2. planning and management

2.1 Planning

In many countries the provision of community water supply systems is a major element in the environmental health programme and they are frequently planned in this context. However, the actual responsibility of the public health authorities is often limited to the quality surveillance of drinking water from community supplies, sometimes coupled with the control of sanitary facilities. In some countries the health authorities have assumed a direct responsibility for small community water supplies and sanitation in rural areas.

The control function in respect to water supplies and sanitary facilities would imply an active part in the planning, management and maintenance of all schemes. But the health authorities may not be sufficiently staffed and equipped to cope with the demands of such an involvement. Engineering units of other government departments usually carry out the bulk of water supply planning and construction. They are likely to concentrate their efforts on engineering and cost aspects, and may tend to overlook the health and social implications of drinking water supplies.

Programmes rather than projects

The planning and design of a large city water supply system usually is approached as a project. The term project is used here to describe all the preparations for the construction of a single scheme or water supply system. Every such major scheme is dealt with as a separate project. However, when planning water supply systems for a large number of small rural communities, the approach should be that of a programme rather than a series of individual projects. A programme is here understood to be an integrated group of continuing activities directed at the implementation of a considerable number of similar water supply schemes or systems. The key problems are likely to be less technical and more organisational and administrative.Community involvement aspects will assume a much greater significance.

Under a programme, technical decisions often have to be subordinated to other considerations. For example, the number of different types or models of pumps used in a programme should be kept to a minimum in order to reduce supply and maintenance problems. In the project approach, a pump would be selected to fit a technical specification, and the maintenance system would then be adapted to the pump's characteristics and service requirements.

Another basic difference is how the users perceive their relationship to the water supply and its cost and benefits. The urban dweller seldom has an alternative water source and is mostly aware of the general benefits of water supply services. Thus little time and effort are required to convince him of the need for more ample or safe water. In a small rural community there is usually no equivalent to this urban 'demand' for water. Rural households frequently have a choice between alternative water sources and people have developed their criteria to choose between them. Water is usually seen as a free commodity. Health considerations play a minor role. The quantities of water used are small, except perhaps for stock watering and plot irrigation. A strong demand for good quality water will then initially only exist in situations of severe shortages or of heavy pollution of the water sources.

It is, therefore, to be expected that an urban-type demand for water will not develop in small rural communities without some change in deeply ingrained water-use customs. An educational effort will have to be linked to the rura water supply programme and carried out with subtlety and knowledge of local habits.

Financial Considerations

In urban areas inhabitants have usually accepted the principle, or at least are familiar with the requirement that they must pay for the water, or rather for the convenience of having safe water delivered near the point of use. In small rural communities the principle of paying for water is usually not widely accepted. People feel that water, like air, is a natural gift. It is also a fact that those living in small communities often have little capacity to pay. Thus, developing financing schemes will be difficult and time-consuming, and requires a clear understand-

ing of local habits. For example, bills may have to be timed with local harvests.

For any rural water supply programme, it is necessary to establish a long-range financing arrangement. Small communities frequently find it difficult to obtain the capital for construction even when they unite into a national or provincial programme. The initiative for organizing and financing these programmes, therefore, must usually come from the central or provincial government.

Revolving funds offer one excellent method of financing because of their flexibility and adaptability to local needs and conditions. A revolving fund is a centrally established fund which finances new projects using repayments on earlier loans. To get started, the funds need to be established at the national or provincial level. The benefitting communities contribute labour and local materials for construction (for example, in Latin America usually up to 20 percent of construction costs). They then pay a water rate that, as a rule, covers local operation and minor repair expenses. To back up such local efforts, the national programme should organize a system for major repairs and maintenance at the district or provincial level. As the payments on earlier loans come in, the revolving fund is available to finance other schemes.

It is important to note that, in financing an urban scheme, basically all the required funds come from the community itself in the form of water revenues. In contrast, for the small rural communities, about 80 percent of construction costs would come from outside in the form of loans, grants, etc., and only the remaining 20 percent are direct community contributions such as construction materials and labour.

Recent studies in Latin America indicate that repayment schemes tend to promote effective organization at the local level. For this, the assistance of local administrators is essential. Communities do get used to community financing of water supply services and one of the major benefits seen is a greater community involvement.

Typical designs and standardisation

As one examines the thousands of small water supply systems required, one is struck by the number of repetitive elements: wells, intake structures, water

tanks, pump houses, etc. Substantial cost savings can be had if standard designs and construction techniques are used. In addition, costs can also be reduced by using technicians who are trained in the repetitive systems, limiting the number of professional engineers needed.

An advantageous approach has been developed in Latin America. Within this approach, the programme is broken down into its component parts - community promotion, technical design, programme financing, etc. - and each component is considered for its effects upon the others. A programme is developed which incorporates these elements into the least-cost solution that will best utilize the programme resources (manpower, finance technology and management). It is obvious that, since a rural water supply programme must repeat many tasks in thousands of villages - in some countries, in tens of thousands of villages - the development of standard designs becomes a necessity.

These designs must allow for rapid and effective construction techniques, through repetitive work by relatively unskilled artisans with standard equipment and plant. Unit design constitutes an essential feature. The savings in planning and supervision costs will almost certainly outweigh the slight technical inefficiency of such a design. It is possible to devise a very simple form of investigation which will enable a technician or sanitarian to collect in one day sufficient information about a small water project to support its qualification for a certain type of design.

Standard design criteria should be selected, predesigned elements (tanks, pump houses, etc.) and uniform equipment lists should be prepared. Once the design of a particular scheme has been reviewed by an engineer, the materials would be assembled in a central yard and sent to the community as a package, together with all the necessary tools and items not readily available locally. Professionals would also develop techniques and strategies for involving the community. These are formalized as work modules for each phase, and used in the training of personnel assigned to implement them at the local level. The design of both the technical and community involvement modules are determined in the context of the overall programme.

WHO Photo

Figure 2.1.
Water, health and development

2.2 Management and supervision

The following table outlines the principal functions carried out at the national, provincial and local levels. In some countries, provincial programmes are set up to operate autonomously but they are linked to the national programme by means of standard criteria, designs and financial assistance.

Table 2.1.
Functional division over different levels of government

Level	Functions
National	. Long-term planning. . Establishment of policies (technical and administrative) and standards. . Management of national funds, and matching these to local contributions. . Supervision of the execution of the national plan. . Supervision of provincial programmes. . General financial control. . Provision of technical assistance. . Training.
Provincial (and District)	. Programme implementation. . Design. . Construction, and administration of projects. . Promotion of community participation.
Local	. Administration of community water supply systems. . Operation and maintenance. . Collection of water charges.

It will not be possible to include all the existing small and rural communities into the national or provincial water supply programme at once. A selection will have to be made which will be amended and updated periodically. The criteria for selection and the order of priority for the construction of schemes will be determined at the national or provincial level taking into consideration all relevant factors.

The objective of any rural water supply programme should be as specific as possible. For instance: 'All

communities of 500 persons or more, and 50% of the smaller communities will have a safe water supply within a distance not exceeding 500 metres from each individual house, within 8 years'. Or, 'The goal is to provide drinking water to 90% of the rural communities in districts A and B within 22 months'. In contrast, it is vague to state the objective as 'Improvement of the water supply of small communities'.

A strong commitment to the programme at the national policy level is essential in order that the programme can operate on a long-term basis. It is often necessary to provide subsidies for some time until the communities served by the new schemes appreciate the benefits of an adequate supply of safe water. Once the people understand this, the process becomes one of a continuous upgrading of the basic service until it, hopefully, will reach a level where it is both firmly supported by the community and financially self-sufficient.

The management, operation and maintenance of a water supply system is a matter that should be kept in mind by policy-makers and design engineers from the earliest planning stage. The following statement summarizes this eloquently (Wagner & Lanoix, 1959):

' The engineer who makes the preliminary field investigations and designs can, by his decisions, facilitate or complicate future operation and maintenance problems. This will depend on whether he is searching simply for a solution, or for the best possible solution. Often, as a result of haste, these studies become less thorough than they should be. The engineer in charge of field investigations and design controls one of the most important phases which bears heavily on the future functioning of the project'.

'If by diligent work he can eliminate a pump, an engine, another piece of equipment, or a treatment process, he is thereby removing a possible obstacle to efficient operation. An understanding of the operational problems of small water systems, perseverance in the search for simple solutions, and vigilance in approval of projects are the best possible measures to facilitate the operation and maintenance of these systems, and, thus, to ensure the fulfillment of their function'.

' From the administrative standpoint, proper management of a water supply system, no matter how small, requires operating funds, personnel and organizational services. Since these are within the control of

local authorities, early negotiations should be undertaken, and a considerable degree of agreement should be reached, before the project gets into the construction stage. These negotiations are not always easy, as some officials, whether selected or appointed, will jealously guard their full authority, even though they may have had no previous experience in water supply management'.

2.3 Manpower and training

The number of personnel needed to manage and operate a small water supply greatly depends on the type of distribution system, if any, and whether there is a water treatment plant and/or pumping station. It should not be expected that qualified personnel will be found in small towns and villages. However, it will often be possible to recruit and train potentially good employees for both administrative and operational functions. One of the methods which has proven succesful consists of using the construction period to select and train the key personnel who, later, will be responsible for operational duties. During this phase, they have an opportunity to learn how the system is put together and works. In this way they can best understand and perform the maintenance work which is expected of them.

The actual selection of these men may, in some instances, be a delicate matter inasmuch as their employment may be the normal function of the local government. With tact and understanding, however, it should be possible to find candidates who are acceptable to the local authorities and who possess the minimum qualifications required.

The challenge will be in the use of sub-professional personnel. While managers and engineers who are experienced in community systems should manage the programme, their task will be so great (and they are usually so few) that they will have to devote their time to directing, planning, reviewing and supervising the programme. A special group of sub-professional technicians and/or sanitarians should be trained for the day-to-day cooperation with the communities, the collection of field data, prospecting for and investigation of water sources, the preparation of the repetitive designs as well as the inspection visits to the completed systems.

In small undertakings, each person in a supervisory position has to perform a number of functions and without proper training he is bound to be inefficient in any individual function. Training is, therefore, particularly important for manpower engaged in small community water supply systems.

Training should stress the practical aspects of the subjects covered and should include a minimum of formal lectures. The programme of training may be accompanied, when circumstances permit, by a programme of examination and certification of water system technicians and operators, several grades being established for each category of personnel. Such a programme, which may be undertaken in collaboration with local educational authorities, will help to create an incentive on the part of the water supply personnel for technical development and progress towards more responsible positions.

One cannot overstress the need to develop in the mind of every waterworks official, whether office or field employee, the concept of 'service to the community'. Both the administration and the operation of a water system, large or small, should be geared towards the provision of a satisfactory service to the consumer. In many rural areas, this will be a novel idea. Often rural or small-town folk do not think of public utilities as agencies from which they can expect or demand service. To them the water supply may be thought of in terms of the mail service: poor and intermittent. Their attitude would be one of complacency. Much effort should be made by the responsible agency to ensure that neither the people served nor the watersupply employees develop this sort of attitude. The objective should be to make the employees understand the importance of giving a satisfactory service to consumers, and their role and responsibility in this. On the other hand, the local population needs to develop a sense of ownership and pride in the water supply system and to understand that it has a right to demand service. These processes are neither simple nor quick. However, once they are established, the service concept will grow and become more generally accepted. The critical time is in the early stage.

2.4 Community involvement

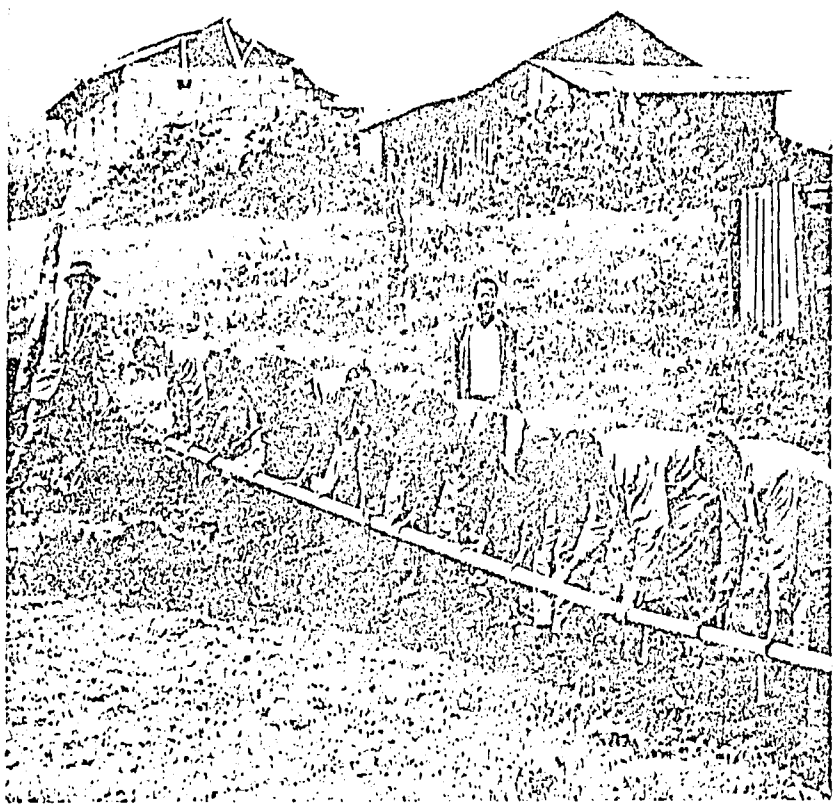
Acceptance of a small water supply system by a community is by no means assured. The users may not be satisfied by the supply provided, if it does not meet their expectations. Waiting in long lines to collect water, intermittent service and insufficient supplies during some or many hours daily, are common problems.

Engineers and technicians sometimes go to small communities, install water supply systems, and expect the villagers to use them with care for long periods of time. Too often, the people who are to benefit from the water supply system are not consulted on matters of design, construction, use and maintenance of the facilities. It is difficult, if not impossible, to achieve the continuous functioning of a small water supply without some degree of community involvement. If the installations are not accepted and supported by the community, they are likely to suffer from misuse, pilferage or even vandalism. Conversely, it has been seen time and again that, with proper consultation and guidance, people can be motivated to help in the planning, construction, operation and maintenance of water supply systems for their communities.

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

Analysis of existing small community water supplies has shown that participation in the early design stages greatly contributes to the success of a project. The choice of water source, the level of service and the siting of the water supply facilities in particular are decisions in which the community can be usefully involved. A second consideration for more

community involvement in the design stage, the safeguarding of the interests of weaker sections of the community, will be more difficult to accept. Yet many of the decisions that are taken in this phase may lead to a worsening of the position of disadvantaged groups. Social problems impairing the access to the supply, loss of employment, loss of social contacts for women, and the domination of local elites in the water organization are all possible consequences of a new water supply system.



UNICEF/WHO photo by Matheson

Figure 2.2.
Community involvement in construction

Community involvement in the construction of small water supply systems can take many forms. Local contributions in cash, labour, materials, services and organization will reduce the required capital investment, stimulate feelings of local pride and

commitment, develop local capabilities, and present opportunities for the selection and training of suitable personnel for maintenance of the supply. It will also promote the proper use of he supply by the people. But such community involvement can make too great a claim on the available resources and time, resulting in a poor standard of construction, delays, difficulties in the recruitment of the required personnel and local conflicts. Generally, some involvement of the community in the construction of the water supply is regarded necessary but the usefulness of local labour depends to a considerable extent on the type of technology adopted, the local conditions and the availability of technical supervisors.

The delegation of operation and maintenance tasks to a community is more common today than it was some years ago. These delegated responsibilities vary widely, from some checking and reporting, or basic routine maintenance, up to the training of caretakers and operators. There is a considerable range of local organisation and administrative arrangements.

Three approaches may be distinguished: a standard approach, individual arrangements, and a compromise combination. In Latin America, a stardard approach has been used with fixed selection procedures, formal delegation of responsibilities and authority, supplemented by training and supervision. Elsewhere, individual arrangements are common which are adapted to the existing community organization. However, these arrangements lack a legal base and their effectiveness is often limited. As a compromise, some flexibility can be brought into the standard approach to suit the local, social and cultural pattern. This relates to matters such as the selection procedures, scope of community organization and division of responsibilities and authority.

If the cooperation between the community and the water supply agency or health deparment is to be effective, both sides will have to be partners in a full exchange of information and views. The water supply agency needs to set forth the desired goals of the community water supply system. Health education may be part of the motivation for the water project and should start as early as possible. On the other hand, local conditions, expectations, and constraints will also play important roles. The water agency therefore needs to receive sufficient information about the socio-economic and cultural background of the community.

Project information and general health education during the planning phase may be followed by more specific educational efforts, such as training for delegated tasks. A users' education programme can be started before the installation is completed. Health education may be continued as a more specific programme on personal, household and public hygiene and other related health aspects. The integration of health education as a part of any water supply project has already been emphasized. The provision and use of safe water alone will not be enough to achieve a health impact. Usually, improvements in disposal of waste, nutrition, animal hygiene, housing, insect and rodent control, and food hygiene will be needed as well. In some countries water projects are part of the primary health care programme, or they are linked to nutrition projects. However, even when water supplies are planned and implemented independently, engineers should discuss with the community the role water can play in local development and they should encourage other agencies to link their programmes to the water project.

WHO Photo by D. Deriaz

Figure 2.3.
Educating the people about water (Iran)

2.5 Maintenance

Experience shows that small community water supplies are often more difficult to be kept running than to construct. The need for maintenance is generally recognized but the actual maintenance work is frequently neglected. A basic principle in the planning of any small community water supply should be that the technical design keeps in view the maintenance requirements of the installations and equipment. The maintenance scheme should be feasible, just as the technical design should be cost-effective and suited to the local conditions.

Two factors contribute to most failures in small community water systems:

a) Equipment and materials are used under conditions for which they are not designed;
b) Operators who, due to ignorance or disinterest, do not recognize the indications which precede breakdowns and failures.

The typical operator of a small water treatment plant also supervises or actually makes water service connections, reads meters, answers complaints and orders needed supplies and equipment. He must also argue his case before the town board, village chief or water committee. He is lucky if he receives half the pay he is worth. Operators of small water supply plants have limited resources available to them, and are frequently called upon to perform extensive tasks. They often get little support and appreciation. Yet they have to carry out their work in a creditable fashion.

By careful review of plant, design and specifications, the water supply agency can prevent or eliminate most difficulties of a mechanical nature. The reduction of troubles caused by the human element is harder to achieve. But much can be done, as previously indicated, through training of field personnel, technical assistance and supervision.

The following reasons make it particularly important to provide for proper operation and maintenance.

The effect of an inoperative community water supply on the health of the users. This may be difficult to quantify but many studies and surveys have shown that the incidence of intestinal diseases is related to the use of polluted water. Improvements in the health

situation that can result from the supply of safe water, are lost when the water supply breaks down.

In small rural and urban squatter communities where the provision of safe water is most important, the introduction of a new water supply is often a major event. Frequently this event also forms part of the health education towards the hygienic use of the water. If the water supply becomes inoperative, the chances of improving the hygienic practices in the community will be lost for months, if not years. Furthermore, if the water supply scheme was constructed with contributions from the community, whether in kind or money, the people will probably view the breakdown of the supply as evidence that their contribution is wasted. It is likely that they will be unwilling to further cooperate with the water supply agency or the government.

The above facts are difficult to analyse from a strictly economic point of view. However, a tentative assessment of the economic impact is as follows:

A country may have some 10,000 small community water supplies representing an average investment of about $ 30,000 each. If only 75% of these schemes are functioning, then 2,500 schemes are out of operation at any one time. Should an improved maintenance system ensure the continuous operation of 1,500 out of these 2,500 schemes, this would be equivalent to a capital investment of $ 45 million! Moreover, experience shows that installations remaining out of order for more than a few days are likely to suffer from pilferage and vandalism. It is not unusual that equipment is stolen from them. Therefore, not only the inconvenience and health hazards of inoperative small water supplies should be considered but also the loss of equipment, spare parts and construction materials.

The primary responsibility for the continuous functioning and maintenance of a small water supply system lies with the community, at the local level, backed by district support and the national water supply programme. A good example of this comes from the State of Tamil Nadu, in India, where a three-tier maintenance system was introduced. Since 1971, about 15,000 deep-well hand pumps have been installed and about an equal number of shallow-well hand pumps, serving villages in the rural areas of the State. The three-tier system is intended to provide maintenance of these wells and pumps.

The three-tier maintenance system comprises the following service personnel:

1) Caretaker at village level

An interested and capable volunteer, who usually lives close to the handpump, is chosen from among the villagers. He may be a farmer, shopkeeper, artisan or social worker. He is given a two-day orientation course on the importance of drinking water supply and on the mechanism, operation and servicing of hand pumps. He is trained to attend to minor repairs and is supplied with basic tools. He is also given pre-stamped and addressed postcards in the local language. When a breakdown occurs, the caretaker tries to fix it. If he can not do so, he specifies the type of repairs needed on two postcards, one of which he posts to the block-level 'fitter' and the other to the District mobile team. So far, some 2,000 caretakers have been trained in Tamil Nadu State.

2) 'Fitter' at the block level

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

3) Mobile team at the district level

In case of the need for major repairs, it is the mobile team at the district level which proceeds to the village upon receipt of the postcard. There is one such team for every 1,000 handpumps and, therefore, this often involves a delay of a week or more. To reduce this waiting, the Tamil Nadu Government is now recommending one such team for every 500 handpumps. Any expenses incurred in the repairs are shared by the government and the local 'gram panchayats' (village councils).

Some breakdown of a water supply plant and equipment is inevitable in spite of the best maintenance measures taken. In order to deal with such breakdown efficiently and with minimum delay, the following facilities should be available:

- Workshop facility
- Sufficient stock of necessary spares, etc.
- Technical staff
- Communication facility
- Directory of addresses and names of firms and suppliers
- Training programme.

2.6 Emergency operation

Every community water supply system, large or small, should have some emergency procedures which may have to be operated in situations such as earthquake, flood, or war damage. It must be recognized that, in such circumstances, water is probably the most urgent need of people who will use any available source, polluted or not, unless provision is made quickly for a supply of safe water. It is recommended that, soon after the installation of a new water system, or even before, a realistic inventory be made covering all available sources of water, public or private. This inventory should include personnel resources and the available emergency-type water supply equipment, hand and motor pumps, water-tank trucks, pipe accessories, mobile or potable filter units, tools and spare parts, and chemicals (especially those for water disinfection purposes).

During emergencies, a minimum of 2 litres of water per person should be provided daily for drinking and 3 litres for other purposes, in such places as temporary shelters. In camps with tents, a minimum of 10 litres per person should be provided. This amount should be doubled for the supply of temporary hospitals and first-aid stations. While ground-water supplies from properly constructed wells, infiltration galleries, and spring structures may be regarded as safe, all surface water should be considered of doubtful quality. It has to be disinfected by boiling, chlorination or disinfection by iodine compounds. The free chlorine residual in reasonably clear water at times of emergencies should be not less than 0.5 mg/l after 30 minutes of contact for water that has not been filtered.