastic tubes, one into the other, manipulated as a piston.

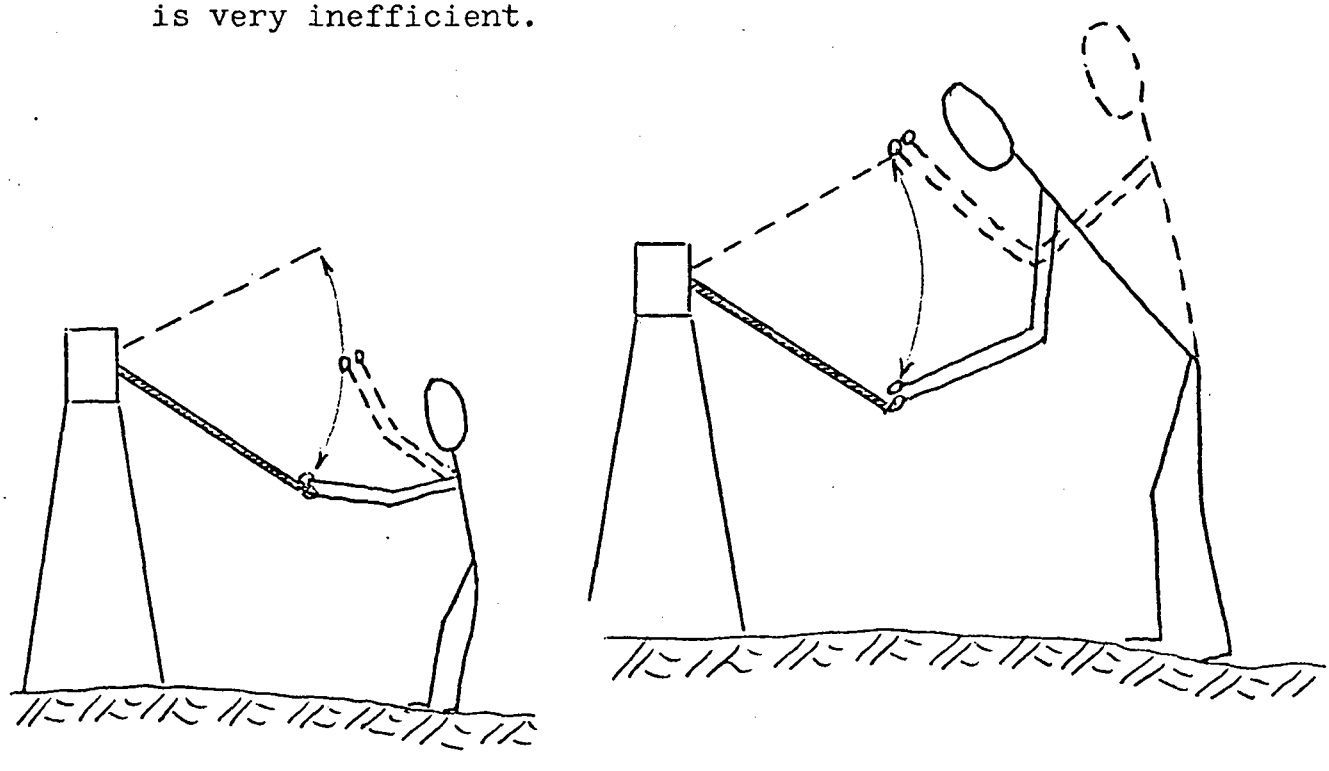
The people will take care of those tubes, because they are private property.



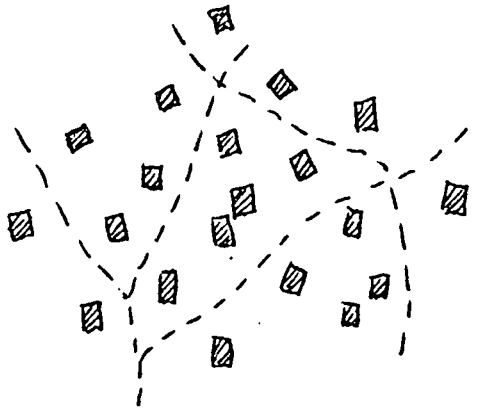
ANTHROPOMETRIC CONSTRAINTS OF TECHNIQUES



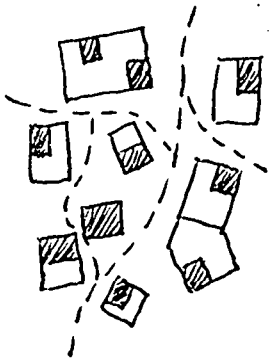
A child, smaller and with less strength than an adult, can adapt the position of the rope and the weight (quantity of water) to his anthropometric characteristics.
The length and the run of the lever of a hand driven pump are optimized for an adult: the operation of such a pump by adults with noticeably different statures or by children is very inefficient.



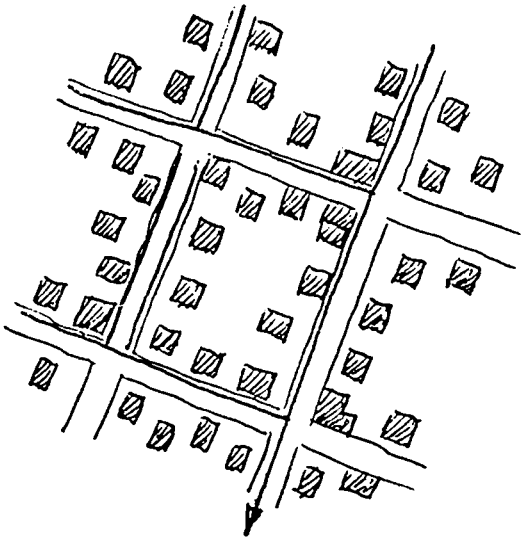
CONSTRAINTS OF EXISTING TECHNOLOGY AND LAND USE, IMPOSED ON THE LAYOUT OF A NEW TECHNOLOGY: HERE A DRAINAGE SYSTEM



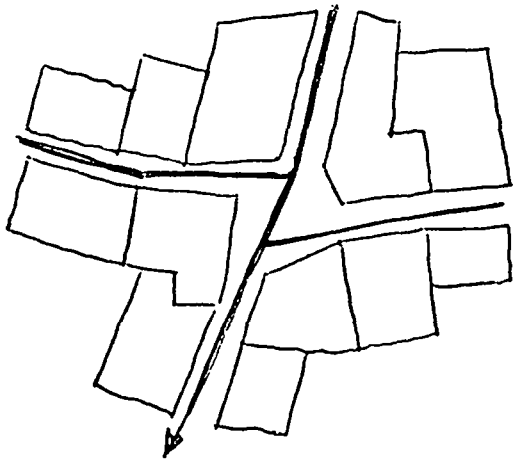
traditional layout of a centralafrican village: common cadastre
few physical limits
foot paths, winding and going up and down



traditional layout of a maharashtra village: common cadastre
compounds materializing most of the limits
foot paths and lanes, going up and down

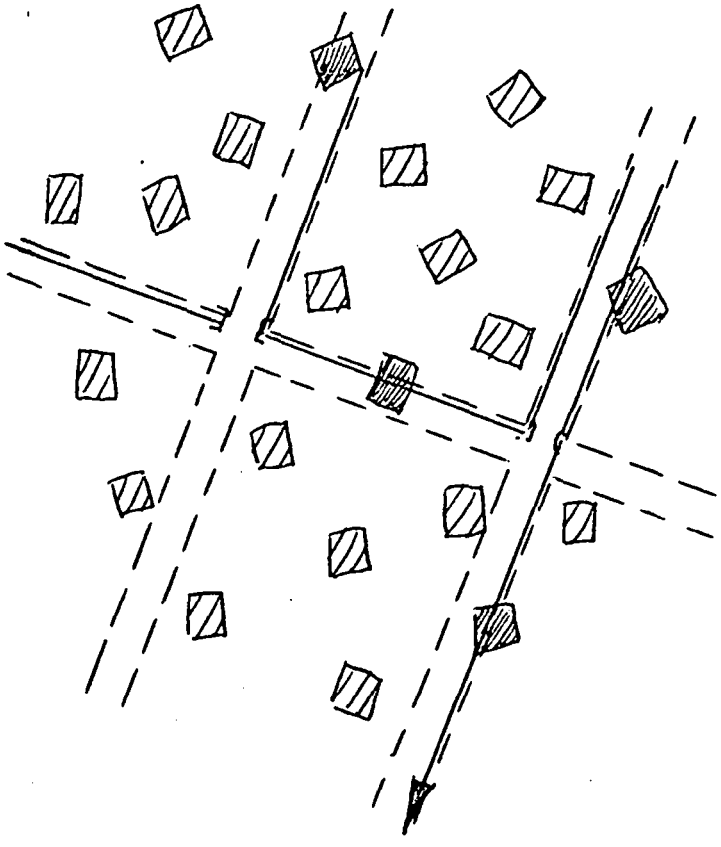


layout of modern centralafrican settlements: common cadastre in clusters physically limited by a draught pattern
streets with regular slopes enabling the layout of a rational drainage system.

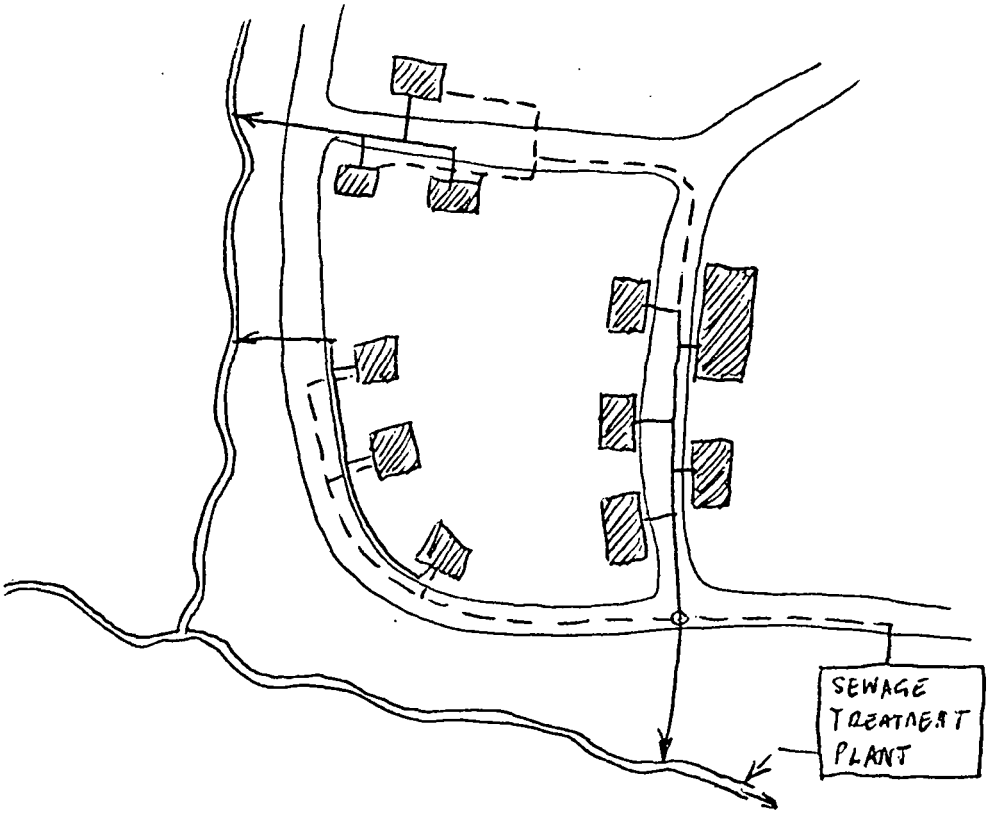


layout of a traditional swiss village: legal cadastre, limiting public and privately owned land.
streets with regular slopes enabling the layout of a rational sewer-system.

THE IMPACT OF A NEW TECHNOLOGY ON AN EXISTING ONE IMPLIES A PARTIAL DESTRUCTION

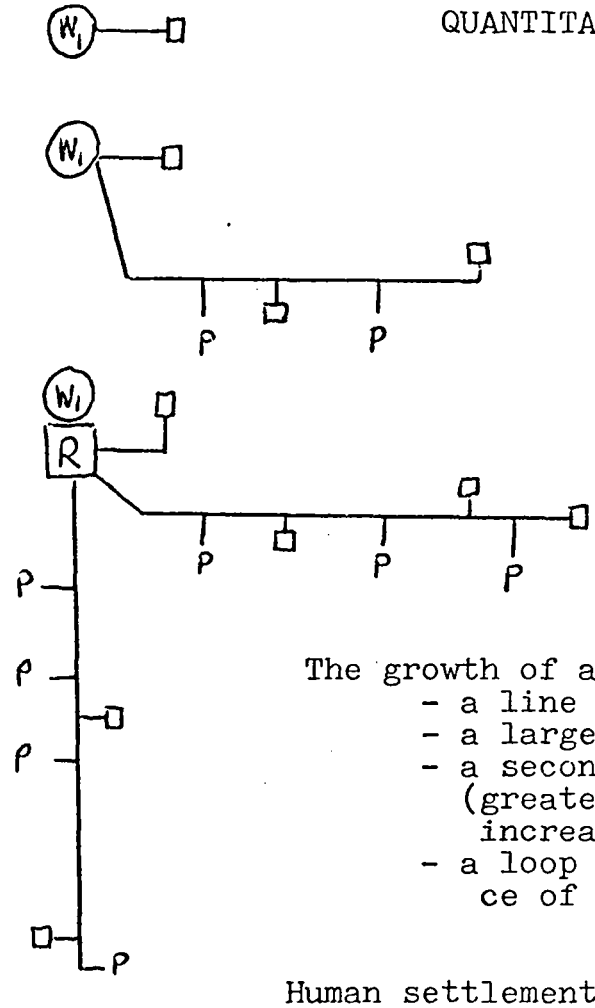


The layout of a rational drainage system along straight streets with regular slopes in a traditional centralafrican settlement implies the demolition of 4 cabins

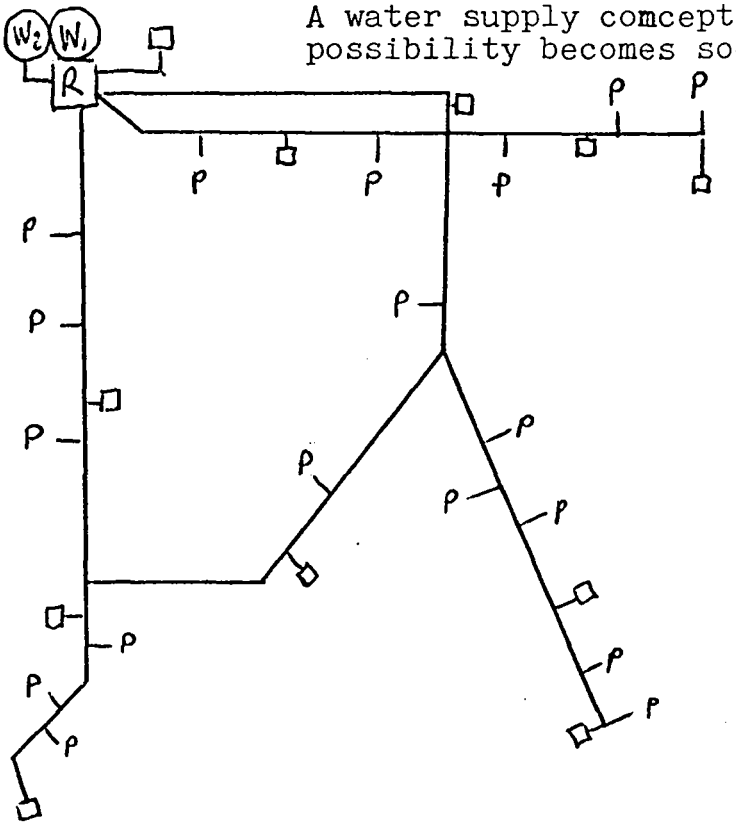


The layout of a rational sewer system ending in a sewage treatment plant implies the break-up of streets and demolition of manholes etc, in a traditional swiss village.

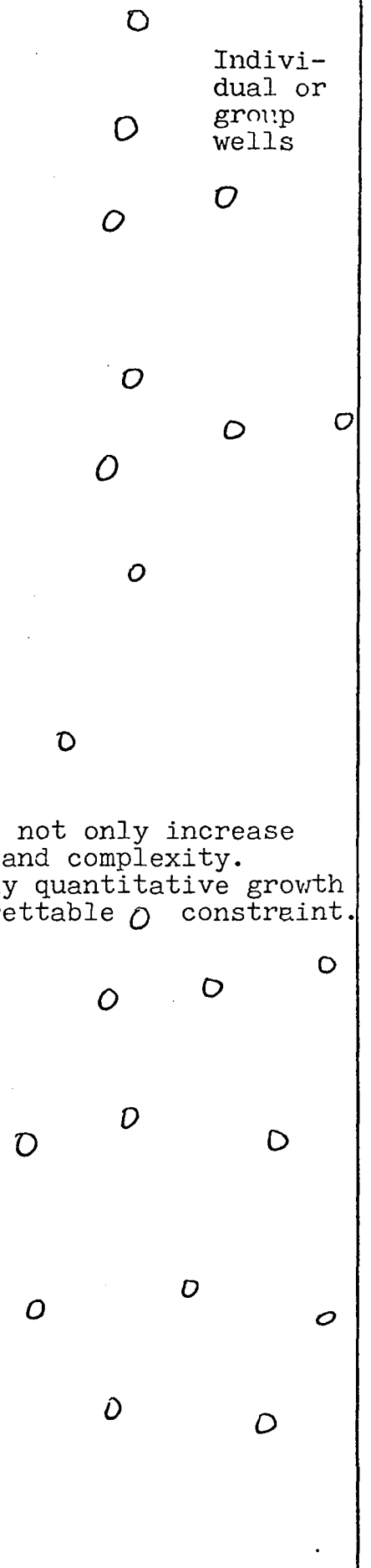
THE DIFFERENCE BETWEEN A GROWTH WITH QUALITATIVE CHANGE AND A MERELY QUANTITATIVE GROWTH



The growth of a network:
- a line
- a larger reservoir
- a second well (greater safety, increased yield)
- a loop (better balance of pressures)



Human settlements grow: they do not only increase in size, but also in diversity and complexity.
A water supply comcept with only quantitative growth possibility becomes soon a regrettable constraint.



JUSTIFICATION FOR A COMBINATION OF WATER AND ELECTRICITY CHARGES

The fact: shallow, potable aquifer: electricity optional
deep, potable aquifer: electricity compulsory for pumping
non-potable aquifer, surface water : electricity compulsory for treatment.

thus: for the larger majority of rural and semi-rural population, water supply implies electricity supply.

The argument:

1. Water supply schemes imply maintenance and operation costs.
2. Public financing policy refuses to give grants for MO-costs.
3. MO-costs have then to be charged to individual consumers or to local bodies (who raise the money by general taxes or otherwise).
4. Electricity can be cut down efficiently: it has no directly available substitute.
5. Water can be cut down: but it has many substitute sources, even if not safe. Cutting down of water contradicts the public health policy leading to give grants for the construction of the water supply scheme. Thus it is politically unfeasible.
6. In most of the cases, electricity is needed for the water supply of the human settlements of more than a few homes.
7. If electrical supply is installed, it will be also used for other purposes than water: e.g. for street and home lights.
8. Thus, a combination of water supply charges and electricity charges is a strong tool for a more regular and efficient collection of charges.
9. In addition, a compensation between the rates for water and for electricity can be a tool to promote water supply in the smaller, poorer villages (consuming more water than electricity) with the charges raised in larger, richer villages and townships (with proportionally higher electricity consumption)

THE PROFESSIONAL STAFF FOR WATER SUPPLY AND DRAINAGE

Basic facts: 1. where large amounts of money are involved (construction), the necessary financial and technical control is exerted: so, the need for professional staff is not mainly there.

2. the specification of the qualifications and tasks of professional staff is mainly needed at the interface of two groups: the white collar academic or pseudo-academic engineers of all type, chemists and biologists; the unskilled blue collar workers more or less trained by years of experience.
this interface is: the lowest level of professional training for staff at the battle-front of daily problems of operation and maintenance.

Needs and responses:

NEEDS	RESPONSE
operation and maintenance	skilled man
right to touch electrical equipment	certificate for electrical appliances
hability to foresee mishaps	professional training (learning of physical laws)
hability to repair all the parts of a water supply scheme and to advise about latrine construction and digging of drainage networks	ad hoc multidisciplinary training program
social consideration cooperation with public health officers (e.g. check of chlorine content in distributed water)	complementary training subject
lasting motivation for the training program offered best profit from training expenses (avoid brain drain)	promotion possibilities
most efficient and stable training institution	integration to existing professional and industrial training institutes.
promotion possibilities organized supply of spare parts	hierarchized landwide spread public service

A suggestion: (as result from discussions with engineers, public health doctors and local elected officials in Maharashtra, India, march 73)

profile of an OM-technician for water supply and drainage:

general education: 10 years school

professional training: 2 years school and workshop training in an industrial training institute.

program for the professional training:

electrical motors and appliances:	30 %
mechanics	30 %
mazonry, concrete, pipe laying	15 %
survey for constructions, lines,	10 %
first aid	15 %

(N.B. first aid was suggested by a medical doctor. Confers much social consideration, which counterbalances the contempt for someone who keeps trying to repair what the public breaks down, e.g. fountain taps, or who looks after latrine construction. Analogy with policemen and firemen training in first aid, in industrialized countries)

promotion possibilities: going from a smaller or simpler water supply scheme to a larger or more complicated one, or as assistant to the engineer-in-charge of a very large scheme.

The water-and-drainage-OM technician <u>is not</u>:

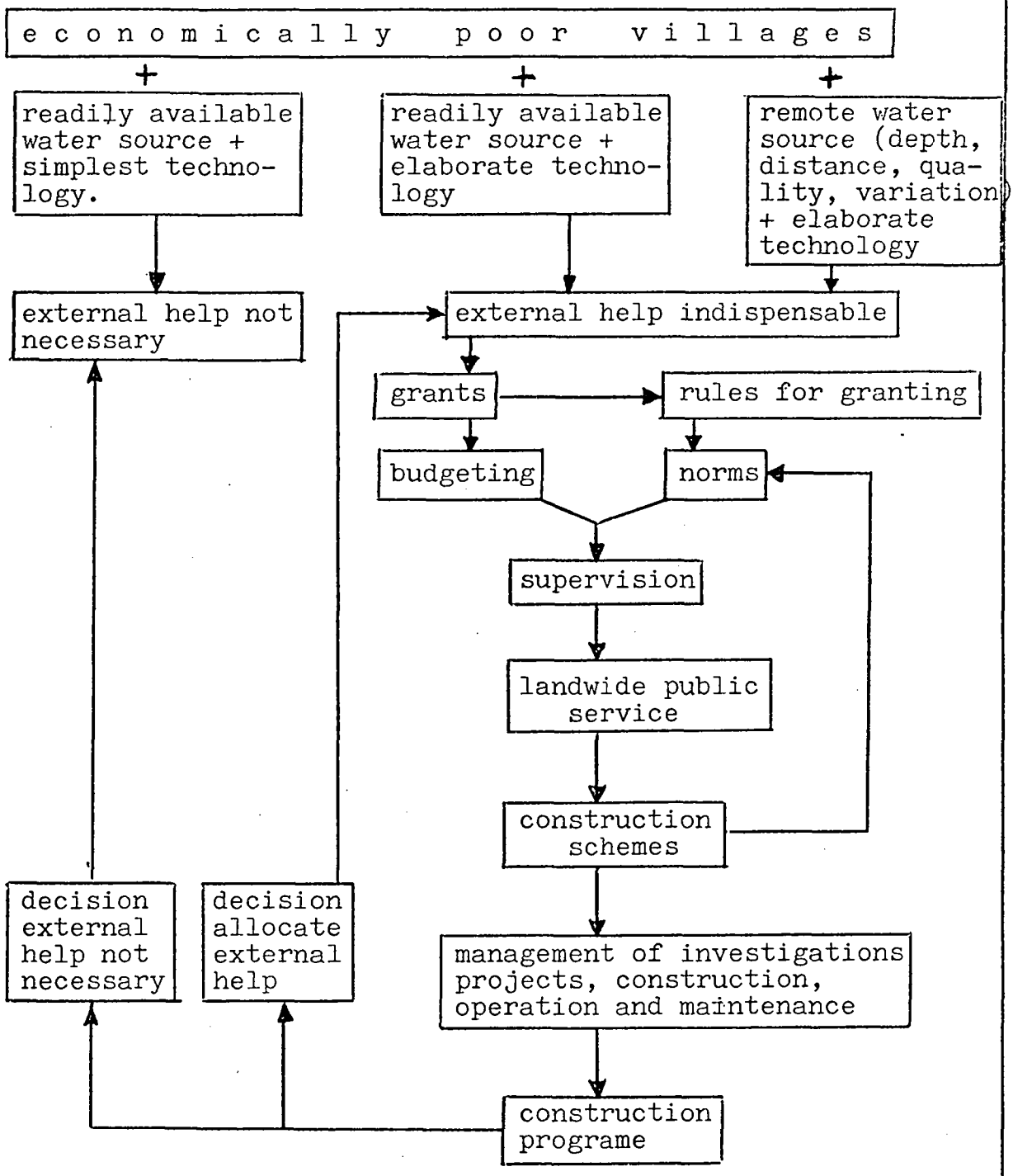
- a sanitary inspector
- a social worker
- a rural animator,

but, conversely, a sanitary inspector, a social worker or a rural animator <u>can not</u> do the work of theWISDOM technician (stands for: Water Intake and Supply and Drainage Operation and Maintenance technician!)

The WISDOM tasks require a solid technical knowledge: technical mistakes are evident and their consequences unescapeable: e.g. latrine outlet improperly laid: clogging and smells will occur; standpipes are broken, water has to be cut except for a few hours a day; drainage channels are digged with improper slopes, stagnation and overflow will occur.

Technical mistakes leads to the discredit of technical innovation, thus to less respect and care and less willingness to give already too scarce money.

THE NORM, AS KEY-CONSTRAINT OF A SYSTEM



external help means system,
system means rules and norms,
norms mean very limited user choice freedom,
limited user freedom of choice means lack of local participation.

THE MULTIPLIER EFFECT OF INTERMEDIATE CHANGE AGENTS

Fact: the communication of change goes through awareness, interest for information, willingness to be trained, then to try and finally to adopt = to change one's attitude.

The training of change agents requires time, money and the possibility to communicate authentically.

WAY 1: CONSULTANT $\xrightarrow{Y}$ N CHANGE AGENTS

after period 3Y, 3N change agents are trained

cost of training per agent: $\frac{\text{consultant salary + local cost}}{N}$

effectiveness of attitude change: low, because language and mental images of consultant and change agents are too different.
"c'est manière de blanc".

WAY 2: CONSULTANT $\xrightarrow{2Y}$ N CHANGE AGENTS AS INSTRUCTORS $\xrightarrow{Y}$ N^2 CHANGE AGENTS

after period 3Y, $N(N+1)$ change agents are trained

cost of training per agent: $\frac{3 \text{ consultant sal.} + 3 \text{ local cost}}{N(N+1)}$

effectiveness of attitude change: high, because the instructors, chosen with a higher initial level of education and modernism than the ordinary change agents, can have a real contact with the consultant and the ordinary change agents can well understand and imitate their instructors.

Comparison with same total expense for training, after 3Y :

N	WAY 1	WAY 2	RATIO
2	6	6	1
10	30	110	3,7
20	60	420	7

WELLS WITH HAND PUMPS VERSUS DISTRIBUTION SYSTEMS: SOME ECONOMIC CONSIDERATIONS.

A well with hand pump costs 20 to 30 thousand Rs (India).

Although its maintenance is very inexpensive, about 0,2 Rs per capita per year according to a survey made over several years, a well needs sulling or resinking, at intervals which depend on the quality of the aquifer.

Since hand pumping takes time and everybody wants to get water at about the same hours of the day, a well with hand pump should not serve more than 30 families (about 150 persons), lest they begin to quarrel or to take water from the traditional unsafe sources.

Without consideration of human effort and of resinking needs, a group of wells with hand pumps amounts to (calculated on the basis of 7% per year interest and amortization):

135 to 200 Rs per capita

= 9,5 to 14 Rs per capita per year

plus 0,2 Rs per capita per year for maintenance.

++++++

A complete water supply scheme (intake, treatment, pumping, storage and distribution) for groups of villages, comes to about 80 to 100 Rs per capita.

Maintenance and operation are relatively expensive: about 4 to 6 Rs per capita per year.

But the service is better than with hand pumps and the human effort to drive the water is considerably less.

The calculation of annual costs with 7% per year gives:

5,5 to 7 Rs per capita per year

plus 4 to 6 Rs per capita per year for operation and maintenance.

++++++

Both solutions are of the same magnitude. But Hand pump wells require less for maintenance. People are poor, so they should not be too much taxed.So hand pumps should be prefered? But the State has also limited means: the choice of distribution schemes allows it to serve twice as many people every year, with a given budget (ratio 9,5-14 over 5,5-7).

It seems reasonable to call for a participation of the users equal to some 7 Rs per capita per year: this may cover the operation and maintenance expenses of a distribution scheme, plus interest and amortization of 10 to 20 % of the construction capital. (present situation in Maharashtra).

The remaining of the capital is a State grant.

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Lausanne Seminar
29th May - 1st June

Working Paper No. 17

IDRC,
Rural Water Supply
and Sanitation

Anne Kirkby,
May, 1973

TOWARDS A USER-CHOICE PHILOSOPHY

I have been asked to consider how we might develop a user-choice approach to rural water projects. As I understand it, user-choice simply means allowing the user to decide, as far as is possible, on the type of system to be installed, or indeed, whether one is installed at all. It is a philosophy which appeals to me not only because it involves self-determined rather than imposed social change, but also because I believe that it will be more successful. Rural water projects have been dogged by lack of success. They have failed for technical reasons, organisational problems, a lack of trained manpower, and mutual failings of understanding on the part of both villagers and engineers. It is difficult to design a project that will be successful and maintained long after the engineers have left the village. It is even more difficult to create a system which will diffuse out from the original village and be copied, with a minimum of initiative from outside, by surrounding settlements. The two problems are linked for successful projects in one village and it will spread to others if they fulfil needs and give benefits as perceived by the users themselves.

Rural water projects require technical expertise, equipment, and the allocation of limited funds and manpower. They also involve the assurance that at least part of the costs will be paid for by the users. It is not possible therefore, to allow users complete freedom of choice. Rather the strategy is one of structuring his choice - by limiting it to what is practicable in design, financial and organisational terms, and by increasing it through making him aware of a wider range of alternatives. A crucial element in the design of this choice structure is an understanding not only of the physical and social environment of the user, but also some insight and appreciation of how he understands, uses and values them.

Considerable progress has already been made in the direction of a user-choice approach. Technological improvements have increased reliability of components and increased their range at the less expensive and less sophisticated end of the spectrum (1). The development of a 'catalogue' of standardised components for water abstraction, storage and distribution allows each system to be individually tailored to the needs and capacities of a community while minimising the costs of skilled manpower and the stock-keeping of components(2). Both these developments actually increase the choice open to users.

A parallel movement towards a user-choice philosophy has taken place on the organisational side. It is characteristic of rural water projects now that local participation is seen as almost a prerequisite for success(3). Partly to reduce costs but also to reduce the chances of the system falling into disrepair and misuse after the engineers have left, local people are involved in the provision of labour, local materials and/or cash. Local officials organise labour and the collection of payments and a local man is often trained to maintain the system and do simple repairs.

The third route being followed towards a user-choice design is the increasing emphasis being placed on rural water and sanitation as an integral part of a broad health education programme and the provision of medical facilities(4). It is now recognised that for people to accept modern improvements in their life, they must be able to understand them and to come to value the benefits they bring. They must in particular understand the relationships between water quality and quantity and health and hygiene.

What I would like to do in this paper is to take each of these movements towards a user-choice design and explore how far one might push further in the same directions and towards an integrated approach. I shall draw upon my experience in small villages in Southern Mexico and south-west Iran both in providing background material for the ideas put forward and in acting as specific locations where they might be applied. Both areas are among the least developed within their countries, both are semi-arid and both have severe water, sanitation and health problems.

My starting point is that rural areas already have user-choice systems. Each area and each community, in some cases over thousands of years, has developed a traditional user-choice system that is finely adjusted both to the forms and processes of the physical environment and to the social and economic context of the community. The traditional user-choice system is basedon detailed knowledge of the area and the community and accords with the users' values and understanding. We would do well therefore, to examine traditional user-choice systems in order to design an improved system that embodies an understanding of water use, water organisation and water values. Without this understanding user-choice systems will have little chance of success.

EXISTING USE SYSTEMS

Traditional water use systems are characteristically multi-source. This is often a response to the constraint of no one source being adequate for all needs. It is also a characteristic response to reducing risk in an uncertain environment. Where sources fluctuate in the quantity or quality of their supply through time, alternative sources of supply reduce the risk of total failure. The use of more than one source also reflects the different values placed upon the dimensions of water quality, water quantity and convenience of location for the different purposes to which water is put.

For example, contrast the water use in Mexico and Iran. In the Valley of Oaxaca, Mexico many villages use unlined wells between 3 and 10 meters deep located in the village for drinking water. The same source is used for ritual bathing (for example, a mother after the birth of a child). However, for ordinary bathing and for the washing of clothes a stream or seep which may be several kilometers away is used. The washing of clothes, particularly, is a communal activity with the women going weekly to a specific spot there to work and talk to their friends for the day. In south-west Khuzistan, Iran, recently settled Lurish nomads use canalised water flowing through the compounds and village streets for washing pots and clothes. They walk a kilometer or so out of the village to bathe at the ceremonial bathhouse located on a stream; and they obtain their drinking water from a spring 50 kilometers away. This is brought by an old truck across the desert plain and is paid for by the gallon. Whenever it rains, the route is impassable, anddrinking water is obtained from natural rainwater puddles as far out from the village as is deemed necessary to avoid the worst contamination.

Here are two very different patterns of water use each reflecting different values put upon water sources for different purposes. In both cases the closest single source would be adequate in quantity for all purposes. However, in Oaxaca the structure of peasant society is such that visiting between neighbours is seen as being purposive rather than casual; privacy within the home is valued yet social interaction is desired. This is satisfied partly by building up a network of small debits and credits between households so that visits are made for the purpose of borrowing or being paid back or buying an egg or a kilo of corn. It is also satisfied by communal activity in public places, such as washing clothes. To provide water for washing clothes within private dwellings if it were used would thus have repercussions on the social interaction and ties between households that form a basis for the village social structure.

In Deh Luran, Khuzistan, the women do more of their duties within the confines of their compounds rather than using them as a reason for social interaction. The local stream would be adequate in quality for drinking water (more so than the puddles used) if water were abstracted above the village. Its taste, however, is sulphurous so that the villagers prefer to pay for unreliable supplies coming the incredible distance of 50 kilometers. This water supply is also bought by nomads camping within 15 kilometers of the distribution point in Deh Luran. In fact, a survey of the distribution of nomad encampments over the whole plain showed little locational preference for natural sources for domestic water use.

The use of several sources for water is not only intimately bound up with the social structure and values of the community. It also reflects a detailed knowledge of the physical environment and the adoption of a variety of techniques and materials over a range in size of system. Even the smallest of sources are used (for example, a well with a yield of 500 liters per hour or a stream with a discharge of 0.5 liters per second). The simplest of materials, such as stone and branch dams or bamboo acqueducts are also employed. Variety and ingenuity make up for size and sophistication with a minimum of environmental impact or social consequences. The lesson to be drawn is that it may sometimes be better to design a project in which the aim is to improve the water supply from several different traditional sources instead of concentrating on the provision of a single, larger alternative source.

Another important feature of traditional user-choice systems is that they show a wide variety of organisational structure. This is easily recognised at the cultural level - for example between Iran and Mexico. It is less appreciated at the local level where it is nevertheless important and, I believe, is crucial to our progress in developing successful user-choice alternatives to traditional systems.

To return to the Valley of Oaxaca as an example - it is a natural physical and administrative unit for a rural water programme, comprising some 700 square kilometers of valley floor with 256 rural settlements. The physical environment is self-evidently very varied and water is traditionally obtained from many different sources using a range of techniques.(5) The design of any overall scheme or projects within it would take account of this physical variation. It would be less likely to allow for the difference that exist in social structure between communities because all the villages are nucleated, agricultural peasant communities similar in appearance and sharing much of a common history. Within this general cultural similarity, however, the different patterns of social organisation which exist are significant for water use and control.

Some villages, particularly those using canal irrigation, have a traditional formal organisation for water use; other villages using floodwater or wells do not. Even within the canal irrigating villages its exact form varies. It may consist of an elected committee with president, secretary, treasurer and several other members who serve for one, two or three years. It may be a single water controller, who combines the duties of daily water allocation, inspection, organisation of maintenance and construction labour and arbitrar of water rights. Sometimes water is paid for by amount used; sometimes it is paid for at a fixed rate per user; sometimes it is free. Where several villages share one river or one canal, the organisation may extend to inter-village level with complex divisions between communities on a time, water discharge, water use, or fixed cash rate basis. In contrast floodwater farming communities characteristically control water on an informal basis of individual responsibility, whereby those that join in the effort of diverting and canalising water can receive the benefit of water. In villages using wells no effective formal or informal water control organisation usually exists.

Two points are important here. One is that these villages have developed very different patterns of social organisation both in direct relation to water control and within the structure of village life in general. The degree to which communal labour (tequio) on village land and community projects is supported; the strength of risk-sharing social mechanisms like the guelaguetza reciprocal exchange of goods and labour; and the value placed on the cargo hierarchy of religious and civil offices varies greatly between communities. These differences are as real and important as the range in the physical environment. They imply that no one organisational form is appropriate for all villages just as no rigid single technical design could be applied in different physical settings.

The second point follows from the first; the establishment of co-operatives, self-help or elected committees will not be successful in all villages even within a small area and the existence of a specific organisational form for one aspect of village life may not necessarily indicate that the same organisation can be transferred to another aspect. In the Valley of Oaxaca, some villages who already had a formal committee management structure for water seemed to more readily be able to use a similar organisation for agricultural development and the provision of for example electrical supply. Villages who had no communal water control were less able to share and maintain a communal tractor and preferred to individually hire the services of one from a private individual. In another village, groups of farmers who co-operated in sharing water to their fields could not co-operate in sharing the use of a tractor on the same land.

My main concern is that the texture of organisational and social differences within an area may be very fine. It is thus difficult to generalise, and a standardised approach to organisation of rural water is as unlikely to succeed as an inflexible technical 'package'. It is however, characteristic of water supply projects that despite flexibility in the technical design of a system, a standardised single organisational structure is imposed on the community at the outset (6). This is usually in the form of an elected committee who collect dues and organise co-operative labour.

THE PROCESS OF CHOICE

I would like to put forward two ideas here. One is that the process of how communities decide between choices varies and that this is significant for the degree of commitment that the individual has towards the community decision. The second is that traditional forms and beliefs are part of a continuous choice process. They are both the results of choices and give rise to choices. It seems to be an attitude common in rural water literature and elsewhere that tradition is a block to change. But tradition is not static; it undergoes change through the very agents that uphold it. Recognition of this process may help us to utilize traditional processes of change for modern forms of change.

COMMUNITY DECISION - MAKING STYLES

Perhaps I can begin by indicating the contrast between community decision-making between nomads in Iran and peasants in Mexico, and then examine the implications for the use by individuals of rural water provisions. Nomads are making choices in relation to water every few days; that is whenever they move camp(7). All the families in the group are involved in the decision but at no point is there an assembly of people. Indeed it is very important that an assembly does not occur because it would allow each view to be more equal; it would require opinions to be made explicit and associated with particular individuals and it might give rise to a confrontation of views - all of which are carefully avoided. Instead as soon as the camp has been pitched, individuals will go and consult with one another in pairs and small groups to discuss the probability of water and pasture in various places. Individuals are careful not to commit themselves to a clear alternative; they will always follow one proposal with the opposite point of view. Rather it is a process of feeling out the consensus. Sometimes no clear common view has emerged after hours of discussion and participants retire to bed not knowing if they will strike camp next morning. The discussions are not entirely structureless for although the camp leader has no means of imposing his opinion on the other tent households, he can influence the decision through his family network. If he believes strongly in a particular choice, he will go to the tents of his sons and other close relatives and let them become aware of his view. They in turn will disseminate his opinion in their discussions with their relatives, and so on through the kinship network. If there is lack of agreement anywhere in the camp it will not be revealed by confrontation but by continued discussion until a consensus is reached. Thus each individual is committed to the group choice and will conform as an individual to that choice. This process is vital to the cohesion and viability of the nomad group.

Decision-making in a Mexican peasant village is based on the very acts which Iranian nomads so carefully avoid an assembly of people; the confrontation of views; explicit, vigorous argument of opinions; and public commitment by individuals to specific choices before consensus is reached. A government project, for example, will first be discussed informally and formally between the village leaders. Individuals will bring what influence they can to bear on the selection of their favoured choice but there is a common attempt to reach an agreed set of recommendations on the issue to be put before the general assembly of the community (usually consisting of all adult males). One of the leaders describes the issue and the alternatives to the community assembly. He then presents the recommendations of the leadership. If the general assembly provides contradictory views the leaders will argue in defence of their opinions.

Usually their views hold sway and a consensus is eventually reached. While individuals participating in the consensus agree with the outcome as a community decision, their degree of commitment to it as far as their individual behaviour is concerned may vary considerably. Miller discusses two examples of this lack of individual commitment to community decisions in a village in Chiapas, southern Mexico (8). The first decision was to build a medical post which involved the village in the provision of labour and local materials with government support for equipment, and personnel. The second decision was to build latrines for each household. In both cases a similar decision-making process to that described above took place with the addition that in the case of latrines, each man also signed his personal commitment to build one. Participation in a community decision to provide the facilities did not commit individuals to conform as individuals in using them. Only 59 per cent used the medical post instead of traditional cures and only 65 per cent of these who actually had private latrines used them.

LEVELS OF USER

This distinction between individual and community choice is part of a more general issue in the design of user-choice systems. This is, for what level of user are we designing? At one level, the user is the national or regional government; at the next level, it is the community and ultimately it is the individual. Rural water projects are designed to accord with the needs of governments and it may not be possible ever to divorce the supply of rural water from government policy, especially in the area of planned social change. This is strikingly so in areas like Tanzania and Iran where water supply has been part of a social policy to settle and concentrate shifting, dispersed populations. It is also less obviously true in Mexico, where water control is taken out of the hands of traditional village authorities and placed in officials who are directly responsible to the central government (9). Whether intended or not, such a policy will inevitably contribute to the fall of community autonomy and peasant social structure.

The emerging strategy of designing user-choice systems is aimed at the community as user and decision-maker. Its success however will ultimately depend on how it fulfils the perceived needs of individuals and how it is used by them. The process of change is a delicate one in which community leaders sit astride two world views, two sets of beliefs and practices. If they move - or are moved - too rapdily towards the western view, they may well persuade the community to install a rural water project or a medical centre but they will not have changed the cognitive structuring of their environment that the main body of villagers hold. Ultimately, it is the set of beliefs, values and knowledge that an individual holds that organises the way he adopts and uses new ideas and new technology.

THE NATURE OF TRADITIONAL ATTITUDES

At this point I want to adopt a different approach to developing a user-choice design for rural water. In discussing water use, water organisation and the process of decision-making I have been emphasizing their detail and variation. The same variety is also true for the beliefs and practices of rural people in relation to water, health and disease. However, it is more relevant here to stress the similarities in traditional concepts between cultures and areas in order to show their relation to social structure. In this way, I believe it is not only easier to understand why some innovations fail, but also how they might best beenabled to succeed.

Modern and traditional concepts of health and disease differ in two important respects. The first is that in traditional views, disease and illness are related to religious, magical and moral concepts instead of just hygiene and aesthetics. The second is that whereas modern concepts of disease are focussed on a knowledge of pathogenic organisms as causal or contributory, traditional medicine is unaware or less concerned with a germ theory of disease. It concentrates less on pathogenic cause and more on the idea of the translation of a substance from one part of natural environment to another. These concepts are intimately bound up with attitudes towards the environment and man's relation to it. Modern views of this man-environment relationship tend to set man farther apart from the rest of nature than do most traditional views. In the traditional world view, the environment is likely to be personal, centred on man and endowed with some of his faculties. At the same time man is not so much set above nature that this spirit cannot exist in, and be transferred between, other animals, plants or even rocks. In a traditional world events are more likely to be explained in terms of good or evil; the physical environment is often endowed with intelligence and the power to discern truth as well as to judge men. The physical environment may be seen as able to respond to, and appreciate gifts, symbols and human speech.

Within this context have developed many of the traditional beliefs and practices that appear now to confront modern medicine and hygiene. Thus ordeal by water can decide if a man has infringed moral sanctions; disease may have a moral cause; illness of an individual may be related to the disease of a tree or animal who shares his spirit-hence reviving the tree will bring good health to the man; cures will be effected instantly once the substance or spirit causing it has been ejected from the body; and a return to good health needs to be accompanied by communication with the natural environment in the form of chants, symbols, purification or sacrifice.

Associated with these beliefs about illness and its cause are sets of proscriptive rules about how to avoid illness in traditional and modern societies. Often these rules are expressed in terms of separation of certain categories within one aspect of life. It may be certain kinds of food that cannot be brought into contact with man, or with each other(10); it may be categories of people who cause defilement or illness to another (11). For the North American Yurok tribe, the categories of separation are focussed on water; good water must not be mixed with bad, nor urine with river water, nor sea and fresh water. What these diverse rules have in common is that whatever their medical rationale they associate health and illness with morals and religion. They also provide a moral code with clarity and definition by making a vague moral issue an unequivocal case of right or wrong. And in order to decide the issue in many cultures the physical environment is brought into play through the proscriptive rule, as an arbitrater and marshaller of public opinion, and a deterrent to wrong-doing (12).

THE FUNCTION OF TRADITION IN SOCIAL STRUCTURE AND CHANGE

While beliefs and practices about health and disease can be seen as arising from a common conception of the total environment, they have an important social function in holding the organisation of the community together. In many traditional societies they also link man with the rest of nature in such a way that when social institutions fail to main cohesion and conformity within the group, the powerful forces of the environment can be brought to bear on the situation.

Adherence to these beliefs and conformity to traditional laws thus ensures the continuity of the social group. Modern concepts which oppose traditional beliefs or make irrelevant the proscriptive rules are thus not changing or threatening merely an isolated practice but may be undermining the whole value structure which holds the group together.

Traditional beliefs and proscribed practices are therefore to bind the group together as well as to bind them to a set of absolute values. Their purpose is as much social as spiritual. As long as they are effective in maintaining the group, as a group, what they actually proscribe can change. Traditional concepts therefore contain the capacity for change. Indeed the very specification of a rule makes conceivable the possibility of breaking it by allowing for that eventuality (13). Douglass also argues that where proscribed practices are associated with easy purification for infringing them then the whole complex of traditional beliefs acts not to impose conformity but to encourage individuals to risk deviation and change by being

> 'a kind of safety net which allows people to perform what, in terms of social structure, could be like acrobatic feats on the high wire'. (14).

IMPLICATIONS FOR RURAL WATER SUPPLY

What does this imply for rural water improvement? First that in designing a user-choice system we are not only concerned only with water as a commodity but as a focus for a whole set of beliefs, values and rules. In bringing a rural water project to an area we are bringing not just new techniques but new concepts about the relation of water to health and disease and new formats for organising the community. In order to improve the health and well being of rural people, we believe that many of the old traditions will need to be transformed into modern concepts and practices of hygiene. However, the process can be one of absorption rather than imposition because traditional value systems carry within themselves the capacity for change, and those members of the community whose role is to uphold tradition, such as the local healers, priests, elected and hereditary leaders are also traditionally the main agents of change within rural communities. If we recognise tradition as a progressively changing body of beliefs and practices designed to adapt to the needs of the serial group - that is, a process rather than a form- tradition itself, can be adapted to, or used to bring about, desired social change as an indigenous movement which is therefore more likely to be successful.

From this belief look at existing user-choice systems two main points seem to me important for the design of improved water systems; one is that we are dealing with a set of pre-existing conditions which we need not only take account of, but can learn from, and use in the process of bringing about change. The second is that where the two systems of practices, organisations or beliefs come into conflict, we should try first to adapt our modern system to the traditional one instead of the other way round.

SUGGESTIONS FOR THE DESIGN OF USER-CHOICE SYSTEMS

From these considerations of traditional systems, what practical outcomes can be suggested? One important element which seems to be missing in present rural water projects if flexibility with regard to how the scheme is organized. The need for flexibility in technical and design aspects of a project because of the variation in the physical environment and the

requirements of the population do not seem to be accompanied by an equivalent flexibility in the design of water management. Most national governments and rural water development agencies insist on a single format for management· usually an elected committee who organise co-operative labour and the collection of materials and cash dues. Yet as I have tried to show, existing management structures are so varied in organization capacity, and integration with other aspects of community life, that it is unlikely that any single administrative system will succeed in all communities.

One solution is to design a 'catalogue' of standarised organizational components which will allow the user to select a complete management system that is tailored to the existing social and economic structure of the community in the same way that a catalogue of standarised technical components allows them to design individual technical systems. Flexibility in organization at the community level could thus be made compatible with the requirements of the government or agency for reliability or organization and payment of cash. As an example, for the Valley Oaxaca, one such catalogue of management components can be suggested that is based on the existing variety of traditional practices, and would allow each village to choose a system that closely resembled this present one (Table 1).

The development of such an organisation 'catalogue' for each regional or national plan would require the appointment of a social scientist in a parallel role to the present design engineer. His task would be to find out the range of management practices and social institutions that already exist in the area and the strength of their support by the communities as well as their potential for adaptation to a rural water scheme. He would then design standardised organization components for various aspects of water management such as the collection of dues, labour for construction, cash for repairs and replacements and labour for maintenance. In table 2 a possible scheme for a regional organization is suggested. It is based on the principle that three parallel roles - those of a social scientist, a health-education/medical expert, and an engineer - together design, implement and evaluate a total technical, management and educational components user-choice system.

The design of an organization component system such as is being suggested here, involves a knowledge and understanding of the social structure of rural communities and their value systems as well as their demographic characteristics. Much can be learned from anthropological and ethnographic sources. In some areas, for example Mexico, another possibility for obtaining such data rapidly is to organize the compilation of a village book in each community. Its format could range from structured questions about the number of households or the sources of water they used for different purposes, to personal accounts and pictures of village life, traditional concepts and practices and the forms that village organization and social interaction take. The quality of such books would inevitably vary but in total they could act as invaluable sources of material for rural water projects and many other development schemes. One such book was organized by Alicja Iwańska in a Mazahua indian village in central Mexico (15). It not only gives great insight into the life of the village but gave the village a feeling of pride and a sense of their own community and history.

If such a scheme were organized, it would provide the advantages of valuable data for the design of a rural water scheme and would enable the community to have undergone a process of self-study so that they would be more prepared for the scheme when it came or when they asked for it. The placing of bound copies of the book in the village church, school or administrative centre would also be likely to produce a feeling in the

community that their customs and ideas were valued and were not to be denigrated by the agents of change. In many areas the best organizers of such a scheme would probably be the village schoolteachers who could involve parents in it as a school project. It might also be useful to make the scheme into a regional competition as was done in the recent village book project in England.

Another element in the design of a user-choice system which seems to me to be desirable is the increasing involvement of the community in not just the construction and maintenance of the system but also in its design. This may require a change in attitude on the part of the engineer in accepting imperfect, small and incremental improvements to perhaps several existing water systems instead of their replacement with a single, large, new system up to high technical and design standards. In respecting the values and knowledge of the villagers, he will come to design the system with them instead of for them.

The design of a user-choice system is best done within a larger programme of health education and the provision of medical facilities. The provision of rural water without also providing some understanding of the relation of water to health achieves only half the objective of improving the well being of rural populations, and does not enable them to make genuine choices. It is in this context that traditional leaders can fulfil the role of change agent. Elected officials, high status families, priests and teachers are obvious examples. Local healers are also particularly influential in the changing of attitudes towards medicine and hygiene practices because it is considered within their special field of competence (16).

It is also practical to design the new roles associated with a rural water project, for example, the maintenance of the system and simple repairs as an integral part of existing roles within the community. For example, it has been found in Tanzania that the most successful scheme for providing skilled maintenance after the engineers have left is to integrate the skills required for water system mechanics with general mechanical training. (e.g. the repair of other machinery and vehicles). Trainees can thus be established in a small general repair shop to serve the community, and are more likely to remain in the village after training (17).

Some of these suggestions are new. Others have already been tried out in different parts of the world and have demonstrated their effectiveness locally. One advantage of the management component system put forward here is that it provides flexibility for incorporating and evaluating locally successful ideas within a broader framework. For example, if such a scheme as that outlined in table 1 were developed for an area, promising ideas - for example the Peruvian use of local healers as change agents for attitudes to medicine, or the Tanzanian experiment in training and establishing general mechanics combined with rural water skills - could be components within the overall design.

An integrated component system can therefore, be used not only for development but as a research framework for field evaluation of many diverse ideas.

The first step in such a research project would be the compiling of successful components from ongoing rural water projects. This may involve short-term evaluative studies of their local success and potential for translation to other areas and cultures. Following from this, it would be possible, for one or two specific areas, to design an integrated component system for management, education and technology. It would be based on a knowledge of traditional patterns of water use, culture and physical

environment as has been outlined for Oaxaca. It could also include as components ideas adapted from other areas and other rural water schemes. In this way we would be structuring the users-choice by both broadening his alternatives to include new ideas and limiting them to components which were designed to fit together and had proved themselves either by being part of the local traditional system or by success elsewhere.

One such field experiment was carried out for evaluating family limitation programmes in Taiwan (18). Different techniques, aimed at different types of population, using a variety of media were structured into one of the largest social science programmes ever conducted under controlled conditions. The design of the field experiment allowed each component (technique, user, media) to be analysed for its separate and combined effect on the success of the aims of the project. I would suggest a useful next step might be to design a similar field experiment for rural water projects which would test not only promising separate components but the viability and desirability of a user-choice approach itself.

Footnotes:

1. For example, the simple cement - lined storage tanks for catching rainwater used in Botswana. See G.M. Bateman, 1971, Intermediate Technology and Rural Water Supplies in Proceedings of Conference on **Rural Water Supply in East Africa**. 5 - 8 April, 1971, University of Dar es Salaam.

   See also Intermediate Technology Development Group Limited 1972 Interim Report on a Research Project on low-cost Water Technologies, London.

2. Ludwig, M.E. & Jorgensen, A.W. 1972
   Package Approach for Development of Village Water Supply Systems, IDRC Rural Water and Sanitation Seminar, Ottawa, August, 17/18, 1972, Working Paper No. 10

3. See Donaldson, D. 1972. Rural Water Supplies in Developing Countries; Water Resources Drill, no.2, p. 391-398
   for a discussion of the elements of successful programmes.

4. This is stated as part of the objectives of philosophy of rival water development programmes in Columbia, Argentina and Peru, for example.

5. See in particular the publications of Servicio Nacional de Agua Potable (SNAP) of Argentina on Elementos de Educacion Sanitaria (1971) for a detailed and comprehensive approach to rural water and health education.

6. Kirkby, A.V. 1973. The Use of Land and Water Resources in the Past and Present Valley of Oaxaca, Mexico; Memoirs of the Museum of Anthropology, No.5, University of Michigan, Ann Arbor

7. See, for example, the official publications on rural water development in Columbia, Argentina and Peru.

8. The process of decision-making among nomads in Southern Iran as well as other aspects of their life is well documented in Barth, F. 1964 Nomads of South Persia; London, Allen

9. Miller, F.C. 1965 Cultural Change as Decision-Making: A Tzotzil example; Ethnology, vol IV no. 1 p. 53-65

10. Lees, S.M. 1973, Socio-political Aspects of Canal Irrigation in the Valley of Oaxaca, Mexico. Memoirs of the Museum of Anthropology; No.6 University of Michigan, Ann Arbor

11. For example, dietary rules about eating cloven-hoofed animals and not wild ones, or eating meat products separately from milk products.

12. The caste system in India is probably the most elaborate example. More widespread are marriage proscriptions between kin and the almost universal incest taboo.

13. Mary Douglas provides great insight into the relationships between morals, religion and pollution laws. See Douglas, M., 1966, Purity and Danger; Routledge & Kegan Paul, London

14. Thus, for example, the strict rules and fear held by the Bembu about adultery were originally designed to uphold the institution of marriage. But by being able to purify themselves from the sin of adultery, they now use the same rule as a rationale for divorce and re-marriage.

15. See Douglas, ibrd, p. 137

16. Iwańska, Alicja, 1971, Purgatory and Utopia: A Mazahua Indian Village in Mexico; Schenkman, Cambridge, Mass.

17. The study by Niehoff and Andersson of the effectiveness of using teachers as change agents for agricultural innovations in the Philippines suggested that failure was because teachers were not considered to have competence in agriculture even though they were highly respected as educationists.

    The Peruvian governments approach to rural water includes the policy of using the competence and influence of local healers in changing attitudes to illness and health.

18. Matanog, R.R. and Mayerle, D., 1971, The Experience with Rural Self-help Water Schemes in Lushoto District; in Proceeding of Conference on Rural Water Supply in East Africa, 5-8 April, 1971, University of Dar es Salaam, p.229 - 238.

19. Freedman, R. and Takeshita, J.Y. 1965, Studies of Fertility and Family Limited in Taiwan; Engenics Quarterly, vol 12, p.233-250.

TABLE 1

RURAL WATER SUGGESTED MANAGEMENT COMPONENT SYSTEM FOR OAXACA, MEXICO

LOCAL MANAGEMENT TASKS	ALTERNATIVE COMPONENTS
1. Provision of construction labour	1. tequio (traditional communal labour) 2. hired labour 3. substitution of animals/tractors/ materials/other services.
2. Collection of cash contribution to project	1. income from specially allocated section of first class community land (of school plot). 2. adaptation of mayordormo office supported by deferred reciprocal exchange system of guelaguetza. 3. local entrepreneur 4. loan from outside source
3. Organise distribution and allocation of water and labour etc.	1. hired water controller 2. elected official responsible to village authorities 3. elected committee within traditional cargo system 4. official or committee directly responsible to government or government agency 5. control by water owner/agent
4. Collection of recurring maintenance/use dues	1. by water unit/land unit/wealth unit/ per capita 2. at point of sale/on basis of proportionate shares of total cost/metered in advance or in arrears 3. on communal basis through income from communal lands/taxes on community for other services or goods/taxes on outsiders
5. Provide maintenance labour and expertise; inspect water quality	1. tequio system of communal labour 2. penal labour 3. youth labour 4. individual responsibility 5. hired labour 6. technical expert from outside 7. technical expert locally trained and paid in cash/kind/reciprocal services 8. technical expert solely for water project or combined with genral mechanic services to community.
6. Provision of insurance against major damage	1. underwriting by insurance company/bank/ entrepreneur/local cacique/village authorities or official. 2. premiums paid as part of water dues/ through guela guetza system/separately.

7. Arbitration of disputes	1. combined with any of the alternatives listed under 2 above. 2. judiciary department at village/ regional national level 3. general village assembly 4. development agency 5. special arbitration official.

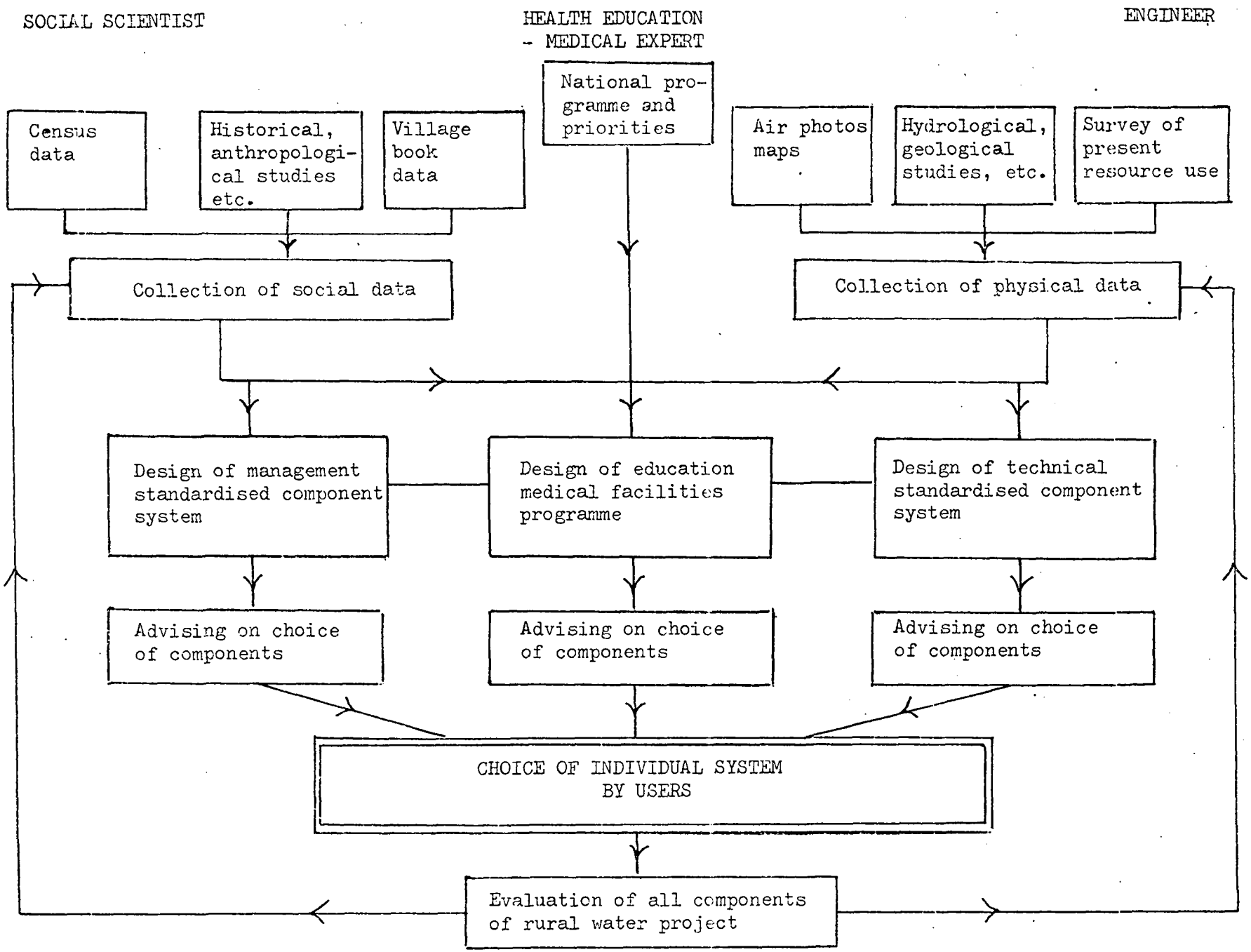

Table 2. Design for integrated technical, management, and educational component system for rural water programmes.