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COMMUNITY WATER SUPPLY

Report of a WHO Expert Committee

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Geneva, 29 October - 4 November 1968

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COMMUNITY WATER SUPPLY

Report of a WHO Expert Committee

A WHO Expert Committee on Community Water Supply met in Geneva from 29 October to 4 November 1968. Dr P. Dorolle, Deputy Director-General, opened the meeting on behalf of the Director-General and welcomed the participants.

Dr Dorolle referred to the many and complex problems confronting Member Governments in their attempts to raise social and economic levels and especially to provide safe and ample public water supplies. WHO could assist in many ways by advising governments on the tactics and strategy that would assure a successful national programme.

This was the first Expert Committee to be convened by WHO specifically to consider problems of community water supply. Its composition reflected the wide variety of disciplines and experience needed for the creation and successful operation of a water supply programme. These included teaching, training and research in environmental sanitation, medicine, public health administration, health surveillance, economics, and engineering.

INTRODUCTION

The WHO programme for improving community water supplies was initiated in 1959 in pursuance of a resolution adopted by the Twelfth World Health Assembly. Subsequent Assemblies have reaffirmed WHO's continued concern with the problems confronting governments in providing safe and ample supplies of water.

Although the efforts of these governments, assisted by international, regional and bilateral agencies, brought some improvement, the Seventeenth World Health Assembly reported in 1964 that "the progress to date in the development of water supplies, while considerable, in relation to the magnitude of the task has been inadequate to meet these needs".

The present report identifies continuing and new problems in water supply; evaluates progress and trends in the community water supply programmes in the world; indicates broad areas in which research and developmental work on the scientific, technical, administrative, financial and economic aspects are required; and makes recommendations for national and international action.

1. REVIEW OF PROGRESS

The Committee reviewed the results of WHO-assisted programmes for improving community water supplies in developing countries. In spite of some progress, the situation in most developing countries still remains critical. From available evidence, it would appear that in many developing countries the present rate of increase in urban community supplies is not even sufficient to make up for past neglect, let alone to keep pace with the population increase. Only about one-third of the urban population in those countries have any drinking water supplies in their houses or on their premises.

In many developing parts of the world, the present rate of progress in improving rural water supplies is so slow that it will take more than 100 years to reach a satisfactory level unless present efforts are dramatically accelerated. Only one in ten rural dwellers can obtain even the smallest amounts of safe water.

The populations living in areas on the fringe of rapidly growing urban communities are in an even more unsatisfactory position. These people are frequently the poorest sections of the population and, while they await the extension of town and city planning, may be without a community organization that can take responsibility for any environmental health measures at all.

The rate of population growth in developing countries is some 40% greater than that in the world as a whole, and in the urban centres, where migration from the rural areas is unchecked, the rate is some 250% higher than that in rural areas. The problems of securing a community water supply for the world are tremendous and it is clear that the countries concerned, in co-operation with all assisting agencies, must make a concerted effort to mobilize every potential source of manpower, money, and materials if realistic national goals are to be achieved in a reasonable time.

2. CONTINUING AND NEW PROBLEMS IN COMMUNITY WATER SUPPLY

2.1 Public health aspects

From a public health point of view, the essential requirements of a community water supply are safety, adequacy, convenience, and continuity.

An adequate supply for drinking purposes is essential because, if a sufficient quantity of safe water is not always available and conveniently

to hand, people are likely to use any source of water, safe or unsafe, that is available. An adequate supply of water is also needed for other domestic purposes, such as cooking, washing, and sewage disposal, as well as for industrial uses, fire-fighting, street cleaning and, it is to be hoped, recreational purposes.

Considerations of safety apply at every stage in the planning and provision of a community water supply, from the choice of a water source to its use by the consumer and its final discharge as waste water into a receiving body of water.

2.1.1 *Sources of water*

In the choice of a source, a water that is free from toxic or undesirable chemicals is preferred and ideally the source or impounding reservoir should not be subject to pollution by : (1) domestic sewage, which may contain pathogenic bacteria, viruses, the ova of intestinal parasites, or substances such as detergents; (2) industrial wastes, which may contain toxic chemicals or substances that would render the water unacceptable; or (3) run-off from agricultural land, carrying residues of herbicides or pesticides that could be toxic, and nutrients that encourage the growth of aquatic organisms capable of interfering with treatment processes. Such pollution would not necessarily debar a source from use for a community water supply — many of these organisms or substances could be removed by subsequent treatment — but clearly impurities of this sort would have an important bearing on the choice of a source and the type of treatment needed.

2.1.2 *Water-borne diseases*

The greatest danger from drinking-water is the possibility of its recent contamination by sewage or human excrement. Many naturally occurring sources of water are liable to such contamination at some point. If the pollution is of sufficiently recent occurrence and emanates from a population that includes cases or carriers of such infections as cholera, enteric fever, or dysentery, the water will almost certainly contain the living organisms of these diseases and its consumption may result in fresh cases.

Where polluted water exists, there is always the risk that an individual will drink it and contract disease as a result. Water-borne epidemics are, however, mainly associated with communal water supplies, and the larger the community the greater the population exposed to risk at any one time. On the other hand, small communities more frequently run the risk of exposure to polluted supplies than do the larger ones.

The two most serious diseases that are commonly water-borne are cholera and typhoid fever, but other diseases such as dysentery, gastro-

enteritis and virus infections may also be carried by water. Cholera is still perhaps the most dramatic disease in which a massive reduction in incidence could be achieved by the provision of safe drinking water and good sewage disposal. There are also a number of diseases associated with dirt that could be markedly reduced by the provision of an adequate supply of water for bathing and for washing clothes. These include trachoma, louse-borne relapsing fever, scabies, louse-borne typhus, and yaws.

2.1.3 *Water-associated diseases*

Impounding reservoirs, rivers, and irrigation ditches may form breeding grounds for the mosquitos and flies that transmit such water-associated diseases as malaria, onchocerciasis or filariasis, and they may provide a habitat for the snails that are intermediate hosts in the spread of schistosomiasis or the cyclops concerned in the spread of dracontiasis.

2.1.4 *Health precautions during operation*

The construction of the treatment works, service reservoirs and the distribution system as a whole must be such as to protect the treated water from any source of pollution, for example, from floods. It is important also that operatives in treatment works are properly instructed in hygiene and provided with the necessary facilities for this purpose. Above all, the safety of the water that is distributed to the public must be adequately supervised by the public health authority of the locality in which it is used. This authority should also provide continuous surveillance to ensure that any new chemicals proposed for treatment and any new construction materials that may be in contact with drinking water meet public health criteria as laid down by the ministry of health of the country.

Continuity of supply is important because the negative pressures that develop in the distribution system when the supply is intermittent cause contamination. This is due to pollution being sucked into the system through any leaks there may be and to back syphonage in improperly plumbed house installations. With these dangers in mind, the local public health authority should keep a close check on the quality of the water reaching the consumers, as well as on that entering the distribution network.

Finally, care must be taken that the used water — whether from domestic or non-domestic sources — does not cause further pollution of sources that may subsequently be used for water supplies or recreational purposes.

From the above, it is obviously essential for public health authorities to be involved at every stage in the planning and development of community water supplies.

2.2 Water supply technology

2.2.1 *Technical design*

A community water supply system comprises many components of a technical nature, all of which have to be operated to prescribed performance standards and given adequate maintenance to enable them to function with maximum efficiency at all times. The need for this maintenance, all too frequently neglected, cannot be too strongly stressed.

The design of these components needs to be tailored to suit the technical development of the country involved, with due consideration to shortage of trained personnel, the local availability of equipment and materials, the use of local talent, and traditional methods of approach. For these reasons, it is frequently necessary to adapt the designs that are generally available elsewhere and to ensure that the specifications involved are truly applicable.

It is obvious that standardized design and prefabrication are to be encouraged, since they provide economy in design staff, in production capacity, in supervision, and in stores and spares. There is, however, the need to keep water quality firmly in mind when considering the application of these standard designs to a particular situation. There is also a risk of retarding innovation; this should be guarded against by continuous research to develop improved designs.

When considering water treatment plant specifically, too much emphasis is frequently placed on the cost of the treatment process in comparison with the running cost of the water supply scheme as a whole. Only in very rare cases is the raw water quality such that these treatment costs become significant.

2.2.2 *Leakage in the distribution system*

Available evidence suggests that, in many communities, water wastage from the distribution system can be as high as 50%. Saving the water lost by leakage can well postpone the need for future augmentation of the supply as well as avoid health hazards from the risk of polluted water entering the water main, particularly when supplies are intermittent. There is urgent need for demonstration of leak detection procedures and for advice on the organization of local service units to carry out this function.

It may be argued that proposals for new water supplies for areas as yet unserved should be directed from the start to the establishment of water supplies piped to dwellings, and should not necessarily go through the intermediate stages, such as the provision of street stand pipes and the like. The replacement of existing public fountain supplies by piped

supplies will significantly contribute to the raising of the standard of health of the community.

2.2.3 *Quality aspects and surveillance*

In framing policies and procedures for the control of water-borne diseases insufficient recognition is often given to the essentially preventive role of public water supplies and other environmental health activities.

Standards for drinking-water quality. Water quality standards are essential for the purposes of surveillance, both in the interests of public health and for operational control. Existing international and regional standards provide a basis for national standards, which should reflect the stage of development of the country. In framing these national standards, limits for bacteriological and toxic substances cannot be sacrificed, but it is recognized that local situations may demand some relaxation of certain chemical and physical requirements. At all times, however, drinking water standards must be adequate for safety and their application must be simple to supervise.

The *International Standards for Drinking-Water* published by WHO¹ have been useful, but periodic revision is necessary and the basis upon which toxicological levels of some contaminants is determined needs further examination.

Standards for raw-water quality. Consideration should be given to the desirability of framing raw-water standards, keeping in view the possible physiological effects of new pollutants

Standards for new materials. In the formulation of standards for new materials of construction and for treatment chemicals, health aspects must receive due consideration. It would be desirable for an international organization such as WHO to assess the available information on this subject and act as a clearing house.

Control applications. The development and application of surveillance procedures to monitor raw-water quality and to maintain the quality of the drinking water throughout the distribution system is of the utmost importance.

Obviously, every effort should be made to protect existing water sources of good quality from deterioration. This may require the imposition of higher standards for effluent quality and disposal and the regulation of recreational uses and of pollution arising from agricultural and community development. There appears to be scope for further enquiry and co-ordination of existing information on this subject.

¹ World Health Organization (1963) *International standards for drinking water*, Geneva.

2.2.4 *Emergency situations*

The Committee expressed concern about the public health aspects of water supplies in emergency situations and noted with approval that this problem is receiving attention as part of the WHO study on sanitation in natural disasters.

2.3 **Organizational aspects**

In any country the existence of a sound organizational structure is one of the prerequisites for the successful development of a community water supply programme.

During the last decade, WHO has collaborated with a number of governments in the establishment of organizational patterns suited to the particular conditions of the countries concerned. From the progress made and the experience gained in this process of "institution building", the following conclusions may be drawn :

1. *Development in stages.* The need to conserve resources in developing countries makes it almost inevitable that community water supply programmes should be developed stage by stage, each stage having a clearly defined objective. In general, three stages can be identified : the first in which public health aspects predominate and high capital investments are required; an intermediate stage when public health engineering organizations are created and water revenues are established; and a third stage when people demand more water of better quality and are willing and able to pay a higher price. The point in the growth of the gross national product when the second stage is reached is difficult to identify, but it is normally a long and relatively stable stage and requires less investment than the first. It ends when the wealth of the community has risen to a relatively high level, permitting the programme to enter the third stage.

2. *Priorities.* What has been termed "the revolution of rising expectations" is making it increasingly difficult for community water supply programmes to obtain an adequate share of the funds available within national development plans, since they have to compete with other important and pressing projects. It is therefore essential to provide sound justification for water supply projects in order to ensure that they receive sufficiently high priority in relation to other sectors of public and private development.

3. *National goals.* It is evident that the principle that community water supplies should be an integral component of a country's development policy does not yet receive adequate recognition from many governments. A sound and orderly construction of public water supplies can be achieved

only by the establishment of short-range and long-range national goals as an integral part of the national economic development plans. There must also be appropriate legislation to cover all aspects of the programme.

4. *Community involvement.* Promotion of community interest and participation is essential for the initial and continuing success of any community water supply programme.

5. *Administrative structures.* It is recognized that the centralization of responsibility for water supply programmes may be of advantage in developing countries. By their nature, however, central agencies can be responsible for delays in programmes, and they may retard the assumption by local communities of responsibility in a matter which should be essentially of local concern. On the other hand, decentralization, while leading to quicker action, also produces diversification of operations. In some developed countries, the amalgamation of existing water supply units into larger ones permits operational supervision by more highly qualified personnel. This is desirable, provided that public health surveillance of water supplies is likewise assured.

6. *National organizations.* There is an imperative need to strengthen existing national organizations and to define the principal responsibilities of various governmental and semi-governmental agencies for the planning, design, and health surveillance of water schemes so as to ensure adequate financial support from appropriate international, regional, and bilateral agencies, as well as from "in country" sources. Streamlining may be necessary in some instances to reduce the number of agencies and to avoid overlapping of functions. It is important also that the ministry of health or other responsible agency should bring into its discussions at the planning stage other appropriate ministries, including the treasury.

7. *Conflict of functions.* The situation existing in certain countries, where the same agency is called upon to undertake not only surveillance of the health standards of a water supply, but also the design, construction and even operation of the system, can impair the objectivity and quality of its control function. Generally, such a combination of functions should be regarded as undesirable because of the potential conflict of interests.

8. *Status of the engineer.* It is essential that, in all ministries of health, the engineer be given the necessary status and authority to allow him to play a responsible role in the development of community water supply programmes and to take part in decisions at a policy level.

9. *UNICEF schemes.* Pilot and demonstration schemes for rural water supply have been undertaken by governments with UNICEF and WHO assistance but difficulties have been experienced in expanding these to meet the total national needs. Such expansion requires a vigorous

and sustained effort, which should have the sympathetic support of all external assisting agencies.

10. *Groups and associations.* The development of professional societies and waterworks associations at the national and international level is highly desirable since, among other functions, they can bring pressure to bear for the benefit of community water supply development. It is important also not to overlook the encouragement of community interest at the local level that these sources can provide.

11. *Maintenance.* Neglect of procedures that directly affect operations and maintenance is one of the most frequently encountered deficiencies in the organization, management and administration of water undertakings in developing countries, especially those serving rural communities.

12. *Task forces.* Under appropriate circumstances the provision of centralized and regionalized task forces and services of a technical nature could result in economy, increased efficiency, and uniformity in the operation of water supply systems. This applies particularly to design functions, maintenance services, and the provision of public health and other laboratory facilities.

13. *Personnel.* Both international and national organizations concerned with water supply problems are having difficulty in recruiting suitable staff members and in finding consultants with appropriate experience.

14. *Joint water and sewerage schemes.* Although community water supply schemes are frequently developed before sewerage and drainage schemes, the policy of combining the water and sewerage units under joint administration should be diligently pursued.

2.4 Economics and finance

In discussing the economic and financial aspects of community water supply, the Committee concluded that the provision of finance, particularly in urban areas, is, in many cases, far less of a problem than at first appears. Projects properly presented can frequently expect to attract support from international, regional and bilateral agencies, and from resources at the national and local level. More information should be provided to governments on the availability of such funds.

2.4.1 Sources and character of loans

In this connexion, it was noted that a "bankable" project is generally defined as one that is financed from consumer charges alone and that

recognition of the need to extend this concept is long overdue in many places. Additional legitimate sources of money should be brought into use to supplement the maintenance and amortization charges on the loans.

International and regional banks and other financing agencies need to be made constantly aware of the long-term investment benefits of community water supply projects. They should be made to realize that deferred repayments of loans, long periods of amortization, and low rates of interest are all vital to the successful development of such projects, the character of which renders short-term loans at high interest rates inappropriate.

2.4.2 *Difficulties in borrowing procedures*

Steps need to be taken to ensure that the existing international, regional and bilateral aid agencies co-ordinate their procedures for the financing of community water supply programmes. It is to be hoped that this would substantially reduce the gestation period of these programmes, which is now often many years.

By their very nature, international, regional and bilateral agencies are slow of action and are frequently able to offer only a small part of the finances needed. For these reasons, it is important that vigorous action be taken to tap the internal resources of the country concerned.

It was agreed that the water authorities are often reluctant to demand higher payment for water supplies, even though the populations have the ability to pay. Wherever the raising of water rates is contemplated, resistance from the consumer is almost always feared by planners, but experience shows this rarely to be justified where due regard has been given to the need for efficient presentation of all the facts to the consuming public.

A water supply scheme could often be usefully and quickly financed from private sources. Sometimes it may be necessary to subsidize consumer revenues from funds derived from other sources, such as general taxation. Many tax structures are obsolete and should be revised or replaced.

It is desirable to safeguard the water revenue account from being used as a source of funds for other municipal and local activities.

2.4.3 *Need for economic assessment*

The economic aspects of many engineering schemes are inadequately assessed, thus making them unattractive to financing agencies. National governments should be made aware of the need to bring management expertise and economic understanding to bear upon the design of community water supply schemes, which at present are often considered purely from an engineering point of view. In this way, projects more acceptable to decision-making bodies and financial institutions may be realized.

2.4.4 *United Nations funds*

It should not be overlooked that UNDP funds exist not only for pre-investment surveys but also for education and training projects, as well as for research and development. It would be valuable if such funds could also be made available for rural water supply projects, particularly for group projects. It is hoped that UNICEF and WHO will be able to continue, and if possible expand, their programmes of joint assistance for rural water supplies.

2.5 **Education, training, and recruitment**

During the last decade, the national community water supply programmes of many countries have been severely hampered by the acute shortage of professional and technical personnel required for management, design, construction, supervision, operation, maintenance, and inspection. Developing countries have suffered the most, for it is in these that the lack of manpower, educational institutions, educators, and funds is most evident.

In many countries, the rate of education and training by the limited number of professional and technical institutions available is not even sufficient to meet the additional manpower needs created by the increase in population and progress in science and technology. Further complications often arise from deficient training, improper utilization and distribution of qualified personnel, and failure to estimate manpower needs correctly.

Although there is reason to be pleased with the progress being made in many parts of the world in the development of training programmes at various levels to meet the needs of community water supply programmes, obvious deficiencies still exist in some regions where there continues to be an urgent demand for additional manpower.

Managerial competence is vital to water supply schemes and the Committee considers that the specialized type of training needed to develop this expertise should be expanded in every way possible. Training courses should include instruction in financial, economic, and administrative procedures. It is to be noted that requests for financial support are more likely to be looked upon with favour by the World Bank and other international agencies if it can be shown that competent trained managerial personnel will be in charge of the completed projects.

In many developing countries, recruitment of waterworks personnel is inadequate owing to the lack of purposeful training programmes and facilities. Frequently, there are no personnel trained and available for the installation of the water services. Waterworks operators and other personnel at sub-professional level can profit as much as engineers, chemists,

and bacteriologists from in-service training, "certification" awards and other techniques for the recognition of merit. Salaries commensurate with increased ability can then be justified and any tendency for the trained men to drift away subsequently can be checked.

The need for low-cost textbooks in the many languages involved is self-apparent, and the attention of national governments should be drawn to the likelihood of securing support from international organizations and from commercial enterprises within their own countries for this purpose.

To help in the dissemination of up-to-date knowledge concerning all aspects of water supply, support for national and regional libraries servicing local units should be encouraged.

2.6 Research and development

2.6.1 Objectives

Any research and development programme concerned with community water supply must aim at improving the whole range of technology involved. Although some research of a fundamental nature is necessary, the main effort should be concentrated on development based upon existing knowledge. A substantial effort must also be made to ensure that the results arising from the development programme are applied effectively and continuously at the operating level. In addition, it is necessary to ensure that adequate use is made of field experience.

The objectives of a research and development programme, particularly in the developing countries, should be influenced by the need to reduce costs, to save foreign exchange by finding substitutes for imported materials, to simplify operation and maintenance, and to evaluate local materials. There should be sufficient flexibility in the programme to enable urgent problems to be studied as soon as a situation arises that calls for special investigation. It is important, wherever possible, to involve all countries in research and development activities in order to stimulate their interest in technical change and in its application.

There appears to be merit in the use of computer techniques to determine optimum solutions and in the promotion of operational research approaches to problems, even in the developing countries. There could be good reasons for by-passing traditional methods in favour of such new and more sophisticated techniques as the use of digital and analogue computers.

2.6.2 Field units

One proven method of ensuring that research and development activity is effectively applied at the work level is the establishment of

"field units" within a country. These are organized to demonstrate new techniques, and to supplement and enhance existing procedures for training and for the dissemination of the results of successful experience.

2.6.3 *Reference system*

It can be seen that the flow of information across the world relating to the development of community water supply programmes at the practical level is not great. The establishment of an international reference centre and a chain of collaborating institutions appears to be a very good way of overcoming this deficiency and of making assistance continuously available.

2.6.4 *Need for further research*

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 the 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 available 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.

2.7 Collection and dissemination of data and information

2.7.1 *Data and information*

The Committee noted with concern the almost complete absence of reliable and relevant technical, economic, and financial data emanating from national governments about their community water supply pro-

grammes and their progress. Such data have to be relevant to the needs of the government planning agencies and suitable for onward transmission to international agencies to enable them to promote improved organization, financing and planning of national water supply programmes. Energetic steps need to be taken to ensure the collection of these data by the establishment of systematic registry, by surveys, and by sampling. It should be borne in mind that the data should be of such a nature as to permit valid comparisons between those collected at different times and in different geographical areas. The preparation of guide-lines for use by governments would be helpful.

The Committee also emphasized the importance of obtaining comprehensive data on the socio-economic benefits that arise from the establishment of community water supplies and from other environmental health projects.

2.7.2 *Documentation*

The Committee drew attention to the need for documentation and dissemination of information on the following subjects :

- Health hazards in public water supplies
- Leakage detection and control
- Rates and tariffs for water supplies in developing countries.

3. CONCLUSIONS AND RECOMMENDATIONS

In many developing countries, the rate of installation of community water supplies is disappointingly low in both urban and rural areas. Unless the rate is dramatically increased, the promise of water for the people will not be fulfilled for at least another half century. After examining the reasons for the failure to make more rapid progress, the Committee made a number of specific recommendations for national and international action to achieve a significant improvement in community water supply programmes.

1. A community water supply should provide to all consumers a flow of water, available at all times, adequate for all purposes, conveniently accessible, and of a safe and acceptable quality.
2. The aim of a water supply project should be to deliver water to every consumer in his house or on his premises. Any measure less than this, for example, the provision of public stand pipes, should be regarded as an interim expedient, to be improved as early as possible.

3. A community water supply can be of great benefit to the health and well-being of the people whom it serves; it can, on the other hand, be a mechanism for the rapid transmission of water-borne disease if the delivered water becomes contaminated. For this reason, close and continuous surveillance by the public health authority is necessary in order to ensure the constant high quality of the water received by each consumer. Precautions must be taken against contamination through leaking mains, cross connexions, and back syphonage. Intermittent supplies should be replaced by continuous ones at an early stage, since the former represent a distinct health hazard.

4. In formulating policies and procedures for control of water-borne diseases greater recognition should be given to the fact that the provision of public water supplies and other environmental health activities are essentially preventive measures. Economic considerations should never be allowed to obstruct measures designed to save lives. The prevention of disability, morbidity, and mortality from water-borne disease is sufficient justification in itself for the provision of safe water supplies, aside from any economic arguments.

5. In designing water supply works, a balance should be struck between the individual requirements of each project and the economics that can be effected by standardization and prefabrication. The publication of guide-lines and recommended criteria would materially assist government staffs and consulting engineers in adapting conventional design standards to the particular circumstances of each country.

6. Maximum use should be made of locally available materials, techniques, and skills in the design, construction, and operation of water supplies. International assistance, in the form of research, specialist advice, and publications, would greatly assist governments to achieve this objective.

7. As an essential basis for surveillance and quality control by the health authorities, the formulation of national quality standards should be encouraged. As far as possible, these should be based on the *International Standards for Drinking Water* published by WHO, but these should be regularly reviewed and kept up to date. Further research is also needed into the basis of the toxicological levels of some contaminants so that more accurate standards can be specified.

8. Preventive maintenance is of vital importance at the water source, the treatment plant, in the distribution system, and in house installations. It is a concept that must receive adequate consideration in the design, construction, operation, training, and management of water supplies.

9. Sound national organizational structures, adapted to the conditions of the countries concerned, are essential if any appreciable progress is

to be made in meeting the existing demands for improved water supplies. The most appropriate pattern can be determined only by making a thorough study of national problems. International assistance in the form of administrative, economic, and legal advice is useful to governments in setting up such organizations.

10. The maximum use should be made of financial assistance from international, regional, bilateral and other sources for waterworks planning and construction. Advice and assistance is available from WHO and other agencies in the preparation of "bankable" projects aimed at attracting such assistance.

11. Possibilities of external assistance are not unlimited, and a greater effort should be made to tap financial sources within the country. In very many countries, the possibilities of raising capital for water supply construction from private investors, banks, insurance companies and other sources are not fully appreciated; the Committee recommends that methods of local financing, appropriate to each country, should be more fully explored. Some form of governmental or municipal guarantee of repayment would assist in creating the necessary confidence in this form of investment.

12. Some water supply projects, particularly those in rural areas and for small communities, cannot hope in the immediate future to be financially self-supporting in view of the limited capacity of the consumers to pay the whole cost of operation and capital amortization. Economic planners should take into account the total value of such projects in terms of improved health, increased agricultural output and similar benefits; these may amply justify their inclusion in their country's development plans.

13. Every endeavour should be made, by the improvement of tax structures and accounting methods, to place the finances of water supplies on a sound, businesslike basis. Not only will this make for efficiency in operation and use of the funds available, but it will also help to attract finances for the construction of similar undertakings elsewhere in the country.

14. Governments could benefit from the professional advice of engineers, at a policy-making level, in all matters relating to water supply. The formation of national professional groups and waterworks associations should be encouraged, as it is believed that these groups can materially assist in raising the standard of water supplies, and in improving their efficiency, to the advantage of the country as a whole. The status of the engineering profession within the ministry of health should be improved in many countries so that engineers engaged in the solution of problems related to water supplies can work in equal partnership with their colleagues in the medical and other professions.

15. One obstacle to the efficient planning and design of water supply projects is the lack of data on similar projects in the same and in other countries. These data can be furnished only by those responsible for the planning and operation of existing water supplies, and governments are urged to initiate the recording of information not only for their own use but also for the future use of other countries and of international agencies concerned with the development of community water supply programmes. The publication of annual reports by governments is one convenient means of placing essential facts on record. It is recommended that international guidance should be given on the form and content of such reports.

16. The construction, management, operation, and surveillance of water supplies demands the services of trained and experienced personnel, professional and sub-professional, if the large investments made in these facilities are to be protected. International assistance has been, and should continue to be, of value to governments in the training of these men. In view of the large numbers of personnel and diversity of disciplines required, however, and to ensure effectiveness, the bulk of training should be carried out within the country concerned.

17. So that the investment in training activities is not wasted by the loss of qualified men to other employment, governments should be urged to introduce such measures as minimum salary scales, promotion by merit, and certification of ability, in order to retain their existing staffs, and to encourage the recruitment of able personnel of all grades.

18. There would be undoubted advantages if research institutions and universities interested themselves in the water supply problems of their respective countries. A close liaison between such institutions and the operative departments responsible for water supplies would be mutually valuable and should be encouraged.

19. The interchange of information by seminars, publications and other means on all aspects of community water supplies, as carried out in the past by international organizations such as WHO, is a valuable service that, it is hoped, will be continued and extended in the future.

The Committee would urge governments everywhere to accord the highest possible priority to the provision of ample supplies of safe water to all their people, having in mind that there is no measure that can have such a far-reaching and beneficial effect upon the health and well-being of every individual.