

# **Community Water Supply**

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## **REPORT ON A SEMINAR**

**BRAZZAVILLE, 21 - 27 APRIL 1971**



**REGIONAL OFFICE FOR AFRICA  
World Health Organization  
Brazzaville**

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Report on a seminar convened by the  
Regional Office for Africa of the  
World Health Organization

Brazzaville  
21-27 April 1971

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Note

This report has been prepared by the Regional Office for Africa of the World Health Organization for distribution to the governments of Member States in the Region and to all who participated in the Seminar on Community Water Supply.

The views expressed are those of participants in the Seminar and do not necessarily reflect the policy of the World Health Organization.

This report is also available in French.

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## 1. INTRODUCTION

The seminar was opened at 9 a.m. on 21 April by the Regional Director, Dr A. Quenum, who welcomed the participants and highlighted the present unsatisfactory situation of community water supplies in the African Region. Some 70% of the population lacked piped water within reasonable distance of their homes and this situation was deteriorating with the increasing rate of urbanization. Pilot projects to ameliorate these conditions had not had the multiplying effect that was hoped for, and there had been inadequate research and insufficient funds for these vital services. In particular, the Regional Director made mention of the inadequate attention that has been accorded to rural supplies where "by means of simple and economic measures, substantial progress can be made".

The next business of the meeting was the election of officers:

Mr G. Ramasawmy was elected unanimously as Chairman, Mr S. O. Fadahunsi, Vice-Chairman and Mr A. Kitoko and Mr A. E. Harleston, Rapporteurs respectively for the French- and English-speaking groups.

Presenting the background paper, Mr J. A. Andu, one of the consultants, remarked that the paper comprised four sections dealing successively with four facets of community water supplies, namely planning, investigation, design and construction; financing; administration; and future studies and training, having regard to the current community water supply situation in the African Region.

Procedures and guidelines for the conduct of the seminar were then laid down, after which the plenary session adjourned, the participants separating into three working groups.

## 2. DEFINITION OF OBJECTIVES

The objectives of the seminar, as already defined and previously circulated to participating governments, were:

- (a) to motivate the participants to plan, develop and implement community water supply programmes in their countries;

- (b) to formulate guidelines and methods for the planning, development and implementation of community water supply programmes in the African Region.

### 3. METHODOLOGY

A working programme was presented outlining the conduct of the seminar along the following lines:

(a) Plenary sessions at which the working documents, previously distributed to participants, were briefly presented. Time was allotted for discussions and for clarification of subjects dealt with in the working document after it had been introduced.

(b) Working group sessions for the purpose of which the participants were divided into three working groups:

Group A - English

Group B - French, and

Group C - English and French.

Each group was assisted by three resource persons which included WHO regional advisers, consultants and temporary advisers for the seminar. A moderator and a rapporteur were nominated for each group and assistance from the secretariat of the seminar was provided as required.

The working groups were presented with a subject for daily consideration and were expected to report back to the seminar as laid down in the adopted agenda. With a view to identifying the problems and to find solutions, the following four subjects were treated during the group discussions which lasted four days:

- the planning, investigation, design and construction of community water supplies;
- the financing of water supplies in developing countries;
- the administration of community water supplies in developing countries;
- future studies and training.

(c) Reports on the daily proceedings of the discussions of each group were distributed to the participants every morning at the plenary sessions. During these sessions a consensus of opinion of all the participants on the reports of each group was obtained and this assisted in the preparation of the daily reports. The final report on the seminar was prepared from the daily reports.

#### 4. SUMMARY OF THE DISCUSSIONS

##### 4.1 Planning, investigation, design and construction of community water supplies

Reports, prepared by the three groups on the planning, investigation, design and construction of community water supplies were presented. The reports included comprehensive analysis, in tabular form, of the following sub-divisions of the subject matter:

- (a) Possibility of WHO targets being achieved by 1980.
- (b) Planning of community water supplies.
- (c) Type of personnel to be used in the development of water supply.
- (d) Scope and extent of investigation required.
- (e) Design criteria for African conditions.

##### 4.1.1 Possibility of WHO targets being achieved

"The target set by the Community Water Supply Unit of WHO within the period 1971 to 1980 is to ensure that at least 40% of urban dwellers have house connections in their homes or compounds whilst the remaining 60% should have access to public standpipes near their premises. The percentage of rural population having access to piped water supply should be raised from 10% to 20% within the same period."

On the whole the consensus of opinion was that the WHO target for the development of community water supplies for the period 1971 to 1980 could only be achieved if a number of difficulties including the inability to formulate well integrated plans for both urban and rural water supplies resulting from the scarcity of professional personnel and the ready availability of funds, are satisfactorily overcome.

#### 4.1.2 Planning of community water supplies

All the groups agreed that there was a need for planning but that there were a number of problems which required solutions, particularly:

- (a) financing
- (b) human resources
- (c) insufficient and unreliable data.

It was generally agreed that the planning periods should be specified in the water supply programmes. There are two possibilities, namely:

- (a) the preparation of a long-term plan, which may be described as a guiding plan covering a period of up to 30 years;
- (b) the preparation of short-term plans within the long-term plan for a period of up to 10 years.

It was also accepted that planning was a continuous process and should conveniently be dovetailed into the national plan of each country; and that close collaboration should exist between the engineers and the medical officers of health.

For any planning to be effectively carried out, statistical data of the water resources available and the requirements must be assembled and the standardization of materials considered. Planning should be based on the available and expected financial resources within the plan period. On the manpower requirements, adequate projections should be worked out and training of personnel arranged accordingly. It was also stressed that health education programmes should be launched for the education of the general public on the need for a plan. The participants agreed that ground water should whenever possible be preferred to surface water.

#### 4.1.3 Type of personnel required for the development of water supplies

It was generally agreed that as far as possible departmental staff of water undertakings should be used and that consultants and contracting firms outside the Region approached only when local expertise was not available.



Two of the problems identified were:

- (a) the collection of relevant data (many of which are not readily available);
- (b) protracted and expensive investigations for large urban supplies which necessarily retard the early completion of projects.

It was felt that crash programmes which should be accompanied by data collection should be sufficient for small rural water supplies in an effort to eliminate lengthy and costly investigations and to permit the realization of the WHO target. Crash programmes would also be particularly advantageous when combating water-borne epidemics.

Water supply investigations should be preceded by detailed programming which should involve closer collaboration than hitherto between the medical, paramedical, technical and financial personnel.

The creation of a national water commission, to control abstraction, use of water, and the prevention of pollution, should be a matter for urgent consideration by countries of the Region.

#### 4.1.4 Design criteria for African conditions

The problems identified as affecting design criteria are:

- (i) failure to consider water supply projects simultaneously with the disposal of the resulting waste water;
- (ii) frequent major extensions of water supply projects because of inadequate initial planning;
- (iii) restrictive standardization and specification of equipment and pre-qualifications regarding experience imposed by donor countries as some of the conditions for granting loans.

The suggestion that the planning of water supply projects should be considered simultaneously with the disposal of the resulting waste water was discussed. It was generally agreed that this was a good proposal. However, the priority facing the African Region was the provision of potable drinking water for the majority of its people, and in view of the limited funds available, the implementation of water supplies ought to be given first consideration.

No immediate solutions were suggested for combating the restrictive standardization and specification of equipment imposed by donor countries. Standardization of equipment should generally be limited in application.

It was agreed that greater use should be made of groundwater resources where available. Suitable low-cost pipes which are easy to lay, handle and maintain should be preferred whenever possible. Local technical personnel should be properly trained.

It was suggested that for rural areas, daily consumption per head should range between 15 and 50 litres, and for urban water supplies, not less than 100 litres.

Where the quantity of treated water is not sufficient for a continuous supply it is the practice to institute an intermittent service. This is an undesirable practice and steps should be taken to increase production if there is sufficient raw water. It is also essential, for health reasons, to avoid the creation of negative pressures in pipe lines which will result from intermittent supplies.

#### 4.2 Financing of community water supplies in developing countries

Reports were submitted by the three working groups on:

- source of funds;
- methods of influencing government, politicians and councils;
- conditions and criteria that should govern external financing;
- UNDP/SF financing for urban and rural water supplies;
- the financing of rural water supplies;
- interest rates, rate of return, depreciation and sinking funds.

##### 4.2.1 Source of funds

The participants identified the departments involved in financing: the respective ministries responsible for water supplies, concessions, local councils and water undertakings.

The major problems were considered to be:

- (a) the low priority usually given to rural water schemes;
- (b) the fact that populations are not always sufficiently aware of the health benefits of safe, potable water, and the possible dangers of the traditional sources;
- (c) lack of experienced technical and administrative personnel;
- (d) excessive government control which, in certain countries, inhibits progress and community efforts;
- (e) control vested in too many authorities.

The general consensus of opinion was that one of the most important problems to solve initially was that of information and motivation of the people concerned. It was considered of the greatest importance that health education should be considered as a priority. Once communities were alerted to the benefits of safe water supplies they could then contribute directly to the solutions of the other problems.

The use of community financing was stressed where, although the government would have to provide initial assistance, the people involved have to make some contributions such as, labour, land and, if possible, materials.

When considering urban supplies it was suggested that loans could be employed as long as they did not constitute an unwarranted burden on the users. It was generally agreed that outright grants or full subsidies were not to be encouraged.

The question of revolving loans was examined briefly and it was considered that these might be a useful form of financing.

One point that was stressed was the need to ensure that the community was closely involved, understood the need for the supply and was prepared to pay for the water and for operation and maintenance. Participants' attention was drawn to the fact that this policy has been successfully followed in Mexico where, by means of simple and economical installations, the needs of rural communities were met in a period of less than four years. These measures

were implemented, thanks to community motivation and participation, while the federal government supplied technical assistance and equipment and ensured independent management of the services through community representation. Each unit comprises a pump, a cistern and a public tap.

The question of national lotteries and insurance as a source of funds met with a mixed reception but was not discarded.

#### 4.2.2 Methods of influencing governments, politicians and councils

The subject of influencing policy makers to ensure that rural water supplies receive more consideration than hitherto was reviewed but again it was thought that the essential prerequisite was a health education programme to make the people aware of the need for and advantages of pure water. They can then influence policy through their representatives.

There is also the need to stress to the policy makers in all ministries that the rate of development of a country in the early stages is a direct function of the health of the population. If the population has a high standard of health there will be a consequent high rate of social and economic development. The most effective method of improving national standards of health is the provision of a potable water supply.

All ministries and other government agencies should be involved in health education campaigns which should include the use of the mass media.

It is most important that the policy makers should also consider the development of water supplies as an integral part of a national development plan which should not be conditioned by political expediency.

#### 4.2.3 Conditions and criteria that should govern external financing

In general the use of external aid should be reserved for large-scale schemes where the government is unable to find internal sources of finance. It is realized that the responsibility for obtaining finance for these schemes rests with the government which also has to ensure that the terms and conditions offered are acceptable both in the short and long term.

Governments can seek external financial assistance from three major types of organization:

- international
- bilateral
- multinational

Some of these operate on a strictly commercial basis whilst others offer less stringent conditions and the relative merits of these must be considered. It was agreed that there was a need to convey to some of these agencies that their terms were often too "hard" for developing countries and that they could well, in the first instance, consider improvements in health and in sociological standards as the most immediate return from a water supply programme. This would lead, in the second phase, to economic advantages that would make the undertaking self-supporting.

When considering bilateral aid the recipient country should ensure that the assistance requested is needed for projects within the framework of the national development plan. It was also suggested that the training of national technical personnel should always be an integral part of any project financed through external aid.

The importance of small scale, unspectacular water projects which nevertheless have a considerable impact on the health and economy should not be neglected when considering applications for external aid.

It was emphasized that the foreign consultants and experts should, in all cases, work in close collaboration with their counterparts in the recipient country, who have to implement and manage the schemes.

#### 4.2.4 UNDP/SF financing for urban and rural water supplies

The participants noted the assistance given by the UNDP/SF to the countries of the Region, and it was generally agreed that this form of assistance should be increased wherever possible.

It was emphasized that this type of funding only applied to pre-investment studies and not to the implementation of such projects. It was noted that the recipient country had to contribute in cash and kind. As a result of the study, a master plan would be prepared but this was the limit of support from UNDP/SF.

The participants again stressed the need for this type of funding to be applied to rural areas and to "mini" projects which have a high rate of return.

It was also suggested that:

- (a) local firms and consultants should be used whenever possible;
- (b) greater collaboration between foreign and national staff was needed;
- (c) foreign experts should be properly briefed and, if possible, be able to speak the official language of the country with some fluency.

#### 4.2.5 The financing of rural water supplies

These schemes could rarely be self-supporting and self-liquidating as the per capita incomes in the rural areas are so low. However, it is essential that the local people should contribute to the utmost of their resources if they are to appreciate this amenity to the full.

It was agreed that either governments or local authorities would have to provide the technical staff, equipment and materials but the communities should contribute staff, labour, land, tools and materials within the limits of their resources.

The money could be obtained either directly from the overall budget, from a revolving loan or any other suitable source. As far as possible, the recipients should be responsible for the unskilled part of the maintenance and operation of the project.

It was noted that if these schemes are to have the maximum impact and results, the local people must be convinced of the need for this amenity and again it was a matter of health education.

#### 4.2.6 Interest rates, rates of return, depreciation and "sinking funds"

These items depend largely upon the local and social concepts concerning water supplies. If regarded as a social service then rates of return are hypothetical although the administrators of the supplies must determine depreciation periods.

Again if the project is partially subsidized the chosen method of accounting will determine the interest rates, rates of return, depreciation, etc.

If an enterprise is self-supporting these items can be usefully quantified. It was thought that, in general, interest rates were too high and more favourable rates might be obtained from some institutions on non-commercial terms. Again, rates of return will depend upon the operating concepts since, if the "consumer of today" is to pay only the full operating costs of the existing plant and administration the rate of return is only enough to cover these items with a small safety margin.

Where it is an accepted practice to make the "consumer of today" pay for the "consumer of tomorrow", then sinking funds are often established to take care of the renewal of assets. This practice was discussed but no formal decisions were reached.

#### 4.3 Administration of community water supplies in developing countries

At the plenary meeting held on 24 April 1971, a WHO temporary adviser presented the reports (see annexes 6-9) of the three working groups.

The reports relate to the following topics:

- sound administration
- centralized or local authority administration
- suitable forms of administration for urban and rural supplies
- ministry responsible and involvement of the ministry of health
- water rates, metering and revenue collection.

##### 4.3.1 Sound administration

The participants emphasized that water is a national asset and noted that its production and distribution should be carefully planned in order to supply sanitary, trouble-free and uninterrupted service. In programming for water supply all departments and/or agencies of government directly concerned with water usage, should be involved.

It was considered that the problems encountered in the administration of services were due to the dispersion of responsibilities among ministries, which greatly reduces the operational efficiency of water undertakings. In order to ensure efficiency in management, all water supply activities should be the responsibility of a single central authority having wide powers, which should:

- draw up and maintain an inventory of all resources and assets;
- plan and supervise their proper and rational utilization;
- protect the water against pollution;
- set up a suitable administrative machinery which will co-ordinate the activities of the various sections of the undertakings, including particularly the training of local personnel;
- ensure that the different ministries and agencies of government are aware of the socio-economic advantages that can be derived from potable water supplies, so as to secure their active participation in the education of the general public; and
- also act in concert and close collaboration with those planning sewerage and sewage disposal facilities.

#### 4.3.2 Centralized or local authority administration

The participants highlighted the difficulties experienced by member countries in instituting sound management practices for water supplies due to dispersion of responsibilities between different government ministries and/or agencies.

They recommended that a central autonomous administration be established and it was considered that the administrative formula proposed had the following advantages and disadvantages:

##### Advantages

- pooling of material and human resources thus ensuring their rational use;
- operation of standard charges;
- better operational and maintenance service;
- planning of all the activities for the country or state as a whole;
- permits standardization within reasonable limits.



#### Disadvantages

- possibility of undue bureaucratic procedures unless properly checked;
- resistance on the part of certain local authorities and officials whose interests are at stake.

It was pointed out, however, that the establishment of any administrative machinery should be preceded by careful study, taking into account all factors relating to the area concerned such as tradition, culture and attitudes.

#### 4.3.3 Suitable forms of administration for urban and rural supplies

The participants recognized the merit of a single administration at the central level; however, to make it more flexible and effective, they advocated the establishment of:

- an autonomous system in urban areas; and
- a semi-autonomous system in rural areas, within the central organization.

It was emphasized that all studies on water supply should be linked with the problems of wastes disposal. It was noted, however, that in view of the priority attached by WHO and the participants to the rapid development of water supply projects in the African Region, particularly for the rural areas, when planning water and sewage works simultaneously, the implementation of water supply projects should be given first priority in the allocation of available funds.

#### 4.3.4 Ministry responsible and involvement of the ministry of health

The participants noted that the responsibilities for water supply matters were usually distributed among several ministries. They recommended the establishment of a body directly responsible to the highest government authority and entrusted with the responsibility for all the water supply activities presently carried out by the different ministries. It was nevertheless clearly understood that in the formulation of projects, it was essential to obtain the views of the ministry of health.

All the participants recognized the importance of the new multidisciplinary approach of the WHO Regional Office for Africa, which should always be kept in mind when considering water supply and wastes disposal projects (design, implementation, administration, etc.).

#### 4.3.5 Water rates, metering and revenue collection

The participants agreed that water should be paid for by the user and at the same time be available to everyone but felt, however, that in view of the special situation of certain areas, preferential rates could be established in line with the essential role of water in safeguarding health.

The question of revenue collection was discussed. It was agreed that specific arrangements should be studied for each area, taking into account the income of the users, the local situation, the psychological impact, etc., but that the guiding principle in the long run should be to require the user to pay for the quantity of water consumed.

#### 4.4 Future studies and training

At the plenary meeting held on the 26 April a WHO temporary adviser presented the report of the three working groups.

The reports related to the following subjects involved in studies and training:

- (a) Health, economic and social impact of water supplies and the necessary resettlement of populations.
- (b) Studies on materials, construction, equipment, and treatment with reference to regional standards and local manufacture.
- (c) All relevant forms of data collection and analysis.
- (d) Training of all grades of personnel.
- (e) Emergency measures, particularly during epidemics.

##### 4.4.1 Health, sociological and economic impact of water supplies and the resettlement of population

In general, the health and social aspects of water and sewage systems are not given sufficient attention particularly in preinvestment exercises where the economic viability of the project tends to be the most important factor.

The major difficulties encountered in such studies are:

- (a) lack of data, funds and personnel;
- (b) lack of adequate comprehensive planning for community water supplies;
- (c) insufficient planning for the resettlement of communities which results in the destruction of the traditional way of life and seriously impairs their social institutions.

It was agreed that these problems could best be overcome if adequate plans were prepared at and for all stages of a project. This includes the necessity for the provision of trained personnel and for their training. Throughout the planning stages, the health of the people and the social and economic implications of the scheme should be considered with the utmost care. The implementation of concerted programmes of community education should also be considered at all stages.

#### 4.4.2 Studies of materials, construction, equipment and water treatment with reference to regional standards and local manufacture

Wherever possible local materials should be used and emphasis should be placed on applied research which will assist in this development. Considerable attention should be paid to ensuring that where goods are manufactured locally standards of manufacture should be maintained particularly in the provision of equipment for water supplies. It was noted, that the WHO Regional Office for Africa is in the process of assisting in the establishment of centres for applied research, demonstration and training. The main purpose of these centres would be to develop simple solutions to local problems taking into account prevailing conditions including the availability and use of local materials, methods of construction, the design and supply of equipment and the treatment of water supplies.

Taking into consideration the degree of development of the Region, regional standards for design, for the performance of equipment and for water treatment could be prepared and the WHO Regional Office might assist in the preparation of the standards, possibly through a regional bureau of standards.

#### 4.4.3 Data collection, hydrology, hydrogeology, demography, topography, water consumption, sanitary and medical surveys: sampling and testing of water supplies

Whilst it is realized that the collection of basic data should be a continuous process, water supply programmes should not be delayed even if detailed statistics are not available.

Data collection should not be the responsibility only of water undertakings but should also be the province of government agencies and other bodies with interests in this information and assistance may be sought from international organizations. It was also emphasized that the collection of data is not sufficient but must be followed by adequate abstraction, reduction and analysis.

The sampling and testing of water supplies is regarded as being of major importance in maintaining adequate standards of health and sanitation and it was agreed that these processes should be standardized at the regional level. The maintenance of water quality standard and particularly the bacteriological standard should be regarded as of paramount importance and governments should always ensure that adequate facilities for sampling and testing are available.

#### 4.4.4 Training for design engineers, water management personnel, hydrologists, hydrogeologists, laboratory technicians, waterworks operators, plumbers, etc.

It was generally recognized that there was going to be an increasing need for water supply personnel at all levels. This supply can only be achieved through the proper training which, as far as possible, should be carried out locally. This should not be considered in an ad hoc manner but should be planned taking account of the real needs of the country and the tasks the trainees will eventually have to perform. In this regard, methods and objectives of the training programme should be adequately formulated.

Throughout these programmes, evaluation of the training should be a continuous process with a view to improving standards.

More specifically, two groups of personnel should be considered: professional and sub-professional. In general, the first group can obtain much of their basic training in African universities and on-the-job training should always be implemented. It is only when there are no specialized training facilities in the

Region that training abroad should be considered. This group will be mainly concerned with planning, administration, financing and with the supervision of the construction, operation and maintenance of water undertakings. Sub-professional personnel should be trained locally and should be mainly used to support and assist the professional group.

Emphasis was placed on the need for refresher courses and for the exchange of information between the technical staff of the countries of the Region. In this area and in general, the WHO fellowships have contributed very considerably to training. It is hoped that this assistance will continue. Further, it was noted that WHO is in the process of assisting some of the universities in the Region in the training of sanitary engineering personnel. Once again the need for teaching objectives and evaluation of the programmes was emphasized.

4.4.5 Crash training programmes - research activities, collaboration among countries of the Region, WHO research centre, conditions of service for waterworks personnel

Some of these topics have been dealt with under other headings but it was thought that only in exceptional circumstances or emergencies should crash training programmes be adopted and these should be provided, where possible, by the local training institutions.

There is a WHO research centre for community water supply established at Delft in Holland but local applied research is important and should be handled by local institutions.

It was considered that the existing conditions of service in a number of countries were such that they did not attract the right type of responsible operatives. This is a matter however for the local civil service or water undertaking.

4.4.6 Emergency measures - cholera control

National epidemic emergency committees should be formed and should be charged with the preparation and implementation of a thorough control programme that would take account of any likely outbreak of an epidemic.

The programme will include, the disinfection of water supplies, isolation of contacts at home, selective mass immunization, mass propaganda and education, enforcement of hygiene regulations in public places, stockpiling of emergency supplies, the listing of sanitation personnel and the determination of the progress of the epidemic.

The committee should ensure the implementation of measures involving environmental sanitation and also prepare an inventory of the relevant local materials that can be marshalled in an emergency since it is unrealistic to expect to maintain stockpiles of all the materials required in the event of an epidemic.

## 5. CONCLUSIONS

The different points of the agenda had been discussed by the participants and following the objectives laid down in paragraph 2 of this report, the following are the conclusions.

(1) The WHO target for the development of community water supply for the period 1971 to 1980, particularly in the rural areas, can only be achieved if a number of constraints are satisfactorily overcome.

(2) The planning of community water supplies must be based on available statistical data, such as available water resources, water requirements available and expected financial resources, the training of required personnel which should be accompanied by a health education programme. The planning should be a continuous process and integrated into the national plan of each country.

(3) National staff should be used in all instances and only when these are not available should foreign consultants and contractors be utilized.

(4) The possible ill-effects of inadequate initial planning and standardization imposed by donor countries must be carefully considered and guarded against.

It is also necessary to consider water supply projects simultaneously with the disposal of waste water.

(5) Since water supply is of vital importance to any population and since there appears to have been slow progress in the development of water supplies in many countries in the African Region, particularly in the rural areas, the participants agreed that emphasis should now be placed on the development of rural water supplies in particular. To this end the governments should provide funds for the development of rural water supplies and seek external financing for urban schemes when necessary.

(6) There is a need to stress to all the policy makers (government) that the rate of development of a country is a direct function of the health of the population. As such it should be brought to the notice of policy makers that the development of water supplies should be an integral part of any national development plan.

(7) External financing should always be considered with great care, particularly with regard to the terms of repayment, as these may well involve foreign exchange. Even if the interest rates compare favourably with those obtaining within the country, these and other limiting conditions must be taken into account. Training of national technical personnel should also be an integral part of such projects.

(8) The UNDP should also extend its assistance to studies and implementation of rural schemes and not just limit assistance to urban schemes as at the moment. The assistance should also include the studies and implementation of "mini" projects which may not necessarily be initially viable.

(9) The financing of rural water supplies ought to be the responsibility of the government with the active participation of the local people. When the initiative comes from the government, the local people must be convinced of the need by health education.

(10) It was emphasized repeatedly that the administration of water supplies should be the responsibility of a single central authority which through a co-ordinating board will ensure the interest of all the ministries concerned with water supply problems, at the highest level. The participants recognized the merit of a single administration at the central level; however, to make it more flexible and effective, they advocated the establishment of an autonomous system in urban areas and a semi-autonomous system within the framework of the central organization for rural areas.

(11) The participants agreed that water should be paid for by the user and at the same time be available to everyone. However, in view of the special situation of certain areas, preferential rates could be established in line with the essential role of water in safeguarding health.

(12) 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.

(15) The basic training should be oriented to the needs of the country and therefore adapted to suit local conditions. The existing staff should have opportunity to attend refresher courses and be adequately remunerated.

## 6. EVALUATION OF THE SEMINAR

The purpose of the evaluation was to learn the views of the participants in order to enable the Regional Office to improve the administrative and technical arrangements for future meetings.

### 6.1 Reception and accommodation

Most of the participants considered that the administrative arrangements were adequate in respect of their journey and stay in Brazzaville. Only four of the 27 participants expressed reservations or made suggestions: it was proposed for instance that accommodation be arranged in Douala in the case of a long wait between flights and that the food and service at the hotel in Brazzaville be improved. Most of the participants expressed the wish that the airport formalities be reduced to a minimum.

### 6.2 Organization of the seminar

As regards the work schedule, one participant advocated 24 hours of rest before the meeting and another a day's rest after the meeting.

Of the 27 participants, 20 felt that the meetings were well organized, although they would have preferred the documents relating to the group discussions to be sent in advance at the same time as the working papers. They also felt that the time allowed for the group discussions would have been sufficient had the schedule of the plenary meetings been respected.



Because the time allowed for the daily plenary sessions was exceeded, less time was available for the working groups. However, none of the participants expressed reservations concerning the value of these changes.

A number of very interesting comments and suggestions were made: some participants felt that research should be undertaken to standardize the qualitative criteria; others considered that insufficient attention had been given to the problems of rural areas. One participant thought that the wording of some of the questions could be confusing.

Suggestions were made concerning the organization of future seminars, particularly for preliminary meetings and group discussions before the seminar itself.

### 6.3 Technical organization

Almost all the participants considered that the object of the meeting was of immediate interest for the African Region; four participants stated that the theme was not entirely in line with their present activities. All the participants felt that the subjects presented to the working groups were directly relevant to the object of the meeting.

Two-thirds of the participants considered that the seminar had not added to their theoretical or practical knowledge, but that it had provided an opportunity for very useful exchanges of information on technical, administrative and financial problems which they encountered in their daily work.

With regard to the working paper, they would have liked more examples to provide better illustration of the different ecological conditions in the countries of the Region, particularly in respect of rural water supplies.

The participants recognized that there had been insufficient time to study certain problems in detail and expressed the hope that other meetings would provide an opportunity to do so.

### 6.4 Future plans

Nearly all the participants (26), in outlining their plans for the activities they hope to carry out on their return to their countries, noted that they had obtained considerable information on the subject of staff training, organization and management of services and the various sources

of financing. Ten participants included in their future plans the establishment of a central service for water supply and, where possible, wastes disposal; 11 expressed an interest in staff training programmes and further training for technical and administrative personnel. All the participants, however, stated their intention of ensuring great involvement of their ministries of health in the solution of water supply problems and closer co-operation between them and the other ministries concerned. Planning and research in both rural and urban areas were given a prominent place. It is interesting to note that two-thirds of the participants stated that public information and community health education are essential to the success of any rural water supply programme.

The participants agreed that a satisfactory water supply, health education and other environmental health measures help not only in cholera control but also in the control of other communicable diseases and indicated that all these aspects would be included in their future plans.

AGENDA

1. Opening of the seminar by the Regional Director .....
2. Election of the bureau
3. Adoption of the agenda
4. Presentation of the working document
5. Group discussions
6. Presentation and discussion of group reports
7. Adoption of the final report
8. Closing session

ANNEX 2

WORKING PROGRAMME

Wednesday, 21 April 1971

09.00 - 09.45

Plenary session

- (1) Opening of the seminar by the Regional Director
- (2) Election of officers
- (3) Adoption of the agenda

09.45 - 10.30

Presentation of the working document

10.45 - 13.00

Group discussion on:

The planning, investigation, design and construction of community water supplies

Identification of problems and solutions

Thursday, 22 April 1971

08.00 - 09.00

Plenary session - Discussion of the daily report.

09.00 - 13.00

Group discussions on:

Financing of community water supplies in developing countries

Identification of problems and solutions

Friday, 23 April 1971

08.00 - 09.00

Plenary session - Discussion of the daily report

09.00 - 13.00

Group discussions on:

The administration of community water supplies in developing countries

Identification of problems and solutions

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Saturday, 24 April 1971

08.00 - 09.00

Plenary session - Discussion of the daily reports

09.00 - 12.00

Group discussions on:

Future studies

Identification of problems and solutions

Monday, 26 April 1971

08.00 - 13.00

Plenary session - Discussion of group reports

Tuesday, 27 April 1971

11.00

Plenary session - Adoption of the final report  
and closure

ANNEX 3

OPENING ADDRESS BY DR A. QUENUM  
REGIONAL DIRECTOR

My dear colleagues,

It gives me great pleasure to welcome you to Djoué, where today a seminar is opening which is of major importance to the health of the African peoples, particularly at this time when cholera is adding to our already countless ills. The vital contribution made by water supply programmes to health development and social progress can no longer be denied: we have only to recall the many resolutions on this subject adopted by the World Health Assembly and the Regional Committee for Africa. Environmental health, particularly as regards water supply occupies a prominent position in the context of the integrated concept of public health which guides medical and health work in this Region. This is no accident: it follows from the unsatisfactory nature of the present situation. About 70% of the people lack running water within a reasonable distance of their homes. Far from improving, the situation is getting worse with the spread of urbanization. Most countries moreover, lack realistic community water supply programmes. There is also a serious shortage of necessary staff and essential financial resources. Particular mention should be made of water supplies in rural areas where, by means of simple and economical measures, substantial progress can be made. Many governments have embarked on programmes of this type, but up to the present very few have produced the desired results. Many pilot projects have been carried out, but it must be acknowledged that they have achieved nothing approaching the "snowball" effect expected. Thus, in spite of the considerable efforts already made, the amount of work still to be done in order to satisfy minimum needs far exceeds that already accomplished. The only sound means of dealing with this problem is to plan and organize community water supply services. That is why we are placing our highest hopes in the results of this seminar, whose general and specific objectives should enable us to find the solutions best adapted to the requirements of the Region. We venture to believe that you will not fail in this vital task.

Our best wishes go with you and we should like to thank you in advance for your valuable contributions to the work.

## COMMUNITY WATER SUPPLY IN AFRICA

A working document prepared by

Mr J. A. Andu<sup>1</sup> and  
Mr J. A. Sandover<sup>2</sup>  
(WHO Consultants)

## PREFACE

Rural communities in Africa have been provided with few of the amenities available to urban areas and a reconsideration of their needs is long overdue. In particular, the supply of adequate quantities of safe potable water to rural areas should receive immediate and sustained attention. In turn, this implies that financial provisions, adequate planning and a satisfactory administrative organization must be provided if the targets of the World Health Organization for the rural areas in the present decade are to be achieved. These matters are considered in detail in this background paper. It should be borne in mind that the comments on finance, planning, operations, administration and in fact in virtually all aspects of water supply apply to both rural and urban water supplies except where differences in methods, approach and solutions are highlighted.

The water supply goal of the World Health Organization in the present decade ending in 1980 is to provide piped water to the remaining 40% of urban populations and to increase the supply to rural populations from 10% to 20%. These figures may appear to favour urban populations, but if we consider the two proposed increases in terms of the total population of a country, assuming that 85% of the people live in rural areas, the actual increases are 8.5% in rural areas and only 3% in urban areas, of the total population. This indicates that, on the whole, more people living in rural areas would benefit than their urban community counterparts. When these percentages are expressed as total

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<sup>2</sup> Professor and Head, Department of Civil Engineering, Ahmadu Bello University, Zaria, North Central State, Nigeria.

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numbers and taking the population growth and the development cost per capita into account it can be shown that very large sums of money will be needed if the target figures are to be achieved.

There are a variety of reasons for the lack of provision of water supplies to rural areas and probably the most important is the political pressures extended directly or indirectly by influential people who usually live in the urban areas. In addition, the residents in small communities are usually relatively poor and uneducated.

It is therefore a social obligation of the rich, the educated and the powerful to see that these inequalities are reduced, that the rural communities are considered and represented and that they are provided with greatly improved amenities including water.

Another important factor is that the rural communities maintain the urban people with food and provide a considerable proportion, in many cases, of the national exports. A safe, potable water supply will of itself greatly improve their health and efficiency and, in turn, ensure greater productivity and an increased gross national product. The rural population will then be able to develop further, since potable water can also encourage the establishment of certain cottage industries.

Those countries that do not take these factors into consideration will in the long run, lag behind in virtually all aspects of development.

How then, are these objectives, to be achieved? First and foremost, governments must be persuaded to apply an increasing proportion of their budgets to the provision of rural water supplies. One valid comment in this respect, however, is that the annual population growth has also to be provided for since even to maintain the status quo needs a large annual financial outlay as indicated in the section on "available economic resources" in section 1. A second and equally vital requirement is the need for extended health education at all levels of the rural populations to ensure that they realize the benefits of safe



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water supplies. They will then bring pressure to bear on their representatives to obtain this amenity. There is also a great need for social education to impress people with the fact that water supplies have to be paid for and must be properly maintained. Governments cannot be expected to supply all the finances needed to build, operate and maintain water supplies indefinitely and those who already have this provision must be prepared to pay a fair but economic price for their water and a little more to provide for further development in the less fortunate areas.

In this respect, revolving loans are suggested as a method of providing finance for community water supplies and that priority should be given to using these loans for rural water supplies. Another proposal is that the proceeds obtained from properly conducted and administered national lotteries could provide yet further funds. It is therefore worth-while that every effort should be made to put urban water supplies on a sound economic, non-subsidized basis as soon as possible and that revolving loans and the proceeds of lotteries should be used largely to finance rural water supplies of the group type discussed in section 1 where a large number of closely grouped communities are supplied by a single source. Then, government finance could be largely directed to the other rural areas with emphasis on those with a high incidence of water-borne diseases; those areas where there are hospitals, schools and maternity centres and those where there are large agricultural populations living in very small but closely spaced communities. When governments cannot afford the capital costs involved in major urban water supply schemes it is suggested that external finance and aid should be sought for them.

This will, as usual, still leave the widely separated small remote communities and those where access is difficult. It is regrettable that funds will not, in general, be available for these communities and for many others remembering that the World Health Organization's target is for the provision of piped water to only twenty per cent of rural communities. The other, the vast majority, of eighty per cent of the rural populations will still have inadequate and often contaminated water supplies and efforts must be made to reach

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these people and ameliorate their living conditions. Health education and the consequent supply of trained health workers who also have a knowledge of the construction techniques required for simple water supplies and sewage disposal, is an essential factor in this respect. If at the same time these workers can educate and persuade the people to use community projects for the provision of water, sewage disposal and access to roads they will be performing a service of the utmost importance.

Community or "self-help" projects should be a feature in every rural community and some of the techniques that will assist in these projects are discussed in section 4. There is also a great personal sense of achievement when these projects are completed that goes a long way to ensuring that they will be properly operated and maintained. In this respect and in the provision and training of health workers, aid from governments and external sources could be requested and would no doubt be forthcoming.

The following four sections have been written with all these factors in mind and very briefly, the contents are as follows:

In section 1 the questions of investigation, design, operation and maintenance and the resulting problems are discussed in general terms but the salient features and pitfalls are highlighted. One, often unconsidered, factor in planning is that population continues to grow and a nation may have to spend a considerable proportion of its resources to maintain the existing percentage of population provided with water supplies.

The next section, on financial considerations, is an important one from the point of view of any water supply organization. Financing is discussed in general terms that apply to both rural and urban projects since it is emphasized that whatever national provisions are made for rural supplies, the needs and interests of the rural areas are best served if the available resources produce the maximum return.

The need is stressed for a particular type of highly efficient, relatively autonomous water undertaking in each region, state or geographical areas, in section three. This type of administrative arrangement has been evolved over the years and is generally considered to be quite appropriate and effective as long as it is properly organized.

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In the first three sections, a number of problems have been raised mainly concerning the organization of community water supplies. There is also, a great need for studies and solutions in more particular and specific supplies and these are discussed in section 4.

It is implied further, in section 4, that it is difficult to define the terms "urban" and "rural" too specifically. If the major proposals are considered, i.e. the need for water authorities to concentrate on "group supplies" then a large number of closely-knit small villages with a single source of supply (a "group supply") will have essentially an urban type water supply. There are exceptions to this and special mention is made of the problems inherent in the supply of water to small communities or to medium-sized communities in remote areas. If, however, a water management unit is responsible for the supplies of a relatively large rural area then the overall planning and management of the area must be considered as a whole, if the major operational criterion is the most economic use of the available resources.

The salient points that emerge therefore are that rural water supplies need a strong central organization which, wherever possible, provides "group supplies"; that this organization be responsible for urban water supplies as well and that whatever schemes are proposed or adopted the priorities are: health education, community awareness, planning, community projects and intense efforts to provide radical solutions that will reduce capital and operating costs of rural supplies.

It is suggested therefore that delegates should individually resolve to do everything in their power to further the suggestions made in this paper, to increase and improve the water supplies to the rural communities in Africa and further resolve to endeavour to improve on the minimum targets laid down by the World Health Organization for the 1971-1980 decade. It will require foresight, dedication and sustained effort if these goals are to be realized.

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1. PLANNING, INVESTIGATION, DESIGN AND CONSTRUCTION OF COMMUNITY WATER SUPPLIES

1.1 General

It is of paramount importance that a country's water resources should be skilfully developed, planned and exploited in order to obtain maximum benefits at minimum costs.

The success of a water supply organization can best be measured by its ability to plan its operations with a reasonable degree of foresight and to execute its plans within the stated period. Planning, therefore, involves the setting of a target capable of realization.

Before a national water plan is embarked upon, a comprehensive study of the existing supplies must be made. Existing information on the water sources already tapped, statistics of the population served, the pattern of water usage, sources of capital and revenue and the available high- and middle-level manpower must all be assembled and critically analysed as these data will assist the planner in formulating the objectives of the plan and arranging priorities.

Some of the objectives of community water supplies which should be taken into consideration in formulating a water plan include the raising of the standard of living of the people, prevention of excessive urbanization, economic development through agriculture and industrialization, improvement in commerce, the promotion of good health and the provision of employment opportunities.

The financial resources of member countries do not permit the realization of all these objectives for all its citizens overnight. However, from the data collected, it should be possible to determine where the emphasis should be placed. For example the answers to the questionnaires forwarded to member countries indicate that 80% of the rural population have no pipe-borne water supplies. If this pattern of development is maintained the interest of the agricultural rural areas would continue to be overlooked through overenthusiasm for urbanization and industrialization.

The main objective of this seminar is to study and discuss how this trend can be reversed in favour of the rural communities.

### 1.2 Planning

The water resources available in a country are often unevenly distributed. In some areas, geological conditions indicate the availability of groundwater whilst in other areas, only surface sources are available. The most important aspect of a plan is to find a source that costs least to develop. This is usually groundwater but not always necessarily so. In addition the cheapest method of supplying this water must be determined and it is suggested, as a result of experience, that the "group supply" system is usually the most economic for closely spaced communities. This has been the practice of the Western State of Nigeria where, in the 1962-1968 Development Programme, towns and villages, often as far as 40 miles apart, have been supplied from a single source which then not only serves urban areas but also the rural ones. It has been found from experience that, in general, the total capital and maintenance costs of a number of isolated individual schemes, each with its own source, are more than those of a "group supply" which caters for the same number of towns and villages from a single source.

### 1.3 Investigation

Investigation for a water supply project consists of finding a suitable source, the collection of relevant hydrological and hydrogeological data such as flow, flood levels and drought periods of the year, the collection of water samples for bacteriological and chemical analyses and the choice of suitable sites for the various components of the project.

For large schemes consultants are often employed to conduct such investigations, and they should be properly briefed by the client. The briefing should include the number of towns and villages to be served, the population, possible sources of supply, the planning estimates for these services, the projected requirement and the per capita consumption. The consultant should be requested to prepare, in the first instance, a feasibility report from his investigations

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which will include the estimated capital cost, the operational and maintenance costs, including the number of operational and maintenance staff, alternative sources of supply, methods of treatment, type of pumping plant, the comparative costs of on-site generation of power and the capital and recurrent costs of purchasing power from another agency. When his report is submitted, it should be critically studied and necessary amendments should be made to his recommendations and approach. It is desirable that the project, as finally conceived, should be within the financial provision. Only after the report has been finally accepted should he be instructed to proceed with the designs.

One should avoid the pitfall of concluding a contract agreement for both the investigation and design without the proviso that the design will only proceed if the client is satisfied with the feasibility report. Without this provision, the client may have to pay fully for the unsatisfactory report as well as some compensation for unacceptable designs.

Departmental staff, if well trained, can easily handle the investigation of small rural schemes whether the supply is from surface or underground sources and the programme of work is usually as follows:

Whilst some members of the investigation team assemble all the necessary equipment and transport in accordance with the standard list, the other members should be detailed to study the topographical maps of the area where the sources of water are located, for estimates of the catchments. Although no high degree of accuracy can be claimed for these maps, they will at least be of some assistance. Available rainfall data should also be analysed.

The team must explain their mission to the local headman and the local people and take them into their confidence as they can be very useful in giving information on flood levels, seasonal variations of flows, etc. It must be emphasized to the team that undue reliance should not be placed on this information.

The location of a possible dam site should be surveyed. The depths of the various strata are checked by geophysical methods which should be complemented by trial pits for comparison and for the provision of samples which can be tested

for shear, permeability, etc. The location of groundwater supplies is achieved by studying the available geological maps and from the data obtained from existing wells and boreholes in the area of investigation. Trial boreholes should be constructed in selected locations and data collected on depth, yield and drawdown. Samples of water should be collected for bacteriological and chemical tests. Geophysical instruments can be used to confirm information obtained from the trial boreholes.

#### 1.4 Designing

##### 1.4.1 Design criteria, general

Design criteria for water supply projects may be defined as the basis for the technical solution to meet the water requirements within available economic resources. The governing factors should therefore be the water requirements and the available economic resources.

Unfortunately design criteria are not often based on these principles. The human mind tends to depend on past experiences or "models" for its solutions. Therefore engineers and technologists tend to base their decisions on experience or "models" in the more developed countries instead of developing their own design criteria. This results, as evidence in many developing countries, in the construction of water supply schemes unsuited to local conditions and/or beyond the economic resources of the community to efficiently operate and maintain.

The design criteria are hereby established within the framework of the principles already set out. It is, however, not intended to go into details of designs which are usually standard. It should, however, be stressed that the construction of a scheme depends almost entirely on its design and the less complicated this is, the easier it is to construct, operate and maintain.

Not all the ills mentioned above are the fault of engineers and technologists. Some can be traced to the "graft" associated with some consultants and contractors and to the desire of the officials concerned to surpass others in the grandeur of the structures designed and constructed without priority being given to their utility. These practices are of concern to all professional engineers who should guard against them.

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1.4.2 Population

This is perhaps the most important factor in estimating the water requirements of a community. Unfortunately in many developing countries, population figures are either unreliable or do not exist except in the form of estimates. Whatever data are used, it is essential to relate them to the consumption per capita of similar schemes suitably projected.

1.4.3 Growth rate

Whilst population figures are absolute, as they are generally the results of actual measurement of observation, growth rates depend on a variety of parameters and are best based on past experience. In the majority of member countries where immigration and emigration are negligible, the growth rate is the excess of births over deaths. The growth rate has been taken, for example, in Nigeria as 2.5% per annum in the 1970-1974 National Development Plan. Although growth rates differ from area to area within a given country, it would be confusing and unjustifiable with the limited statistics available to apply a multiplicity of growth rates. Therefore it is usual to apply the official rate and make contingent allowances in the form of fixed additional percentages after taking into consideration all relevant factors. Whilst the population provides the basis of estimating the water requirements, obviously the determination of the projected water requirements depend on the probable growth rate.

1.4.4 Water requirements

Per capita requirements of the population served can range from a minimum of two to three gallons to over 100 gallons per head per day. The make-up of the per capita requirements are:

1.4.4.1 Domestic

The domestic requirements of those drawing their water from public standpipes will differ from those having water connections to their premises.



From experience, the per capita consumption at standpipes situated 400 yards apart is a maximum of three gallons per day. However, with the growing awareness of the benefits of potable water supplies, there will be a demand for more closely spaced standpipes with a corresponding increase in consumption. It is therefore suggested that a more realistic design figure of 10-15 gallons per capita per day should be used.

#### 1.4.4.2 Requirements of premises with water connections

The demand from houses with water connections varies from 20 to 30 gallons per capita per day excepting in the more exclusive residential areas where the consumption can be 100 gallons per capita per day. It is realistic to allow 10 gallons per capita per day for rural supplies and between 15 to 30 gallons per capita per day for urban supplies.

Although houses with water connections may require 20 to 30 gallons per capita per day, in developing countries the proportion of the population with water connections to their houses is generally very small. In Ibadan (Nigeria) with a population of about 1 million only 10% of the population is served by house connections.

#### 1.4.4.3 Commercial, public utility and industrial requirements

Under this heading come the requirements of hotels, restaurants, shops, offices, hospitals, schools, public institutions and industrial concerns. Unlike the basic water requirements, these requirements will be governed by the extent of the commercial and industrial activities of the community and their expected growth rate. Therefore there can be no hard and fast rule on what to allow for these requirements. However, the best course of action is to include a reasonable provision for industrial requirement as industries can be imposed by those in authority without adequate warning.

#### 1.4.5 Design period

Considered from the point of view of the operating life of plant and equipment a 10-15 year design period would be rational, especially with the poor maintenance conditions of such equipment in developing countries. Furthermore, it is even more desirable to have different design periods for

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different elements of a water supply project. Care should be taken to reckon the design period from the probable date of commissioning of a project. The overall time from the planning stage to commissioning which averages at least six years for an urban project and three years for a rural supply, should not be included.

1.4.6 Available economic resources

Different countries attach different importance to the development of their water supplies. The economic resources of different countries and the costs of their projects also vary a great deal. It is therefore difficult if not impossible to deal with this aspect in general terms.

Considering Nigeria, the 1970 population is estimated at 64 millions and the growth rate is 2.5% or 1.6 millions per annum. Therefore the extra water requirements for the increase in population is at least 16 million gallons per day per annum. Assuming an average value quoted by the Western State of \$0.75 million required for every million gallons of new supplies, the annual expenditure would be \$12 millions whereas the government in its development plan has set aside \$11.5 millions per year. At this rate of increase, the gap between the number served by water supplies and those not served will only just be maintained. The average costs referred to above are those from an area where the water resources are relatively plentiful and therefore it is clear that if the gap between the number served by water supplies and those not served is to be drastically bridged, a more critical approach will have to be made in the economic design of community water supplies.

1.4.7 Dam design

It is the normal practice where streams are known to dry up, for the net storage to be for a six to nine month period supply at the design consumption and the capacity is determined by assuming the reservoir full at the beginning of every dry season. In all cases the guiding principle in the choice of a dam structure is the maximum use of locally available materials and where suitable soil is available, earthfill dams should be constructed. In locations where

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great quantities of rock are available a rockfill dam is the answer as it possesses the additional advantage that occasional overtopping would not be as harmful to it as to a purely earthfill structure. Apart from these comments the design of these dams follows normal procedures but to cut down on the quantity of excavation, every effort is made to choose a dam site with as small an overburden to the rock as possible. In the case of perennial streams, weirs are constructed to "pond" the available water and to provide a storage of at least 30 days supply as an insurance against an unusually long period of low flow.

#### 1.4.8 Pumping

Many water supplies have been designed to allow for staged installation of equipment but in developing countries this poses certain problems. For example where there are two pump sets of a particular make and it becomes necessary to install a third one, it would be logical to choose the same type and make but the price may be greater than that of other manufacturer's pumps and the choice becomes a difficult one.

Due to the fact that maintenance of equipment in developing countries is poor, it may be more economical in the long run to allow for "once and for all" installation of equipment for a specific design period and to accept the necessity of changing the entire equipment after that period.

#### 1.4.9 Motive power

Where electricity is publicly available but of doubtful reliability and tariffs are high, 100% standby plant is recommended and, although not the cheapest method, the arrangement of generators driven by diesel engines has been found quite satisfactory especially in remote areas. A simple change-over switch in the distribution panel enables the plant operator to run all his machinery either from public or privately-generated power. Slow speed engines for 750 rpm or less have proved to be worth the extra capital outlay compared with the faster ones. The speed of pumps is generally limited to 1400 rpm.

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Where there is no public electricity supply, high-lift pumps are driven by diesel engines through speed-increasing gears or by vee-belt with a separate power take off from the shaft to drive small ancillary equipment and plant. A small diesel engine driven generator is also provided for use when the high lift pumps are not operating. Further, in these circumstances, low lift pumps can be driven by individual diesel engines and it is normal to provide complete standby pumping equipment to give a continuous 100% supply.

1.4.10 Water treatment

This is a well documented and well understood practice but certain points need noting in developing countries.

There has been a considerable use recently of pressure filters as these are simple to erect and require only nominal maintenance. They are however expensive (and require foreign exchange) and a careful cost analysis should be made by comparing the overall costs of these, over the design period, with those of slow sand filters to determine which is the cheaper. Further this use of pressure filters has been rationalized on the grounds of high maintenance costs of slow sand filters. When, for example, labour costs one-eighth to one-tenth of the cost in some developed countries, this reasoning makes little sense.

Water treatment technology has been making tremendous strides in recent times. From the three to five gallons per square feet per hour of the slow sand filters, it is now possible to pass over 200 gallons per square feet per hour in some of the modern rapid gravity filters. However, at the moment, most developing countries lack sufficient skilled personnel to undertake treatment techniques requiring a great degree of control but this position is gradually changing.

1.4.11 Distribution system

Generally distribution systems are designed for peak flows of 2.5 times the average daily flow but actual computations of peak flows in two West African cities have returned figures of slightly less than twice the average. A figure

of twice the average would therefore appear to be reasonable enough. This is an area where a more critical analysis is needed to obtain optimum sizes of pipes in keeping with the concept of economic design.

#### 1.4.12 Storage

One feature notable in some developing countries is the lack of standardization of reservoir construction. Standardization of reservoirs would not only eliminate the design fees payable every time, but would also result in other considerable savings.

#### 1.4.13 System reliability

One of the decisions to be made in designing water supplies is the degree of reliability required for the system as it greatly affects the cost of a scheme. Therefore unjustifiable standby capacities or larger than necessary factors of safety would increase the cost of a scheme. It is difficult to lay down any hard and fast rules on the degree of reliability that a water supply should have; however, there is definitely room for a more critical approach to this.

### 1.5 Construction

#### 1.5.1 Construction, general

Emphasis was laid on investigation and planning as these greatly affect the construction costs. Construction of water supplies schemes is usually executed by direct labour or by contract. Large projects are usually put out to competitive tender and the wisdom or otherwise of construction by these two methods is governed by several factors. The employment of contractors is usually more expensive and requires close supervision to ensure that satisfactory standards are adhered to, but since definite periods of completion are stipulated and the specifications for materials have already been agreed, the construction work is usually completed faster by a contractor than by direct labour. Savings can be effected by restricting the contractor to the civil engineering works whilst the supply of equipment, plant and pipes is

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undertaken by the client. The contractor is usually requested to take the responsibility for the installation, at an additional cost, of the plant and equipment, if these are supplied by a reputable firm which provides the skilled labour for erection. When ordering equipment and plant it is essential to include two years spares and 10% extra of all pipes and fittings to ease maintenance problems. Clients should not change the scope of a contract without examining the financial implications and obtaining the prior agreement of the contractor to the cost of the change as this is one of the main causes of disagreements which usually end in protracted negotiation or arbitration.

Construction by direct labour entails investment in plant and construction equipment and the employment of experienced professional and sub-professional staff which are difficult to find in developing countries. Where there is a central organization, however, it is worthwhile having constructional gangs well trained in the construction of small dams, the drilling of boreholes and the digging of wells where a modest investment in plant and construction equipment will be worthwhile and will pay dividends.

Oftentimes delays occur when work is undertaken by direct labour owing to a failure to place orders at the appropriate time for materials and plant which have to be incorporated in works. These problems must be obviated by careful planning. A further problem can be attributed to irregular release of funds resulting in failure to pay promptly for skilled labour and for urgently required materials.

Although not considered desirable, the employment of a large staff whose duties are to design and to construct schemes within a departmental organization should be carefully considered before such a step is taken. Apart from being related to the plan of the organization, provision should also be made to guarantee their continued employment to prevent unscheduled redundancy and the resultant financial implications for all concerned.

1.5.2 Package deals

Proposals to plan, investigate, design and construct water supply projects are often made by consultants and contractors to developing countries.

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Such proposals should be rejected because it is professionally unethical for a consultant to engage to act as both a consultant and a contractor. Where a contractor makes such a proposal, he should be viewed with considerable suspicion. The excuse that such a project can be completed early is not likely to be economically justifiable because such package deals are usually very expensive. However, package deals may be permitted where patented designs have to be constructed by the firm that prepared the design.

1.5.3 Local consultants and contractors

It is realized that the design and construction of large community water supplies will, for some time to come, be undertaken mainly by foreign concerns. It is however necessary that local firms of consultants and contractors should be encouraged to participate in the design and construction of small water supply schemes. It is of the greatest importance also that local firms should be encouraged to form partnerships with the more experienced concerns. It is recommended that conditions should be included in all major contracts for the subletting of as much as possible of the works to local firms.

1.5.4 Commissioning

It is important to include in the contract agreement at least a three-month maintenance period for all the equipment and plant after performance tests are carried out. It is during this period that any defective piece of equipment or plant should be discovered, repaired or replaced. It is equally important to get the operational and maintenance personnel employed before the start of the three months maintenance period. This can be arranged by absorbing the contractor's skilled and semi-skilled staff employed in the installation of the equipment and plant. Additional staff should be employed as necessary. It is the usual practice that a formal opening of a project should be performed as this will afford those in authority the opportunity to impress on the consumers the necessity of paying their rates so that the new supply can be adequately maintained and operated.

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1.6 Conclusion

The subject matter of this paper has been considered in general terms and the most important conclusion is that the economic development of water supplies depends largely on effective planning, investigation, design and construction methods which are interdependent. It is particularly important to apply engineering economics in the design of water supplies to ensure the maximum utilization of money, time and labour and to minimize the influence of the all too frequent companion of the poor designer - "the Factor of Safety".

2. FINANCING OF COMMUNITY WATER SUPPLIES IN DEVELOPING COUNTRIES

2.1 Financing, general

Financing is the prerequisite of any capital development of water resources. Without adequate funds the other operations such as planning, investigation, construction and maintenance cannot succeed.

The World Health Organization has carried out comprehensive studies of the world distribution of community water supplies and has come to the inescapable conclusion that the rural communities must have more attention than hitherto in the provision of water supplies. This conclusion implies a very considerable financial outlay by member countries.

It has now been estimated that only 35% of the urban populations of the world are supplied with pipe-borne water within or near their premises whilst another 25% receive their water supply from public standpipes situated at some considerable distance from their homes and the remaining, 40% have no pipe-borne water supply. Only 10% of the rural populations of the world have access to pipe-borne water supply which is in many cases, intermittent and of doubtful quality.

In the developing countries of the African Region an average of only 4% of the rural populations have access to pipe-borne water in three selected countries. Four countries maintain the global average whilst only two others supply an average of 20% of the rural population.



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The target set by the Community Water Supply Unit of the World Health Organization, within the United Nations Development Decade (1971-1980) is to ensure that at least 40% of urban dwellers have house connections in their homes or compounds whilst the remaining 60% should have access to public stand-pipes near their premises. The percentage of rural populations having access to piped water supply should be raised from 10% to 20% within the same period. It has been estimated that a total of \$11 480 000 000 would be required to achieve this laudable objective, i.e. an amount of \$1 148 000 000 per annum. Since developing countries particularly in the African Region lag behind others in the provision of this social amenity, a considerable amount of their annual estimates would have to be invested in the development of community water supplies. It would be very difficult, however, to provide sufficient funds when considering that the average per capita income in a number of selected African countries is \$129 per annum, particularly when compared with the average of \$2706 per annum for France and the United States of America.

When the situation is viewed in this perspective the developing countries would have to increase their national budget for the provision of community water supplies substantially and also seek the help of economically stronger developed countries for financial aid in terms of loans and/or grants.

More specifically, finance for water supplies may be divided into two broad categories. The first is the finance needed to meet capital expenditure and the second to meet operating, maintenance and replacement costs. The former will be referred to as capital finance and the latter, operations and maintenance finance. For the purpose of this paper, capital finance will be deemed to include the cost of servicing debts.

## 2.2 Capital finance

In many developed countries the water undertakings are generally viable organizations and the raising of capital therefore follows the commercial practice of the issue of shares, which may include ordinary shares (or stock) and preference

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shares (or stock) or by loans secured by debentures, debenture stock, mortgage loans, etc. In the case of water undertakings managed by local authorities or boards, the loans are secured upon the rates and revenue of the authority and are usually guaranteed by the government which usually enacts comprehensive statutory regulations governing the raising of capital by local authorities and boards.

If it were always possible to finance water schemes by these methods, there would certainly be little to stop the rapid development of water systems. However, in most countries the very low per capita incomes of the people coupled with the lack of well developed financial institutions make it difficult or impossible to apply such methods of financing. Therefore the developing countries have to resort to nearly all other forms of financing which are discussed below.

2.3 Community finance

The contribution of a community towards the construction of a project in cash or in kind is treated under community finance which, where water supplies are concerned, may take a number of forms. In some instances the community may actually provide land or other local facilities for projects meant for their benefit but whatever form community finance may take, the participation of the people in a project develops social consciousness as well as continued interest in the proper operation and maintenance of the project.

A lot more can be achieved by local communities if:

- (a) they are properly directed;
- (b) the efforts of those concerned with the provision of water supplies, particularly in the rural areas, can be co-ordinated.

Unfortunately the efforts of local communities are often misdirected in that they are willing to contribute to the construction of prestige projects some of which are of socio-economic importance, e.g. roads, townhalls and post offices. On the other hand, there is an obvious lack of concern in the provision

of water supplies as long as the traditional source (pure or impure) satisfies their daily requirements. Until there is a public awareness and understanding of the intimate relationship between untreated water supplies and water-borne diseases (highlighted by the present outbreak of cholera) the local communities, especially those in hamlets and villages, will not accord the provision of potable water supply the priority it deserves.

This is an area where health education can be of tremendous assistance. Since there are many channels of communication with the people, official and otherwise, it should not be too difficult to deliver the message that clean water is of the greatest importance to health. This type of programme should not be spasmodic but should be organized and implemented by sustained efforts of those who are specialists in the field. It is another area where world agencies can definitely make their presence felt in developing countries since if they sponsor a programme of health education, it would greatly augment local efforts.

The co-ordination of efforts of all those concerned with environmental health is of the greatest importance in the development of rural communities. For instance, the training of health inspectors varies from country to country and in some they are trained to be able to construct or to supervise the construction of small water structures such as wells, boreholes and intakes. In others, they are only trained to ensure that the standards of hygiene are adhered to. The result is that those who can construct, usually known as technical officers or simply as inspectors of works are found in executing ministries such as works whilst those trained to assure the standards of hygiene are usually employed by the ministry of health.

There is therefore an urgent need to create a forum where the health educator, the technical officer and the health inspector can co-ordinate their efforts. This can probably best be achieved by the local councils employing these categories of staff. If they are unable to do this, the state or central government should assign or second these officers to work

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with the local councils and give them the exclusive responsibility of providing rural communities with water supplies on the clear understanding that the community should carry a certain proportion of the financial burden.

Where the responsibility for the provision of community water supply is in the hands of an autonomous authority, the authority should be given the mandate by the state or central government to give priority to local communities who are prepared to help themselves.

It should be brought home to all that the government treasury is not inexhaustible and that the expenditures of government derive from the taxes collected from the citizens. These funds, in general, are not sufficient to implement all the socio-economic projects which the government is willing and eager to provide and the people therefore, should be willing to supplement the efforts of the government to the best of their ability.

2.4 Government finance

This is the most important source of finance in nearly all developing countries. Governments are interested in the financing of water schemes not only for the provision of a basic necessity of life, but also in the investment value.

Notwithstanding the economic benefits of providing water supplies, governments have to decide on the percentage of their available financial resources which can be allocated to these projects and often this is woefully inadequate. Therefore although governments do provide finance, they also expect some form of contribution from the communities or local bodies. Broadly, government finance can take three forms: the provision of outright grants, loans and subsidies.

2.4.1 Grants

Governments do not consider grants as a favourable form of financing water supplies except in special circumstances where either the high incidence of certain water-borne diseases and/or the extreme poverty of the community make it absolutely necessary. However, government grants for nearly the full cost of the works will continue to be the basis of finance in a number of areas,

particularly in very sparsely populated but highly arid places where this may well be the only way of sustaining the populace. Similarly in communities where the very high incidence of disease has either decimated the working population or drastically reduced their productivity, grants may be the only way of saving such communities.

One problem concerning government grants is that it is difficult to divorce them from partisan politics. Therefore, however well intentioned or deserved, the label of favouritism can and will still be tagged to any such decision.

#### 2.4.2 Loans

The most favoured form of government finance is the provision of loans which can either be interest free or carry a very low rate of interest or carry the normal commercial rates. Experience has shown, however, that whatever money has been loaned to a community for the construction of its water supplies the repayment terms were usually not fulfilled by the recipient local authorities.

Perhaps a much better system than the provision of ordinary loans is the creation of a fund from which revolving loans can be provided. One such scheme was developed by Walter R. Sanches, Chief Engineer and Assistant Chief de Servico Especial de Sana Publica de Brazil.

The basis of the scheme is that instead of the piecemeal expenditure on water schemes by the government, it will pay these amounts into a special fund from which loans will be made to municipalities without interest. With proper planning, the annual payments of the central government into the fund together with the repayments from the municipalities already benefited, will ensure that funds will become available for an ever increasing number of water schemes. Since the loans are interest free, repayment periods can be made shorter, and possibly different periods can be applied to schemes depending on their viabilities.

The biggest advantage of the scheme is that proper financial planning will be possible and, by insisting that loans are liquidated before additional loans are granted to a particular municipality or water undertaking, optimum

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and careful use of funds would be ensured. In order that rural communities may benefit substantially from any revolving loans made available by a government, it should stipulate re-lending conditions which would favour rural communities.

### 2.4.3 Subsidies

Subsidies can take a number of forms including interest free loans or loans at very low rates of interest but in this context a subsidy is usually obtained in the form of duty and tax concessions and in the provision of certain services at nominal costs.

The most common form of subsidy is the waiving of import duties on materials and plant which is practised in many countries. The problem is to ensure that materials or plant are in fact utilized for the purpose intended. Often, the relief of duty makes the materials or plant so cheap that there may not be any real incentive on the part of the resident engineer or the contractor to exercise economy. It is essential that every effort should be made to ensure that the full benefit of such subsidies is obtained.

### 2.5 External finance

We have pointed out that in developing countries the finance that can be made available by governments can never be adequate. External finance therefore is often a welcome supplementary source, and in many developing countries it has made an important contribution to the development of water systems.

As in government finance, external finance can be in the form of outright grants or loans where the loans can either be soft or hard depending on the terms of repayment and there can even be a combination of both grants and loans. However, one of the biggest drawbacks to external financing is that it is often circumscribed with conditions which are never easy to quantify for purposes of comparison, and the recipient may be saddled with something which he does not envisage.

In the following, some of the elements of external finance together with their implications are considered, particularly in respect to external finance from foreign governments.

### 2.5.1 Interest rate and repayment period

The interest rates and repayment periods are often the most attractive features of external finance. Interest rates are never higher than bank rates and sometimes are as low as one per cent. Repayment periods are also often very generous with periods extending to 50 years with a grace period before commencing repayments.

### 2.5.2 Mode of repayment

The modes of repayments are not always so generous and often these repayments have to be made in convertible currency which can and often does cause difficulties to the recipient. In others the recipient is allowed to pay in his own currency.

### 2.5.3 Finance conditions

This is the most crucial aspect of external finance. Whilst the terms are generally advantageous the donor governments generally take the view that they know what is good for the recipient and often specify conditions on the operation of the scheme, collection of taxes, etc., and it is these conditions which sometimes make the financing of doubtful value.

Some of the conditions usually insisted upon by donor governments are:

#### 2.5.3.1 Use of consultants and contractors from donor countries

This is not a reasonable condition. In the case of consultants from donor governments, they may not be familiar with the local conditions and tend to design works to the standards in their own countries and unless the local departmental staff charged with the responsibility for the projects are vigilant and insistent, they will have very little say in the conception of the project.

Donor governments prefer to heed the advice of their consultants rather than the protestations of the recipient, with the result that the recipient often gets saddled with projects which may be unsuited to local conditions. It has been said that developing countries have often had to pay very heavily in the long run for their anxiety to attract external finance.

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The specified use of contractors from donor countries has often boosted the cost of schemes and in addition, donor countries may not have contractors operating in the country of the recipient. Therefore the immediate effect of this condition is that tenders are usually higher due to the necessity to meet the extra overheads of an overseas office and to narrow competition.

2.5.3.2 Materials and plant from donor country

This condition too has the effect of inflating costs. In addition, plant from the donor country may not be the standard type used by the recipient. This may result in increased operating and maintenance costs. There have been, also, examples of importation of materials from donor countries when in fact such products are manufactured in the recipient country.

2.5.3.3 Administrative redtape

The processing of loans applications and the amount of time involved are such as would discourage any recipient country from seeking loans for projects.

In some instances from the time of application to the granting of a loan, a period of about three years may elapse. Examples abound of projects taking up to eight years to complete from the time of application for a loan. This is of course due to the administrative redtape which requires the submission of intimate details and the fulfilment of stringent conditions before a loan is approved and granted.

2.6 The International Bank for Reconstruction and Development

The International Bank for Reconstruction and Development or the World Bank and the International Development Agency are some major sources of external finance. For loans granted by the World Bank a number of provisions have to be met. Among these provisions are (a) the loan must be for productive purposes, (b) except in special circumstances the loan must be used to finance the foreign exchange components of specific projects, (c) the merits of all projects must be carefully examined and priority given to the most urgent and (d) the borrower must be a member government or a non-governmental enterprise but for the latter the loan must be backed by a government guarantee.



The World Bank charges interest based on the cost to the Bank for raising money in the world's capital markets. However there are many countries which are too poor to service hard loans at normal rates of interest.

Developing countries must therefore study the conditions stipulated by financing agencies and governments with the greatest care and must institute a common set of principles and conditions under which external financing could be accepted. It is by so doing that they can obtain the maximum value from finance offered to them and eliminate some of the iniquities and difficulties of external finance. There can then be a great upsurge in the development of community water supply systems.

In the Western State and in some other parts of Nigeria, external finance has definitely played a significant role in the development of water systems, and it may continue to do so. What is now required is a standardized way by which conditions attached to external finance can be quantified.

## 2.7 Contractor finance

Contractor finance is probably the most controversial form of finance but if properly negotiated, it can compare favourably with other forms.

In contractor-financed projects, the unit rates for work are usually arrived at by negotiation rather than by open competitive tender. This can give rise to certain abuses as the rates may not necessarily be the lowest obtainable by tender. In addition, there is often an advance payment involved, in the region of 10 to 20% of the contract value, with the balance payable partly during the course of the contract and partly by instalments over five to ten years, with interest rates usually higher than the prevailing bank rates.

A number of projects have been contractor-financed in Nigeria, some in water supplies and others in roads and bridges. The terms of these

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Contractor-financed projects generally include, in addition to the negotiation of rates, contract conditions similar to those recommended by the various international engineering institutions. Other conditions include the payment of 20% of the value of work done monthly on certification and 60% of the contract sum in 30 equal bi-monthly instalments commencing a year from the beginning of the construction and an 8% interest rate on the deferred payment. Payments are often made in free convertible sterling currency.

These stringent conditions may be tolerated as long as the negotiated rates compare favourably with the ruling rates and where there are no additional advances involved either for plant or materials and there is a provision for increasing the repayment period if the contract period is exceeded.

There are two major disadvantages of this type of financing. The first concerns the problem of agreeing rates and here the contractor often has the advantage since some developing countries may not have the appropriate qualified professional staff who can bargain on equal terms with the contractor. Secondly, the process of agreeing the rates is usually a most tedious and often a somewhat arbitrary process and may well lead to friction between the two teams of negotiators which is not an asset should a contract be pursued.

As an example, the comparative costs of purchasing and installing pipes of different diameters, in the Western State of Nigeria between 1964 and 1968, are indicated graphically in Appendix 1 - the works executed by direct labour, competitive tenders, and by contractor finance. There is no doubt that contractor finance was much the most expensive method.

However, contractor financing is not an unworkable concept but it is essential that the evaluation, negotiation and planning should all be directed to the employer receiving the maximum benefits whilst the contractor receives a reasonable profit. It is preferable to advertise open tenders not only for the execution of works but also for the provision of the funds.

Incidentally, the term itself is a misnomer, as the finance is usually provided by a bank and therefore, pursuing the idea of competitive tendering, this would be a feasible proposition if consortium arrangements could be made between the banks and the contractors.

It is our firm conviction, for the reasons stated above, that contractor financing of projects should only be undertaken if the provision of the required service is a matter of great urgency.

Further, it is recommended that those responsible for advising government and in charge of projects, should urge the government to advertise tenders public y for both the construction works and the provision of the finance.

## 2.8 Financing of rural water supplies

Experience has shown that whilst external financing has been used for urban water supplies, very little success has attended requests for financial aids or loans in the field of rural water supply programmes. The governments of developing countries therefore have to take some positive action by allocating internal funds for these programmes. This can be achieved by reducing the capital works programme of urban water supplies in favour of the rural projects and then to seek external aid for the prosecution of urban schemes. As an alternative, governments may consider instituting national or state lotteries as a means of providing the extra finance needed.

Again, in the rate cases of external loans or grants being obtained for rural water supplies the donor countries have usually applied restrictive conditions similar to those obtaining for larger urban projects.

## 2.9 Operation and maintenance

In developing countries the ability to meet operation, maintenance and replacement costs is generally taken as the minimum criterion for the provision of a water scheme. These costs should be financed by taxes at the local level, water rates, and/or water charges.

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However, in the days when water supplies were managed by local councils, it was not uncommon for the supplies to be interrupted either due to lack of funds to meet operational costs or for the purchase of spares, fuel and chemicals.

As a solution to this problem, the necessity for a central organization to be responsible for the development, operation and maintenance of water and sewerage systems has for long been recognized. Although such organizations have existed in the developed countries it has only been recently that some developing countries have instituted such organizations.

In Nigeria, the Western Nigeria Water Corporation commenced operations in 1967 and the establishment of this corporation has made available a pool of human and material resources which would have been beyond the means of the various individual bodies operating waterworks. This in turn has resulted in greater efficiency in operations and maintenance. A measure of the success of the corporation is the fact that since its establishment there have been few interruptions to over 50 different water supply schemes under its control in the State. There has also been a considerable increase in revenue collection.

At present there are two other states in the Federation who have either established central water authorities or are in the process of doing so which augurs well for the future of water systems in Nigeria.

## 2.10 Conclusion

In the foregoing, we have examined the various forms of finance available for water supplies and some of their advantages and disadvantages. Whatever form of finance is utilized, the recipient has eventually to pay for it. Therefore the question of finance must not simply be related to what is immediately obtainable but to what the recipient can afford in future years.

With this in mind a thorough assessment of the terms of finance offered must be made, compared to what can be obtained in the capital markets of the world. In this assessment any special conditions should as far as possible be quantified and cash flows prepared to determine in real terms the actual content and extent of the finance offered. Developing countries must study all the

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conditions usually stipulated by financing agencies and governments and must institute a common set of principles and conditions under which external financing could be accepted. It is by so doing that developing countries can obtain maximum value from the finance offered to them and thus eliminate the iniquities and difficulties of external finance. Consequently this can result in a great upsurge in the development of water systems.

It should be emphasized that, in view of the difficulties of attracting external loans for small rural projects, governments should allocate substantial internal funds to this sector and use external finance for urban projects. In addition if revolving loans are created it is suggested that a reasonable proportion of the money should benefit rural communities. Finally, the proceeds from state lotteries should be allocated to rural water supplies.

### 3. THE ADMINISTRATION OF COMMUNITY WATER SUPPLIES IN DEVELOPING COUNTRIES

#### 3.1 Administration, general

The administration of community water supplies whether rural or urban can be defined as the orderly, effective and economic management of the capital investment in water supplies to ensure maximum benefits which thus encourage the planning of future investments. It therefore consists of the proper maintenance of plant, equipment and machinery, the collection of revenue and the control of expenditure. These functions cannot be efficiently performed without experienced professional, sub-professional and skilled personnel supported by clerical and other categories of staff.

The types of organizational set-up for the administration of water supplies depends largely on the constitutional arrangement in each country. Where there is a unitary form of government the powers and functions of the organization are determined by the national government. In a federal structure, the state or provincial government, if it has responsibility for water supplies, will determine its powers and functions.

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In several countries in the African Region the responsibility for the planning, investigation, design and construction of water is vested in ministries or a combination of ministries of the government such as health, works or agriculture. If more than one ministry has the joint responsibility for the development of water supplies, it is bound to create friction and slow the pace of development because of the inter-ministerial jealousy and bureaucracy which is usually associated with the modern civil service. Even if only one ministry is responsible but has other divisions which compete for the limited financial resources available the allocations may or may not be equitable.

The majority of water supplies however are administered by local councils, municipal authorities and private companies who are, usually, also responsible for the assessment of rates and collection of revenue. In a few African countries, these duties are performed directly by the government ministries concerned.

Nearly all the governments finance capital works either through grants and/or loans whilst the local authorities maintain the supplies. In a number of countries the local authorities are even subsidized in the maintenance and operation of supplies constructed gratis by their central governments. It is important to mention that the arrangement, whereby local authorities and government share the responsibilities, works fairly successfully where the latter is prepared to continue to subsidize the operations and maintenance of the supplies both financially and technically. As long as the number of existing supplies is few, a government may continue to render such assistance. With increased political pressure, however, from areas demanding their own supplies, many governments find that they cannot perpetually continue to shoulder the additional responsibility for the maintenance and operations of existing supplies and at the same time find the funds for the implementation of new projects.

The sharing of responsibility between a government ministry and the local council is not conducive to efficiency in that neither willingly accepts responsibility for maladministration and inefficiency.

It is evident that the majority of governments in the African Region recognize the necessity to have local participation in the administration of water supplies constructed for them and they also appreciate the necessity of providing their citizens with pipe-borne water and have taken this responsibility quite seriously but for the limitations imposed by lack of sufficient capital and experienced professional manpower. The pace of development has also been restricted by the fact that instead of investing more funds in new works the maintenance of existing supplies often has first claim for obvious reasons.

It is important, however, to stress that any administration which ignores the participation and interest of the people who benefit from the supplies is bound to fail. Therefore the operation and maintenance of water supplies by local councils is in itself not a bad concept since it engenders their interest, in what they regard as their property and many of them have successfully operated such systems in both the developed and developing countries of the world.

The general trend in the developing countries, is for those in authority to examine the defects in local authority administration of water supplies, identify them and offer remedies. Some of these shortcomings are caused by lack of adequate maintenance funds and/or experienced, and sometimes, responsible, operating personnel. This may result in the pumping of bacteriologically and chemically unsatisfactory water, failure to repair and maintain pumping and treatment works which break down, or the supply of inadequate quantities of water because a shift or a fraction thereof is run instead of two or three shifts daily. Lack of funds is often caused by overstaffing and the diversion of water revenue to other facets of the council's activities, perhaps of a political nature, resulting in non-supply of chemicals, fuel and spares needed for efficient operation and maintenance. It is therefore not surprising that many of these local council waterworks are usually insolvent and are perpetually dependent on the state or central government for their continued existence.

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Whatever the faults of local councils, and there are many, they have laid a foundation, however weak, on which a sound administration can be based. There are however, a number of suggested solutions to remedy these faults, namely:

An appropriate government ministry should take full responsibility for the development of water supplies and the administration of the existing undertakings.

This is not a desirable solution both for the government and the people it serves. The administration of a public utility such as a water supply undertaking by the civil service has nothing to commend it. The bureaucratic method of the civil service does not help when quick decisions are needed and the collection of revenue by a government department without the participation of local councils is a difficult task. Further, because water supplies are a fundamental service to the people, they must be operated with the efficiency and with many of the concepts of a commercial undertaking. A good water authority, to some extent, should also be self-sustaining. These concepts are not compatible with civil service administration.

We may venture to add that in developing countries the provision of water supplies is increasingly becoming a political issue and any government that decides to take the full responsibility for these supplies without the necessary financial backing and the willing co-operation of the people will carry the entire blame if it fails to satisfy the local needs. The government also would have denied itself the opportunity of having a buffer such as a council or water board which can absorb any resulting political stresses without causing much embarrassment to the government.

It may be argued that since water supply is a recognizable social service like the ministry of health or education, there is no reason why it cannot be managed by the civil service like the other ministries. If the central or state government is prepared to subsidize the development and management of all water supplies to the extent that the civil service is subsidized, the



arrangement might work satisfactorily were it not for the reasons advanced above. Furthermore, the government by virtue of its great variety of responsibilities, is already an unwieldy enterprise and should not be too much involved in the day-to-day administration of public water supplies. Its interest can best be served by the establishment of a water authority.

The councils should continue as they are but arrange accelerated training for technical personnel and supervisory staff with a view to improving the operational maintenance of the supplies as well as the revenue collection systems.

On the surface this sounds a possible solution, but the inherent problems will not be fully solved by the accelerated training of capable men. One such problem is the elimination of the political involvement of councillors in the day-to-day administration which would be a very difficult issue to handle and until the general public is politically aware of the wisdom of putting men of probity, who will look after their interests, in positions of responsibility the major problems will persist. This system is also wasteful in terms of manpower, materials and funds since if these were pooled in a central organization, a considerable amount of duplication and wastage could be avoided. Moreover the local councils are rarely able to attract capable men whose first choice of employment is usually the civil service or large commercial and industrial organizations. Even if a training programme is established, those trained will leave for better employment and if they are tied down by stringent conditions, they will become dissatisfied employees.

One other very important objection to local council operation of water works is the usual insistence that only people belonging to the local ethnic group be employed. This may result in the employment of incompetent personnel whose only claim to employment is their birth place, and this will not promote inter-district harmony. It is also possible that a local council may refuse to extend its supplies to a neighbouring town because of past prejudices. For these and other reasons, it is not considered

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advisable to allow local councils to retain the responsibility for their water supplies except where the council has proved to be efficient.

Autonomous regional or state water boards or corporations should be established to take full responsibility for the administration of water supplies under the general direction of the government.

The administration of water supplies by the amalgamation of small undertakings in a single authority has several advantages. The pooling of professional and sub-professional staff would make it possible for the authority to carry out its functions more effectively than these small units with insufficient staff. It will permit the bulk purchase of plant, materials, equipment, chemicals, fuel and lubricants, through a central stores organization. The operation of standard charges throughout its area of jurisdiction will be possible, and each town under its care would have an equal opportunity of attracting industrial and commercial development. The qualifications and experience of the staff recruited can be standardized, and the best available men employed.

### 3.2 History of water supply administration

The world history of water supply administration indicates the gradual change from the control of individual units by local councils and municipalities to the amalgamation of small undertakings controlled by a single water authority having wide powers.

In Western Europe and North America the community water supplies were originally managed by the local authorities, municipalities and water companies which constructed them. The central governments of these countries, on realizing the importance of water supplies to the health of the people, began to play a more active role in the development of community water supplies and gradually assumed a dominant role by controlling their modes of operation and maintenance and by setting water quality standards.

In the Netherlands in 1874, there was, for the first time, co-ordination of the public water supplies in Amsterdam under a public water supply commission, an idea that rapidly spread to most of the municipalities of the country. The Acts of Parliament of Great Britain (1945) made the amalgamation of small water supplies into large organizations possible. Several other countries in various parts of the world such as Puerto Rico, Mexico, Ghana and some states of Nigeria have established such institutions for the administration of their community water supplies.

These changes, as might be expected, were not effected without some opposition. For example there was considerable reluctance on the part of local councils to agree to the transfer of their water systems to the Western Nigeria Water Corporation to the extent that they needed considerable persuasion to act as agents for the collection of water rates from the general public even though they were to be paid five per cent. commission on the revenue collected.

Therefore although it would appear preferable to have a single water authority for a number of supplies the final decision should depend on the prevailing circumstances in each country and such an institution must have the full and continued backing of national or state government and the co-operation of the people.

### 3.3 The establishment of a water authority

Before a water board or corporation is established, it is advisable that a working party should be set up and it should have representatives of the various ministries concerned with water supply development, such as the ministries of works, agriculture, economic development, local government, finance and health together with representatives of local councils who own waterworks and the ministry of justice. If the recommendation of such a party is positive, and accepted by the government then the instrument for its establishment which will define its powers, its area of jurisdiction, its functions and modes of operation would be drawn up by the ministry of justice.

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The administrative organization of a water supply authority depends largely on its statutory functions, responsibilities, its magnitude and the complexity of its operations. These duties can best be performed by a number of departments which should be functionally interdependent.

3.3.1 The planning and design department

This department will be responsible for the planning and development of the water resources which includes the designing of extensions and improvements to existing supplies. It should be subdivided into sections, viz., rural and urban water supplies with well-defined responsibilities, otherwise, as it is often the case, the rural supplies development will be subjugated. This department will also have responsibility for the collection of all hydrogeological and hydrological data for its immediate and long-term needs.

3.3.2 The operations and maintenance department

This department will be responsible for the efficient operation and maintenance of existing undertakings, control of plant equipment and supplies and it must be stressed that the reliability of the various undertakings depends mainly on the efficiency of this department. The calibre of the operation and maintenance personnel should match the degree of sophistication of the equipment and plant otherwise there will be difficulties. For its effective performance the department should have several sections including a mechanical and electrical section which may constitute a department on its own in a large water supply organization, and deal specifically with the installation of new plants, effect electrical and mechanical repairs of defective equipment and plant, and maintain all operational vehicles. It should be equipped with repair workshops where meters, engines and pumps and vehicles can be repaired.

A stores section should also be housed in the operations and maintenance department, to deal with the purchase of stores such as spares, chemicals, fuel, lubricants, pipes, fittings, etc. It will issue spares and will have a stock system that will enable it to alert the other departments of the need for early replacements when stocks are running low.

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### 3.3.3 The accounts department

The accounts department, which will have an internal audit section, will be responsible, in liaison with other departments, for the preparation of budgets, the development of a reasonable but equitable water rates structure, the collection of rates and other forms of revenue. It will also keep records of all capital and recurrent expenditures, long-term debts, depreciation, insurance, etc.

### 3.3.4 The administration department

This department will have responsibility for arranging the recruitment of staff, their training and welfare and will have a section which deals with legal matters.

All the departments will be suitably staffed and be supervised by heads of departments whose qualifications and experience are eminently suitable for their responsibilities. The heads of departments will be responsible to the general manager who will be assisted by an assistant general manager, who must both be qualified and experienced professional engineers and administrators.

The general manager would be responsible to the chairman of the board of directors. The corporation or board is usually supervised by a minister in charge of a ministry responsible for the development of water supplies.

The organizational set-up described above is the headquarters organization. Where the field of operation is extensive, there should be field or area offices which will look after the development and administration of water supplies in the areas under the general supervision and control of the headquarters. It will have sections dealing with the various facets of the corporation's functions.

### 3.4 A typical waterworks organization

Each waterworks would be the responsibility of a waterworks superintendent or a professional engineer depending on its size and operations. The maintenance and operation of a waterworks will be carried out as described below.

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##### 3.4.1 The headworks section

This will have responsibility for the prevention of contamination of the sources, inspection and general care of the intake structures and their appurtenances, the operations and maintenance of the engines, pumps and the treatment plant and perform routine tests on water quality.

##### 3.4.2 Distribution section

This section will be responsible for the maintenance of the distribution system including the service reservoirs, the prevention of waste or misuse of water and the service connections to houses. In this section there should be an emergency gang ready, at all hours of the day and night, to repair bursts in pipes, or any serious leakages arising out of defective joints in pipes, or sluice valves or the clearance of lines affected by airlocks. Where the demand is greater than the supply, as is usually the case in a number of areas, this section will arrange an equitable distribution of the available supply.

##### 3.4.3 Stores section

This section would handle stores of all kinds, keep accurate records and ensure the replenishment of stocks before they are completely depleted.

Each department and the sections of each department should have well defined duties so that the overlapping of functions is eliminated or reduced to the barest minimum.

##### 3.5 Problems of administration

The problems encountered in the administration of a water authority are numerous and can only be tackled by patience, perserverance and the dedicated service of the personnel.

##### 3.5.1 Financial problems

Funds available are rarely sufficient for its capital development and the maintenance and operations of its supplies. The remedies for this, though not always easy, are to have a sound fiscal policy and arrange monthly priorities of

expenditures. The best approach, in our experience, is to arrange payment of all creditors pro rata from available funds so that no section of its operations suffers. Above all, all wastages of materials and stores should be prevented at all costs.

### 3.5.2 Lack of qualified professional engineering personnel

The authority cannot create an impression in the minds of the public if there is no practical evidence of its activities. On the other hand, it cannot demonstrate this unless it has capable and qualified men within its fold. Yet the salaries it can offer are not competitive in the world markets. The few indigenous staff, even though some of them are relatively inexperienced, will be overburdened with work. One solution is the employment of consultants and contractors to carry out major works which are supervised by those departmental staff who can be spared from routine administrative work. The few available staff can carry out designs of minor schemes and extensions and also supervise their construction. To combat inexperience, in-service training courses should be arranged for promising officers. Others just have to learn the hard way, which is probably the best way, by doing the job as best they can under supervision.

### 3.5.3 Relationship with government

Those in authority are usually anxious to develop the water supplies and they are apt to blame the slow pace of development on the board of the corporation. There is therefore the necessity to acquaint them with the problems clearly, even if bluntly, to lay the plans of the organization and its requirements, financial and otherwise, before them, all of which implies the need for constant consultation, between the two.

### 3.5.4 Relation with the public

It is well-nigh impossible to satisfy all the members of the public all the time, especially when the demand is always greater than the supply. This is where a good public relations programme is vital and however difficult the water situation is, it is incumbent on those in charge to improvise ways and means of easing the problem.

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Another cause for unhappy relations with the public is the presentation of inaccurate accounts, particularly if this results in over-charging the customer. It is therefore very important to ensure that accurate bills are sent to consumers, since many equate inaccuracies in the account with overall inefficiency. Above all, since a dissatisfied public is the greatest obstacle to success, all members of the staff should act as public relations officers and be courteous at all times.

3.5.5 Communications within the organization

Unless the channel of communication is defined, there is bound to be delays in the execution of any business. In addition, the organization should ensure that there is an effective communication of ideas and instructions which should be clear and unambiguous particularly to the field staff. Management decisions should, unless classified as secret or confidential, be relayed to all staff immediately in clear and simple language. These can be posted on notice boards available at all offices and waterworks. Management should at all times maintain contact with all levels of personnel and particularly with the trade unions.

3.5.6 Stagnation

There may be a tendency to feel too satisfied if there are no major problems and work is progressing smoothly. This is a false sense of security. The management must continue to devise means of improvement, to study new methods and approaches; it should also keep abreast of developments in all parts of the world and participate as time permits, in conferences and seminars dealing with public water supplies.

3.5.7 Bureaucracy

An autonomous water authority may not necessarily be allowed to operate entirely as such. There may be the necessity to have the approval of the government or major decisions affecting the citizens and since government has other equally pressing duties to perform, decisions or approvals of recommendations may take longer than would appear necessary. In many instances, letters



fowarded to government ministries are not dealt with as expeditiously as possible and there is, therefore, the need for constant reminders and personal contacts which often takes a considerable portion of executive time. The remedy to this is that a water authority should be independent of any ministry although there must be adequate liaison and co-operation. Its chairman, if possible, should have the status of a minister especially if the authority's operations are state-wide. The government will thus demonstrate the authority's importance to the well-being and economic life of the nation.

### 3.5.8 The establishment of water rates structure

This is perhaps one of the most sensitive areas in the administration of a water authority. The water rates structure evolved must be such that its total revenue should cover its capital as well as the maintenance expenses and leave some small profit which can be used to finance improvements. In practice this objective cannot be easily achieved in developing countries, at least during the first few years of operation, but the situation whereby government should continue to subsidize a water authority primarily set up to operate as a viable organization would appear to be anomalous. It should however be remembered that the authority cannot levy rates which have not been approved by the government and if the proposed economic rates are regarded as too high, the chances are that they may not be approved. The logical answer is therefore for the government to subsidize the operations until the generality of the people can afford to pay the economic rates for water as this should be the ultimate goal.

In establishing a rates structure therefore, the authority should work on the assumption that it should levy rates which will make its operations viable and present these to the government for it to take a decision on whether to approve them as they are, and if not, what the rates should be and the corresponding amounts of subsidy which will be granted to the authority for it to fulfil its statutory functions adequately.

Annex 43.5.9 The consumers

There are several categories of consumers, and generally, the rates levied on each category are different. A rates schedule should be worked out for the following categories of consumers:

- (a) commercial and industrial concerns such as banks, factories, financial institutions, hotels, laundries, public wash-houses, restaurants, etc.;
- (b) institutional consumers such as hospitals, health centres, schools, government departments, military installations, etc.;
- (c) metered domestic consumers with house connections;
- (d) unmetered domestic consumers with house connections;
- (e) domestic consumers supplied through public standpipes.

Generally the commercial, industrial and institutional consumers are metered and are usually charged rates which will still however encourage their presence.

3.5.10 Metering and flat rates

There are arguments for and against the metering of private consumers. If water is regarded as a commodity, the most equitable system is to meter all consumers, so that they pay for what they get but this entails a considerable financial outlay on the purchase of meters, the establishment of a meter repair workshop and other administrative overheads. Further, it is suggested that metering discourages consumers from using the quantity of water sufficient to maintain high standard of personal hygiene. The same level of revenue can, however, be obtained by assessing premises with water connections either on a property rating or by using the floor area as a unit of charge.

Those who draw their water from public standpipes and who are generally the low income earners, can be assessed on flat rates per annum. The method of collection can be by appointing local councils as collecting agents or the

supplies to standpipes can be metered and the respective local councils billed for the bulk supply, in which case the local council will levy appropriate rates in its area of jurisdiction. The difficulty with this arrangement is that should a local council default in paying its bill to the authority the disconnection of public standpipes would create a public outcry. One possible way of circumventing this difficulty is to arrange with the state or national government to freeze the payment of any subventions due to the defaulting council until it pays its water bill or as an alternative the government should pay the debt on behalf of the council and debit its account accordingly.

Water bills should be sent to all consumers monthly with the exception of the flat rate payers, i.e. those who draw their water requirements from public pipes. These are generally defined in the Western State of Nigeria, as gainfully employed males of 16 years and above. Those living in premises with water connections and whose premises have been assessed in a different category are exempted from the payment of flat rates.

#### 3.5.11 Emergency operations

All water authorities should always be in a state of preparedness to combat any possible disruption to the supply arising out of natural catastrophes or damages to equipment or plant. It should have a manual which deals with the operations during an emergency and the duties of all categories of staff should be laid down. The manual should be revised and brought up to date annually. It should always have a record of all available water resources in the vicinity, have standard standby pumps, generators and engines which are skid-mounted and mobile filter units which can be easily installed.

#### 3.6 Conclusion

The subject matter of this paper is so wide that it can only be treated, within the space allowed, by dealing with specific problems and the suggestions for resolving these problems. The history of water supply administration is one of gradual evolution, and the establishment of water authorities

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in many developed countries is one of the results of this evolution. It is not a perfect administration, but it follows the pattern of successful administration in other fields, where for instance, many small business organizations with separate administrations cannot successfully compete with the big combines. So it is with the establishment of water authorities for the administration of water supplies. It is this type of administration that can cope quite effectively with the growing needs of the people both in urban and rural areas provided the basis for its establishment is firm and it is adequately equipped financially and technically for the task.

#### 4. FUTURE STUDIES

##### 4.1 General

Although the practice of providing water supplies is well understood, particularly in the urban areas, there are still many problems in rural water supply practice, which need attention if the small towns and villages in Africa are to be supplied with safe, potable water at a price that the local people can afford. Some of these problems and suggested solutions are considered in this background paper with particular reference to the physical aspects of supply such as improvements in materials, construction techniques, in the use of new or unusual materials, testing, water treatment and in the training of personnel.

##### 4.2 Water supplies

These are usually divided into rural and urban schemes and whilst there are problems associated with urban supplies, the greatest emphasis must be placed, in the African context, on the solutions of the many problems of rural schemes.

In the past funds set aside for the provision of water supplies have largely been used in the urban conurbations since the influential people live in these places and even if they do not try to influence policy on water supplies directly there is a considerable temptation for the administrator to ensure that

things are changing a little and the majority of governments are subscribing to, at least, the minimum goal set by the World Health Organization, i.e. 20% of all rural communities should have reliable pipe-water supplies by 1980. This and the financial implications have already been discussed in section 2.

The three most important obstacles to attaining this goal of serving 20% of rural communities are (1) lack of sustained interest at government policy levels since this is apparently an expenditure with little obvious and evident return; (2) lack of interest on the part of those people who will have to maintain their new supply; (3) lack of, or such poor, roads that make construction or maintenance so difficult that these communities cannot be considered.

Government interest must be maintained by continued education of the policy makers with particular stress on improved production due to better water supplies with a resultant growth in the gross national product. Lack of interest on the part of the local people must be replaced by a sense of involvement and a cardinal rule for all rural water installations is that the local people must be prepared to match the government's payment even if only in a small proportion or on in the form of land and, or, of labour. This is regarded as essential if the community is to have a sense of involvement and ownership. On the question of bad communications, all that can be said at the moment is that the communities that are really remote from any semi-reasonable roads or tracks will be among those who are not supplied in the first development period. They should, however, be encouraged to use community labour to construct their own access roads and the government can assist by providing culverts, bridges, etc.

Rural communities can be considered as (i) closely linked groups; (ii) large isolated groups (iii) small isolated groups.

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4.2.1 Closely linked communities

There is almost no doubt that the most appropriate method of supplying water to a closely linked group of communities is to use a single source if it is available and adequate. This is a solution that should always be investigated and in each country and in each type of geohydrological terrain the economics of these combined systems should be investigated to determine the economic limits.

The actual type of supply - boreholes, gravity feed or impounding - will of course depend upon local conditions and it is again essential that a careful survey and cost analysis be performed in each area to determine the most economic type of source both in capital outlay and in current expenditure.

A decision must also be reached on the minimum number of a community that will warrant the provision of a supply. This is not only a matter of economics but also of preventive medicine, as an uncontrolled small community in the centre of a group of control (supplied with reliable water) communities can act as a focus for fresh infection.

4.2.2 Large isolated communities

Almost inevitably, large isolated communities must have their own supply and it may be worthwhile to invest in a system which is initially uneconomic if the community growth rate appears to warrant it or if there appears to be the possibility of industrial or agricultural growth. A typical example of the latter is the introduction of tomato farming on a large scale in an area where the farmers' profits can be ten times those obtained from more usual crops such as groundnuts. Here there is going to be a considerable rise in population, in the general community prosperity and consequently there will be a greater demand for amenities.

A point to consider if the financial provision is very limited is the possibility of a central water supply without feeder lines in the first instance. This will encourage the migration of the population of neighbouring villages to this local focus. Although the farmers will have to travel greater distances

to their farms, this is compensated for to a certain extent by the economic advantages of amalgamation. Government, at the same time, should make adequate provision for the resettlement of these villagers.

#### 4.2.3 Small isolated communities

The temptation here is to accept that these communities will not receive water in the first planning period. However, if such a community is in a region that is otherwise well provided with water the small community should be provided with, at least, a hand-dug, covered well or some relatively cheap and simple source of water. There is also the possibility of persuading the people to migrate to the larger communities if they are of the same tribe or ethnic group. These considerations only reinforce the need for careful planning in an area rather than making ad hoc local arrangements.

#### 4.3 Specific studies

There are a number of specific studies that need consideration:

- |                                     |                           |
|-------------------------------------|---------------------------|
| (1) Data collection and exploration | (5) Types of supply       |
| (2) Materials                       | (6) Treatment and testing |
| (3) Equipment                       | (7) Standardization       |
| (4) Construction                    | (8) Training              |

##### 4.3.1 Data collection and exploration

The necessity for data collection of all kinds - meteorological, hydrological, geohydrological, water properties, demographic, water consumption, social and health - needs little emphasis and little elaboration except in two important aspects particularly in the remote areas.

There are few problems of data collection in the large towns as this is very much the province of any constituted water commission. In small towns, however, with low standards of average education and in the rural communities data collection is at the best spasmodic and usually unreliable.

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For instance, 50% reliability means that the overall results are totally unreliable. It can be accepted that rural depth gauging records will be largely unreliable since the worst flood conditions usually coincide with the worst weather conditions or darkness as very few observers will venture out in the pouring rain or at night to take readings of flood levels. Since reliable records are those automatically recorded, this should be the objective of all data collection in all areas. This is particularly so where continuous records are required such as rainfall to determine "intensity-duration" curves for design purposes.

This in turn leads to cost considerations but it must be emphasized again that unreliable records are of no more value than no records at all. Therefore if funds are to be used for data collection it is much better to have a few reliable records than many unreliable ones. There is then only one answer to this problem - automatic recording devices. Accepting this, the degree of automation is worth considering further.

In remote areas, difficult of access, consideration must be given to more fully automated stations where the data is stored either on paper rolls or on tape. A possible ultimate refinement is to have the data radioed directly to the headquarters. Complete remote stations are now available which record as many parameters as required, but the one difficulty with these stations, if the records are retained on paper rolls, is that if a breakdown occurs it is not noticed until the next visit to the station. It is therefore advisable either to duplicate the equipment or, and possibly more reliable, have a simple radio monitoring system which only indicates a break in service.

The use of surface equipment to determine the depths of the local water table without disturbing the ground, is another matter that requires further study. It is well known that using equipment such as the simple resistivity meter, the depth of the interface of various strata and the depth to the water table can be determined from surface measurements. Experience has shown however that having made these measurements at a series of positions, usually on a rectangular survey grid, having plotted the resultant water table surface and determined the potential yield from average permeability value, a well may be



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drilled with almost zero yield whilst another, some little distance away, has an excellent yield. This is generally due to the fact that the grid is too coarse to show where local geological changes occur. It is therefore suggested that the use of this and similar equipment used in exploration could be studied further with a view to improving the percentage success in well drilling and in an attempt to ease the calculation procedures which are onerous at the moment. Such a study has been started by one of the writers but it needs to be extended to other geological areas.

4.3.2 Materials

This is probably one of the most profitable areas for research in the efforts to provide rural water supplies at minimum cost. For ease of study, the subject can be divided into source, distribution and supply.

4.3.2.1 Source materials

(a) In general, the most reliable, and easiest material to install for well linings is concrete in the form of precast rings. If reinforcement is available then it is worth making very thin sections that can easily be handled and if steel rod or mesh is unobtainable a most useful replacement is galvanized wire netting. The present need is for investigations to determine the easiest method of construction that can be utilized by both relatively skilled labour working in the headquarters precasting yard and by unskilled labour, in the village, constructing their own well.

(b) Efforts should also be made to design simple moulds that can be made and used by the villager and which can easily be dismantled and reused. Stripping the moulds from "green" concrete should also be investigated with a view to speeding production and to enable "weep-holes" to be cut before the concrete sets but without damaging the remainder of the concrete. If sand is not readily available for concreting, good quality laterite makes a useful substitute.

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(c) If the provision of concrete rings is not feasible, concrete block linings can be used but this usually implies that the well has to be dug to its full depth before constructing the lining with the consequent danger of a cave-in unless strutting and shoring is used. Vertical steel rods spaced at intervals in the hollow concrete blocks greatly improve the strength of the lining.

(d) Another suggestion is to plaster the walls of the well with cement, as the work progresses, to peg galvanized wire netting to the well and then plaster over the wire to a suitable depth to provide a reinforced lining.

(e) Timber is an unreliable material to use in any form of well construction but bamboo has been used with some success as a reinforcing material.

(f) Well yields can be increased using steel, galvanized iron or asbestos cement pipes radiating from the well, and buried in the aquifer. Holes are drilled or cut in the pipe walls to allow the ingress of water to the well. The use of specified plastic piping can also be considered for this purpose. If not available, every effort should be made to encourage local businessmen to set up a plant for the production of plastic products, particularly, piping.

(g) The extended use of gravel packing is also recommended as a method of improving well yields. In one instance, where the well was situated on the bank of an ephemeral stream which had water bearing sand in the bed, the bed was excavated to bed rock across the width of the stream, the excavation lined with guineacorn stalks to restrain the sand and filled with gravel. This acted as a large, crude, lateral supply extending to the well, yet the pumping capacity was at least the equal of similar wells fitted with steel laterals. The cost of all these types of well were the same but imported materials were not used in the one described and the work was performed by local semi-skilled and unskilled labour.

(h) Attempts have been made to find substitutes for borehole screens which are usually very expensive. In one attempt longitudinal slots were cut with oxy-acetylene cutters in ordinary steel or GI pipe and thin steel sheet, punched with a large number of holes, was brazed or welded over the slots.

Asbestos pipes have also been used as screens when properly adapted for the purpose, by drilling holes in the pipe walls.

#### 4.3.2.2 Distribution

As already noted, the use of locally produced plastic piping should be encouraged wherever possible and plastic distribution pipes, up to 6 inches diameter are generally cheaper, lighter, easier to handle and more easily worked than steel or cast iron. Previously, some plastic pipes were subject to attack by termites but this problem has been overcome to a large extent. An alternative, particularly for larger sized pipes is asbestos cement and again every effort should be made to encourage the establishment of a manufacturing plant. There can be one drawback to these home manufacturing schemes, particularly when government dictates the use of these products and that is, there is a considerable temptation for a company, if it has no rivals, to increase prices and to make unreasonably large profits. Prices of such indispensable products should therefore be carefully controlled.

Towers and tanks are usually made of reinforced concrete but steel rod or mesh usually has to be imported. Careful consideration should be given to the use of block walls with a small space in between, filled with water-proof concrete.

Tanks can be simple excavations in the ground, lined with plastic sheet, covered with timber and plastic sheeting. Alternatively unreinforced concrete linings can be used so long as (i) good quality concrete is used, (ii) the lining is cast in sections not more than three feet square, (iii) a plastic water bar is used between each section and (iv) the sections are cast in such a manner that each dries out for at least three days before a neighbouring section is cast. In some areas, particularly where corrugated iron sheets are used for roofing, rainfall is collected and discharged through pipes into underground tanks.

Pipe fittings, usually have to be purchased abroad, except in the case of joints for asbestos cement pipes. The Indian Government has instituted a programme for the development of the design of various types of fittings

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and for flow measuring devices which can be produced locally. Further information should be obtained and development groups in African countries should pursue this matter of development with vigour.

#### 4.3.2.3 Supply materials<sup>1</sup>

These range from village standpoints to the more sophisticated units such as washhand basins, showers, baths, etc.

A number of designs are available for the construction of village standpoints by local labour and there are useful descriptions in the bibliography. Where more sophisticated devices are concerned such as taps and sanitary fittings every effort should be made to encourage the local production of these. In the majority of cases, the use of high quality vitreous ware is not justified and the the adaptation of simple metal bows for wash hand basins should be considered as well as the production of sanitary units in locally produced plastics.

#### 4.3.3 Equipment

The provision of equipment should always be considered in relation to all the relevant factors such as water type, qualities of water, total distribution distances, topography, etc. The majority of these items are standard and the characteristics can be obtained from the manufacturers' catalogues. However, it is thought that much more attention should be given to the design and use of windmills. These have been most successful in the savannah region and in coastal regions where the wind usually blows for a period each day. The production of designs that will permit local manufacture as well as the collection of wind velocity and duration data, in likely areas, should be the subject of an immediate study.

There are many types of handpumps and again a careful, detailed study is required so that the most suitable types can be recommended for local use and

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<sup>1</sup> A request was sent to Member governments by WHO requesting information on the use and studies relating to new materials, equipment and unconventional methods in rural water supplies in March 1970. The replies such as they are will be made available later.

for local manufacture. One such design is the "Bati" pump which originated in Afghanistan; the manufacturing cost is very low and within the reach of most rural communities.

Jet pumps are now commercially available and whilst requiring minimum maintenance, the efficiencies are very low in the region of 25%.

#### 4.3.4 Construction

Probably, one of the most important factors is that, in general, construction is best performed by qualified and experienced contractors. It may be that no local contractors are available with this expertise and immediate attempts should be made by the local government authorities through recruitment, to obtain the services of experienced construction engineers who can instruct and help local contractors in this work. The two exceptions to this are direct labour for small contracts and secondly community efforts. Here it is essential that the authorities provide, by some means or other, the necessary construction expert to advise and to supervise the work and this particularly refers to the construction of small earth dams by a local community. Attention should be given to the production of general purpose designs for the construction of wells, boreholes, impounding works and service reservoirs.

More thought is needed in efforts to improve the efficiency of construction of wells using local labour and efforts made to codify available information on the subject.

#### 4.3.5 Types of supply

These are, in general, wells, boreholes, reservoirs, gravity supplies from reservoirs, rivers and lakes.

In general, boreholes or well water is preferred, so long as the supply is adequate and is not contaminated. In one rural study all except one of the public wells were situated less than 100 feet from and downhill of latrines and, in consequence were highly contaminated. The one exception was the well near to a church which only confirmed the old adage that "cleanliness is next to godliness".

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Impounded water should, where possible, be fenced and a careful education programme conducted to prevent the reservoir being used as a latrine, swimming pool, laundry and watering place for the cattle. There should be provision for these activities downstream of the reservoir well or embankment. The treatment of these open surface supplies is usually more costly than the treatment of well or borehole water.

River water, except in the upper reaches, is nearly always highly contaminated and, nowadays, is frequently industrially polluted. Pollution and the use of rivers as open sewers must be dealt with by legislation and vigilant water authority action.

Lake and creek water suffers from the same drawbacks and difficulties as river water except where it occurs in relatively uninhabited terrain.

#### 4.3.6 Treatment and testing

Water treatment is a well established technique in urban supplies and in the larger rural supplies. However it is at the village level that the problem arises particularly in the treatment of water from community wells. It is important therefore that a study and recommendations should be made for the design of very simple and inexpensive treatment works for rural supplies.

One very useful device, in this context, has been developed by the Indian Government for the disinfection of shallow wells which consists of a simple pot container with small holes drilled at the sides or bottom and the mouth of the pot is well sealed with plastic sheet. A mixture of sand and chloride of lime has been placed in the pot which is then suspended at one metre below the water surface of the communal well. The proposed amounts shown in appendix 2 will provide protection for approximately one week.

Testing of the water supply should be a matter of regular routine. In large waterworks the more usual tests, both chemical and bacteriological, should proceed continuously and therefore a simple laboratory should be attached directly to the waterworks. More detailed studies should be regularly undertaken in a more sophisticated laboratory which should be available in each region. Continuous testing is essential when dealing with river water subjected to varying degrees

of pollution and contamination and consequently the rates of treatment should be in keeping with the degrees of pollution.

The testing of rural supplies is much more difficult but the simpler tests should be carried out, on the spot, in the larger rural installations and the operators carefully instructed in the interpretation of the results and the necessary changes, if any, in dosing. These instructions should be provided verbally and in writing in a form similar to that used in military instruction manuals which even the semi-literate can follow. Operators should be expected to learn these procedures.

The testing of small rural water supplies can best be accomplished using a mobile laboratory which is also equipped for the more sophisticated testing of the larger rural supplies mentioned in the preceding section.

#### 4.3.7 Standardization

There is no doubt that standardization on equipment, materials and general supplies can lead to very great savings and greatly reduces stores expenses as fewer items have to be held. Further, it is easier to train maintenance men to be effective on one type of equipment rather than on several. There is also the further advantage that if, say, 30 identical pumps are needed, the manufacturer will quote a lower unit price than that expected for an order of one or two similar pumps. This concept can be extended into all areas of the supply of manufactured goods and further, with this in mind, every effort should be made to encourage the establishment of local industries to manufacture goods that are required in large numbers, such as pipe lengths. Finally, there is the advantage that "stand-by" equipment can be reduced to a minimum as it is a simple matter to rush a replacement from the central stores if the equipment is standardized.

It has been indicated, however, that complete standardization has two considerable potential drawbacks. The first concerns the risk, slight though it may be, that a manufacturer may go out of business. The second is the possibility that, if all the goods are ordered from one supplier,

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the quoted prices are likely to rise more than necessary as the supplier has a monopoly. For these reasons whilst accepting the principle of standardization it is realistic to standardize on at least two lines and to use more than one purchasing agent so that neither manufacturer or supplier can hold the customer to ransom.

4.5.8 Training

No discussion on water supplies would be complete without a mention of the training of operational, professional and instructional personnel. If the provision of adequate potable water supplies is regarded as a necessity then the appropriate people needed to conduct explorations, to plan, organize and construct waterworks, those needed to operate the installations and finally those needed as instructors must be provided. One approach to this is to attempt to determine how many people will be required for these purposes but whilst this may be regarded as appropriate some time in the future, the problem at the moment in most developing countries, is an acute shortage of most technological grades.

The approach needed therefore is to specify the training programmes required and hope that a fraction of the people needed will be available to take these courses.

Considering the professional grades there is an acute shortage of trained and experienced engineers of all categories: hydrologists, geologists, land surveyors, academics and health education specialists. A number of African universities train civil engineers and geologists and the numbers of these although insufficient are steadily growing. Very few opportunities exist for the training of hydrologists, water engineers and land surveyors except as part of the civil engineering undergraduate curriculum. One university has provided a final year specialization for hydrologists and an M.Sc. course in water resources and hydrology, all of which could easily be extended to train water engineers. Academics in the areas listed are also in very short supply whilst the training of health education specialists is not available. Evidently, if governments are going to expand their water programmes they will, as a corollary, have to expand the appropriate university programmes at both undergraduate or post-graduate level



or find themselves in the position of having insufficient indigenous professionals to act for them.

One suggestion that has been put forward by the United Nations Organization and by interested universities is that regional centres should be established in, at least, West and East Africa for "water resources and water engineering" as one unit and "public health engineering" as another unit. One of the writers has been closely associated with these submissions in West Africa and it is hoped that something concrete will come of these suggestions which have now been mooted for at least five years. They would provide invaluable centres for the training of post-graduate professional personnel in water, and sanitary engineering and community health specialization as well as acting as centres for research and data collection and could, possibly, undertake some highly specialized aspects of training of technical personnel.

To support the professional grades there should be a considerable number of senior technical staff of the higher national and ordinary national diploma or certificate level and appropriate courses are needed at the technical colleges.

There are plenty of courses available in building technology and these could be used as the basis of similar courses in public health engineering. Some of the materials in the public health courses will then be of use to the medical auxiliaries needed in health education.

At the ordinary national level there should be nationally organized courses in water engineering, hydrology, land surveying, health education and in general public health engineering. There might well be scope for individual countries to state that they will specialize in the training in one area and accept students from other countries.

At the lower technical levels there is every expectation of obtaining people who can be trained for virtually all grades - if there are sufficient incentives. Training programmes can be organized at the technical colleges

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either on a resident short-term basis, on day release and the time has come in the larger urban areas to consider the provision of evening courses.

Two points must be added here. There is an idea prevalent among students that when they clutch that all-so-important piece of paper indicating that they have a degree, diploma or certificate they can then rest from their labours and coast through life. At the moment, there is little to disabuse the man of this idea. There needs to be radical rethinking on the part of all concerned. There should be rewards for extra work, for proven ability, for innovations leading to increasing efficiency and particularly for those who are prepared to work in the field.

#### 4.4 Final considerations

(a) A considerable amount of attention has been paid to the "Zaina" experiment in Nyeri, Kenya, which is described in the bibliography. An effort was made to determine, statistically, the effect of the provision of a reliable potable water supply to a rural community at the end of four years. The results show some improvement but the whole scheme was beset with a variety of data collection difficulties and with changing parameters whose effect is difficult to determine. It is suggested, therefore, that at least four separate communities with four separate controls should be employed which are sufficiently close to each other for the whole area to be regarded as homogeneous, but sufficiently far apart such that no one community can affect another. This is urged as a project that would have many advantages.

One interesting point is that attention was not drawn to the results obtained from water analysis of the potable supply.

(b) It is suggested that sometimes there has been too much planning in water supplies which has led to extended delays in the start of construction. It is realized that hasty, ill-conceived schemes may do more harm than good, but occasions frequently occur where a bold approach to a scheme, prepared by highly practical, very competent and experienced engineers will often succeed and produce positive results well in advance of any more formalized planning.

It is suggested therefore that it is usually worthwhile accepting the advice of practically minded, experienced engineers when considering the implementation of a project and not only the views of the planners and consultants.

(c) Finally, it is worth reiterating one point. "None of these ideas will come to fruition unless it is the earnest wish and endeavour of the government and its civil servants that they should do so."

In this section an attempt has been made to outline some areas where future studies and research could most validly be applied. Many areas and notable problems have been omitted because space is lacking. It is hoped that the ideas put forward will receive consideration and will provoke comment and discussion and bring forth further suggested studies.

## 5. CONCLUSIONS

If potable water is to be supplied to the people at minimum cost, it is essential that a carefully detailed programme of planning, financing, investigation, design, construction, operation and maintenance be prepared. In the initial stages, and particularly where finance is concerned this effort should be made on a national basis. At the same time consideration should be given to the establishment of regional or state water corporations which are largely autonomous and which will prepare a similar programme, projected for some years ahead, for the area under its control.

To ensure that the emphasis, in the provision of water supplies, is placed on the rural areas, the water corporation must have separate planning departments for rural and urban areas which are, at least, of equal importance although a much greater effort must now be placed on the provision of rural supplies. This is essential if the minimum WHO targets are to be achieved as, assuming on average that 85% of an African country's population is essentially rural, an extra 3.5% of the total population must

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be provided with rural supplies and an extra 6% urban supplies by 1980. Another factor urged for consideration, is that a very considerable financial outlay will also be necessary to maintain the status quo of the percentage of the population supplied, since populations steadily increase.

In financing, great emphasis must be placed on devising checks and conditions, on an international basis, that will eliminate many of the undesirable features of external financing. The greatest efforts must be made using revolving loans and state lotteries to improve rural supplies but at the same time every effort should be made to reduce the costs of these schemes if the WHO targets are to be achieved. "Group supplies" is a method that greatly reduces costs per capita, if properly applied and is one that is strongly recommended for further study and application.

Community self-help schemes also could greatly reduce costs if properly planned and organized. It is further recommended that governments should use external aid for urban projects and much of its internal allocations for rural supplies.

The administration and organization of all water supplies should be matters of great concern since only if there are adequately functioning administrative and organizational units will water be made available at minimum costs. It is suggested that ministries and local councils should not have this responsibility for very good and sound reasons but it should be allocated to state or regional water corporations, which whilst largely independent, should work in close collaboration with the appropriate ministries. Water corporations, in turn, should be well administered organizations and should have as their major goal the provision of water at a price that is economic. It is essential therefore, that all these corporations should endeavour to operate as viable commercial units. Only if the government wishes to subsidize a particular section of the community should water rates be less than economic and this leads to the need for considerable campaigns to convert people to the belief that water, like all other staple commodities, has to be paid for. There is no doubt, as a corollary that much work remains to be done on the related questions of fixing water rates.

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It is also advised that a great deal of effort needs to be applied if rural water supplies are to prove cheaper than they are at present and a number of suggestions have been made in section 4 to this end. It is also suggested that where attempts are made to persuade rural population to migrate to the sources of water, the government should consider extensive resettlement plans to assist the people in the building of new houses, etc.

The question of training of all grades and types of personnel associated with water supplies and the importance of health education has been stressed in a number of places. The recommendations include the provision of regional centres of public health engineering to provide training at different levels as well as organizing research and data collection.

In addition, it is suggested that a variety of courses should be established and supported at the technical levels, in the technical colleges.

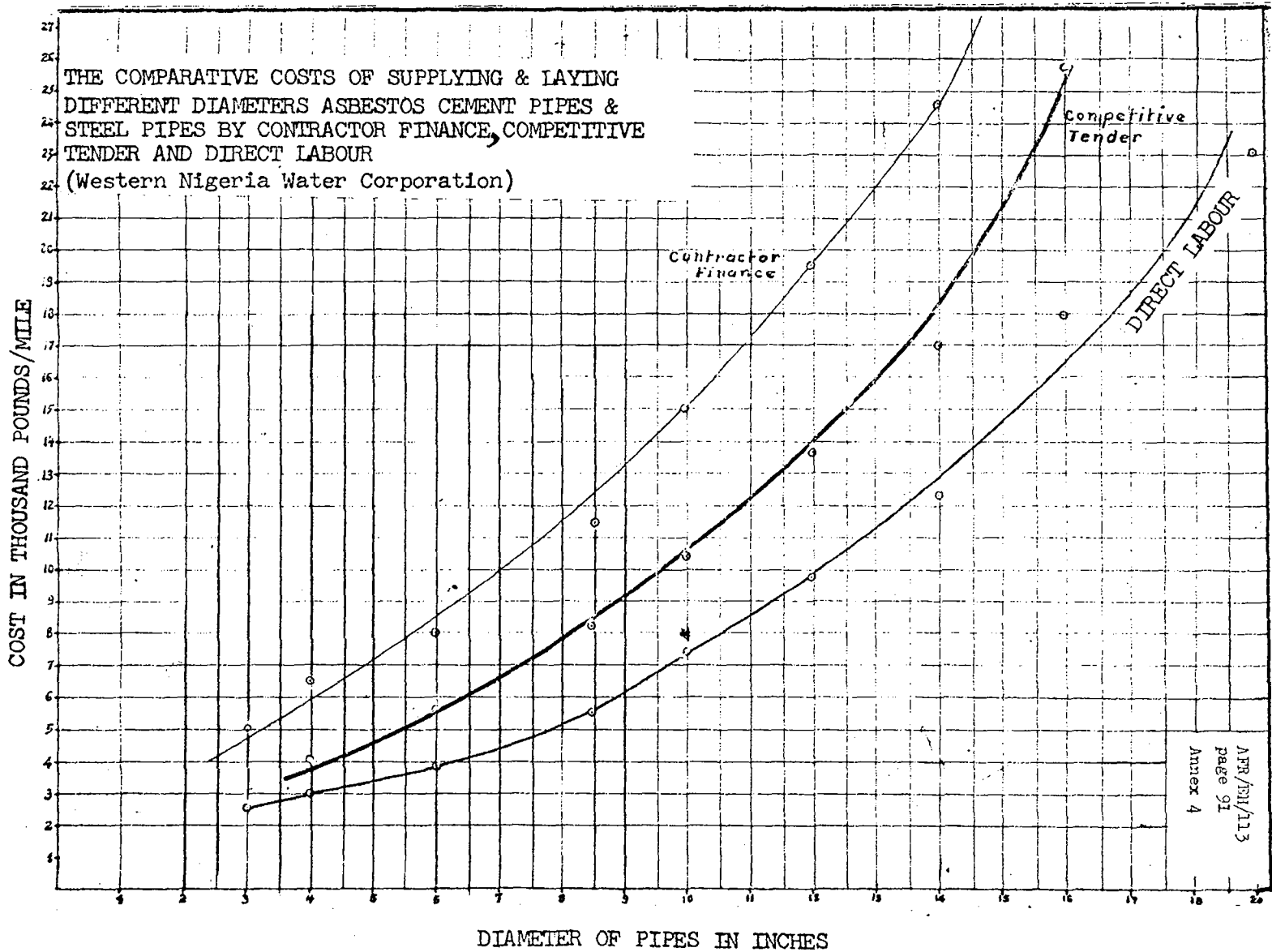
A note is also included to the effect that although planning has been stressed in this paper there is often too much planning and not enough "doing". It is sometimes preferable to provide a badly needed water supply on an ad hoc basis based on the advice of competent and practical engineering experts rather than wait for the outcome of a lengthy planning programme.

Finally, this seminar will only be a success if it achieves some practical results. It is to be hoped that the delegates will do everything in their power to see that the appropriate recommendations in this report are given careful considerations. This is definitely a case where "doing" is all important.

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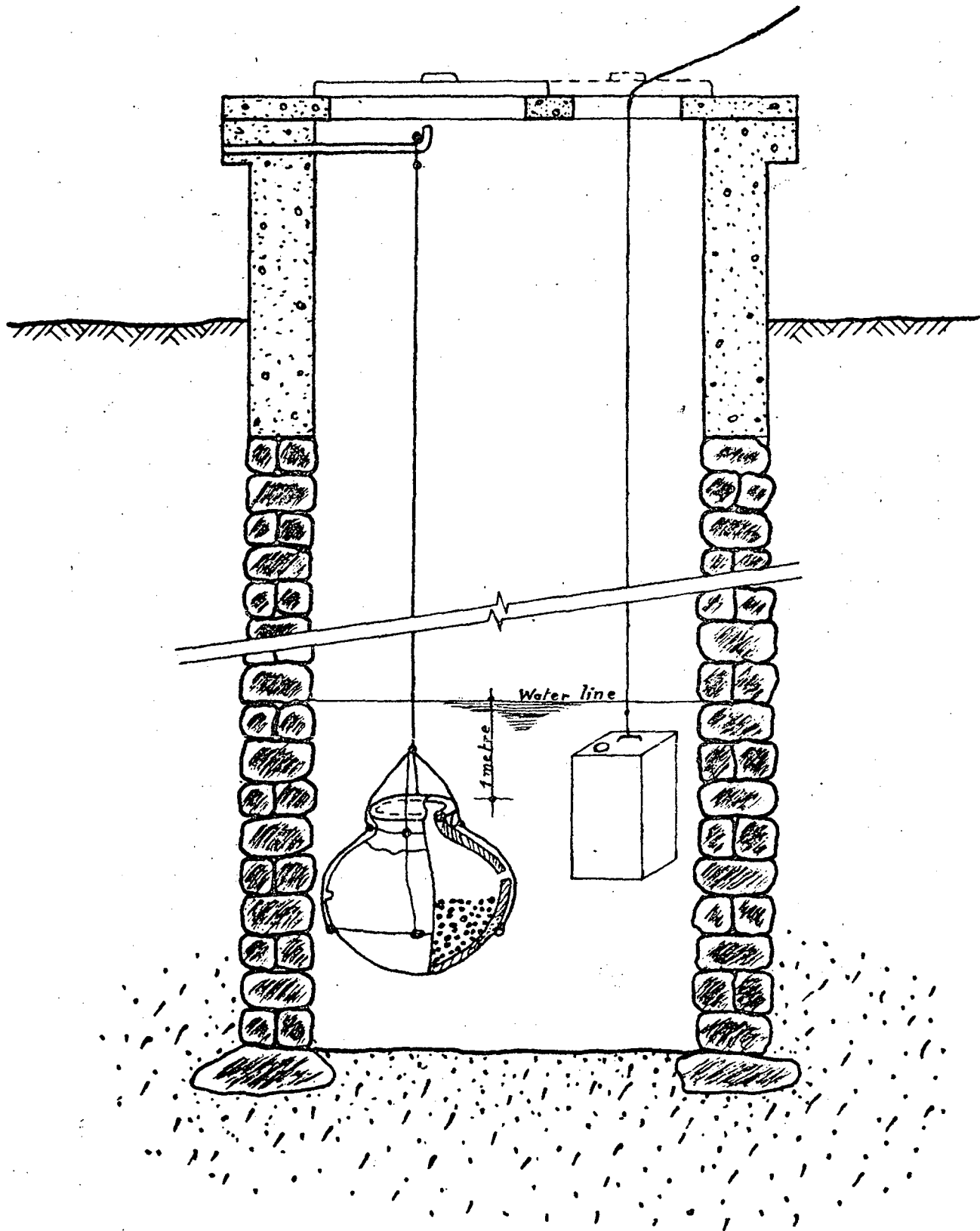
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Annex 4

SHOWING THE USE OF A SIMPLE POT METHOD FOR CHLORINATION  
OF A SHALLOW WELL UNDER EMERGENCY CONDITIONS





## INFORMATION TO ASSIST GROUP DISCUSSIONS

## 1. SOME ASPECTS OF COMMUNITY WATER SUPPLY PROGRAMMES

1.1 Goal of the community water supply programme

The Director-General of WHO, at the Seventeenth World Health Assembly, proposed the following world-wide goal which was considered to be realistic within the terms of available resources, both human and material, for completion within the next 15 years. The goal proposed was that:

- (a) everybody living in a community should be provided with piped water within a reasonable distance of his home;
- (b) the number of people with water services on their premises should be increased to an overall figure of 50%;
- (c) adequate volumes of water should be provided through non-intermittent services maintaining at least a suitable minimum pressure at all times;
- (d) drinking water quality should meet suitably established national standards which can be based on WHO's international standards for drinking water;
- (e) administration of water supplies should be independent;
- (f) revenues or other short funding should provide for operation, maintenance, capital charges and depreciation; and
- (g) adequate supervision should be provided for operation of treatment works and control of water quality.

1.2 Paying for water

As long as the "free water" concept persists, water supplies will always be deficient. Communities must be made aware of the cost involved in conveyance and in improving water quality. The principle that consumers should pay for the water supplied should be very well understood.

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On the other hand those who benefit from a rural water supply are usually among the lowest income group of the country. Construction of water supplies in such conditions might have to be subsidized by the Government, however, consumers should at least make a token contribution towards the operation and maintenance.

As for urban water supplies the need for making them self-supporting is evident and water rates have to be charged accordingly. A flat rate which takes into account the purchasing power of the community may be levied initially. But the ultimate goal or the long-term objectives should be exact payment for the water consumed and this implies metering.

1.3 Assistance from United Nations Development Programme (Special Fund)

Assistance from UNDP/SF to carry out engineering and feasibility studies for water supply is becoming increasingly popular in the African Region. In projects benefiting from UNDP/SF assistance funds are generally made available for expert services, subcontracts, equipment and supplies and training of counterpart personnel. These projects are mainly oriented towards the preparation of engineering and feasibility studies and include normally finance and management studies necessary to make the project "bankable".

In all UNDP/SF-assisted projects in the Region in the field of water supplies either in operation (7) or in active planning (10), WHO has assisted the countries in the preparation of the request for UNDP/SF. Once the project becomes operational WHO has also been nominated as the Executing Agency, responsible for the implementation of the project.

Though assistance in the past was provided mainly for urban centres, the present trend is towards assisting also the rural areas.

1.4 UNICEF assistance

UNICEF and WHO provide assistance to countries through a number of programmes planned to improve health and to meet the specific needs of children. And assistance for the development of rural water supplies is a major component of this programme.

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Since 1954 over 80 countries have benefited from WHO/UNICEF-assisted projects. Currently over 70 countries have rural water supply and sanitation projects in operation in which WHO and UNICEF are jointly participating.

The problems of unsafe water affects all age groups. However, the problem becomes more dramatic among children especially the very young. Deaths associated with diarrhoeal diseases among infants have been estimated at nearly 5 000 000 annually.

A government request for UNICEF assistance is necessary and WHO may be called upon to assist in the preparation of this request. Assistance normally involves the supply of materials and equipment like cement, steel, pumps, pipes and fittings, etc.

1.5 Assistance from the International Bank for Reconstruction and Development (IBRD), the International Development Association (IDA), and the African Development Bank (ADB)

The International Bank for Reconstruction and Development, better known as the World Bank, and its affiliate, the International Development Association, are international co-operative organizations with the status of specialized agencies of the United Nations. Although legally and financially distinct they are under the same direction and administration and share a common aim: to assist the economic development of their member countries and so raise the standards of living of the peoples of the world. And to this end the Bank is increasingly involved in providing loans for member countries for the development of their water supplies.

Before the Bank and IDA will appraise a project, preliminary engineering, feasibility studies, and cost estimates have to be completed. WHO and UNDP are often involved in carrying out these studies which may lead towards a bankable project.

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The rate of interest charged by the Bank on loans is related to the rate which it itself has to pay to borrow money in the capital markets of the world. Its current rate is 6.1/2%. The length of and repayment schedule for loans are related to the character of the particular project financed and the debt position of the borrowing country. Loans average 20 years.

(b) Development credits extended by IDA have been for a term of 50 years bearing no interest. The favourable terms upon which IDA lends makes it possible to extend credits to countries which for balance of payment reasons could not assume the burden of repayment required for Bank loans.

(c) The African Development Bank operates very much in the same line as the World Bank but its possibilities of financing are much more limited. The ADB has made its funds available for water supply projects in the Region and its activities are expanding.

#### 1.6 Administration of water supplies (French-speaking countries)

Although the management and organizational aspects of water supply administration are very much alike in the developing countries, there exist however, certain differences mostly due to the legacy from their colonial past. In the African Region this difference is clearly felt between the English and French speaking countries. The pattern of administration of water supplies in an English speaking country (Nigeria) has been dealt with in the background paper. So it is proposed to indicate briefly conditions prevailing in countries of French expression.

It is mainly due to lack of qualified personnel in the latter countries that the administration is often in the hands of "societies" or private bodies (Regideso) responsible for the development, maintenance and operation of water supplies.

In most cases these societies are local branches with main offices located in France. For this reason they maintain and adopt the same pattern of organization and administration as followed in the main office, with slight changes that reflect local laws like taxation, etc.

In recent years, since countries have become independent, governments have tried to take over some of the responsibilities for the administration of water supplies. However, in view of problems they had to face, particularly due to lack of qualified personnel, limited financial resources and certain resistance to changes on the part of the societies, they were obliged to fall back on their assistance. In some cases these societies were given back old rights for the administration of water supplies and in others they became associated with the local administration under contractual agreements for the production and sale of water.

Some countries have also taken over the administration of water supplies only in order to qualify for World Bank loans. This has also been disappointing since they were not prepared to shoulder these responsibilities.

Another aspect that to some extent contributes to the administration and management difficulties is the fact that often in the same country there are more than one government bodies responsible for water supplies. As an example there are countries where there are three ministries namely the Ministry of Works, Agriculture and "Génie Rural" in charge of water supplies. In other cases it is the Ministry of Mines and Industries and Public Works.

It is evident that countries are trying their best to take over as much of the responsibility they can from the "concessionaires" to run their water supplies. They are at the same time aware of the difficulties they have to face. And no doubt this is a vital problem for which a solution has to be found if not in the immediate at least in the near future.

#### 1.7 Community water supply research and development

Following is an extract from the report of the WHO Expert Committee on community water supply which met in Geneva in 1968:

"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

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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."

With the above objective in view, the WHO Research and Development Programme was set up in 1968 in The Hague, Holland. The programme aims at assisting countries to find an efficient simple and economical solution to their water supply problems. And in this connexion collaborating institutions have been established in Africa at the Universities of Lovanium, Nairobi, Zaria and Pretoria.

As means to this end, it is desired to promote an increasing use of local materials and skills to encourage the local manufacture of items for waterworks construction and operation, to simplify construction and operation techniques and to adopt methods which have proved successful in one country to suit the needs and conditions in others.

A WHO-assisted Centre of Public Health Engineering Research Demonstration and Training is also expected to be established in Africa by 1974.

### 1.8 Emergency operations for cholera control

Cholera is a waterborne disease and the only way to stop its transmission is to keep the disease carrying organisms away from food and drink. It should be, however, well understood that the improvement of water supplies is not the only environmental health measure to be considered though it is evident it should have the highest priority.

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Improvement of water supplies in case of emergency is often not considered with the urgency and importance it deserves because it is thought this is difficult and expensive undertaking. It is essential that this idea should be dispelled. The reduction of biological health hazards and the maintenance of a high degree of bacteriological quality are the prime factors in the control of any epidemics.

In this connexion it is essential that those responsible for the maintenance, operation and surveillance of water supplies should be fully aware of the important role they have to play in case of emergencies. A well operated supply should contribute to an immediate arrest of the disease whereas on the other hand a poorly operated one could be an additional hazard.

Precaution against an outbreak<sup>1</sup> will include the identification of all sources, public and private, which are, or may be, used by the public. These sources should be checked for sanitary defects and should be tested for bacterial contamination. Where supplies are shown to be of doubtful safety, they should either be protected, closed, or (where both these expedients prove impossible), warnings should be given to consumers against drinking the water.

Open surface water sources should always be regarded as unsafe unless adequate treatment is given. There is no point in wasting time and testing materials in examining such sources. Properly protected deep groundwater sources will usually prove safe but should be tested as a check. Shallow ground water sources may be contaminated and the water unsafe even though the top is adequately sealed and a hygienic pump installed - if the well is an open one the hazard is obviously increased considerably.

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<sup>1</sup> Document WHO/EH/70.1 by W. E. Wood.

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To test water for the presence of cholera vibrio is a difficult and lengthy process and is usually impracticable under the circumstances. Hence the normal procedure is to examine samples for evidence of faecal contamination by the standard test for coliform organisms and to assume that cholera is to be expected wherever such contamination exists. The use of portable membrane filter testing apparatus will be found very useful for an exercise of this sort but cannot be efficiently used on dirty samples. Results can be quickly obtained, a high degree of skill is not needed in its operation, inadequate laboratory facilities are not overstrained, there is no problem of transport of samples since testing is done on site, and the equipment is not unduly expensive.

Probably even more important than the membrane filter apparatus is the portable equipment for testing chlorine residual, using ortho-Tolodine or DPD as an indicator reagent. In piped supplies particularly it is the quality of the delivered water which is vital, and the presence of an adequate chlorine residual at the point of draw-off is the best guarantee of its safety. Simple colorimetric test kits should be held in sufficient number; these may be manufactured easily and cheaply within a country, as has been done in India (details may be obtained from the Central Public Health Engineering Research Institute, Nagpur, if required).

Test kits, both membrane filter and chlorine residual, together with a good supply of membranes, growth media and indicator reagents should be held against an emergency, and as many of the staff as possible should be instructed and practised in their use. Stocks of disinfectant, such as chloride of lime or high-test hypochlorite and dispensing devices should be built up, plans should be made for alternative sources of water should the existing ones prove unsafe, arrangements should be worked out for carrying water by tanker or in other suitable containers, and for vehicles to transport these should it prove necessary. Above all, there should be close supervision of all water supplies to ensure that all possible sanitary precautions are being taken, and that staffs are fully aware of their special responsibilities.



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If an epidemic does occur, it will be necessary to ascertain the source of the infection. This will be done in close liaison with the medical authorities, but precautionary measures should be taken immediately without awaiting the result of epidemiological investigations, i.e. the water supply should be regarded as suspect until it has been proved otherwise. Normal chlorine dosages should be increased - a residual of 0.5 ppm is suggested. Wherever possible, an infected source should be immediately closed, and its use forbidden to the public. In those instances where there is no practical alternative source, either water will have to be brought from outside by tanker or temporary pipeline, or treatment and a high dosage of disinfectant must be given. Where, for instance, the danger spot is a river or lake which cannot be closed or treated, then temporary treatment should be given to small quantities for drinking and cooking purposes, or individual sterilizing tablets given to those who are forced to drink from this source. Actions such as these must be supported by an information service to the public (referred to later) and it may even be necessary to enlist the assistance of the police to prevent people from drinking infected water. Constant and systematic testing of all possible sources in the affected area must be carried out to identify infection before anyone contracts the disease. Advice to boil all water for drinking and food preparation may be issued, but this should never be considered a substitute for preventive measures, since such advice will never be completely followed.

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## 2. COMPILATION OF DATA FROM QUESTIONNAIRES 1 AND 2 RECEIVED FROM THE PARTICIPANTS ON COMMUNITY WATER SUPPLY CONDITIONS IN THEIR RESPECTIVE COUNTRIES

### 2.1 General

The questionnaires, which were distributed to the governments at the time the invitations to the seminar were sent, are attached as appendices 1 and 2.

The questionnaires were sent to 33 countries and 19 returned either completed questionnaire 1 or completed questionnaire 2 or both. The returns were summarized and compiled in appendices 3, 4, and 5. The following analysis should be considered provisional as it is felt that some of the figures will have to be revised and some countries may still wish to submit their contributions. It would be desirable if participants of the seminar check their respective questionnaires after return to their countries and submit the revised or additional figures to this office.

### 2.2 Results

#### 2.2.1 Population

##### 2.2.1.1 Population, general

The population figures used in this analysis are the first instance based on the Demographic Handbook for Africa, March 1968.<sup>1</sup> Before the finalization of this analysis, the most recent corrigendum of the population estimates and projections, 1965, 1970, 1975 and 1980 were received. The revised figures were used in appendices 4 and 6 whilst in appendix 3, column 1, the revised slightly lower figures are shown.

##### 2.2.1.2 Urban population

The urban population, as estimated by the governments, is reflected in appendix 3, column 3, and these figures differ from the United Nations estimates of the 1970 urban population, which is given in appendix 6, column 3.

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<sup>1</sup> United Nations Economic Commission for Africa.

Annex 52.2.1.3 Population outside urban areas

In appendix 4 the population outside the urban areas was determined by subtraction of the figures of urban population from the total population. It may not be very correct to consider this population as rural population. It has, however, been done in appendix 4 in order to determine the number of served and unserved population in the urban areas.

2.2.2 Urban water supplies

The data received together with the total population figures in each case is shown in appendix 5.

2.2.2.1 Sources of supplies and water treatment

When reading the figures in columns 5-10 of appendix 3, it should be realized that some water supply schemes have more than one source of supply and others more than one kind of treatment. In some cases sources of water supply and methods of treatment are not indicated.

2.2.2.2 Population served by standpipes or house connections in urban areas

The number of people served by standpipes varies from 5% to 100% in some communities whilst the percentage of people who draw water from house connections varies from 2% to 90%. Based on the information received, the following average figures can be assumed:

- people supplied by standpipes: about 70%;
- people supplied by house connections: about 30%.

It appears that the figures received relate in most cases to the population served in each community. Hence the percentages are in relation to the population served only.

2.2.2.3 Budget for operation and future investment

Some countries provided budget figures for operation and future investment. These figures are also related to the number of "people supplied" in these countries. Data received may be analyzed as follows:

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- (a) the average annual expenditure in seven countries (Mauritius excluded) with a total "population served" of 7 018 143 is:

$$\$ \frac{7\ 147\ 753}{7\ 018\ 143} = \$ 1106 \text{ per head per year.}$$

- (b) the lowest annual expenditure is:

$$\$ \frac{1\ 230\ 000}{3\ 644\ 755} = \$ 0.34/\text{h.y. (Western State, Nigeria)}$$

- (c) the highest annual expenditure is:

$$\$ \frac{150\ 000}{16\ 000 \text{ head}} = \$ 9.35/\text{h.y. (Rwanda)}$$

- (d) the total future investment estimated by five countries (Mauritius excluded):

$$\$ \frac{37\ 830\ 398}{6\ 131\ 375 \text{ head}} = \$ 6.20/\text{per head}$$

The period over which the investments fall has not been indicated in most cases.

- (e) the highest future investment is:

$$\$ \frac{250\ 000}{16\ 000} = \$ 15.6 \text{ per head (Rwanda) - Investment period unknown}$$

- (f) the lowest future investment is:

$$\$ \frac{292\ 000}{245\ 000 \text{ head}} = \$ 1.19 \text{ (Togo) - Investment period unknown.}$$

#### 2.2.2.4 Water price

The water prices as indicated in column 16 of appendix 3 show considerable differences between \$ 0.45 per cubic metre. It has to be assumed that in some cases figures given relate to production costs of water and in others the consumer prices per m<sup>3</sup>.

#### 2.2.3 Rural water supplies

Appendix 4 shows the UN population estimates and the percentage of rural population supplied with water, as submitted by the different governments. The difference between the total population and the urban population has been considered as rural population, although this may not be valid in some cases.

Out of the 200 938 000 people living in the WHO member countries of the African Region, 173 000 000 or 86.5% are living in non-urban (rural) areas, according to UN estimates.

The total population in the countries that have sent percentage figures of rural population supplied with water is 91 735 000. The total rural population served is 9 754 000 and the unserved 81 981 000. This leads to the following percentages:

$$\frac{9\ 754}{91\ 735} = 10.7\% \text{ of rural population } \underline{\text{served}} \text{ through water supply schemes.}$$

$$\frac{81\ 981}{91\ 735} = 89.3\% \text{ of rural population } \underline{\text{unserved}}.$$

#### 2.2.4 Professional staff

In appendix 5, the number of engineers, responsible for design, construction, operations and maintenance has been compiled. For the purpose of this analysis, the number of engineers has been related to the total population of the country. In view of the relatively high number of engineers available in Ghana, and in order to obtain more realistic average figures, analysis has been carried out with and without Ghana. In order to get an idea of the average demand for engineers in the next five years, the number of engineers in the countries which sent estimates (Ghana, Upper Volta, Kenya, Lesotho, Liberia, Mauritius, Nigeria (Western State) and Seirra Leone) has been related to the total number of population of these countries, totalling 41 913 000.

<u>Analysis</u>		<u>Engineer/ population ratio</u>
1. Ghana has the largest number of national engineers in relation to the total population of the country	$\frac{8\ 376\ 000}{175}$	48 000

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<u>Analysis</u>		<u>Engineer/ population ratio</u>
2. Central African Republic has indicated that no national engineer is available in the country (total population 1 508 000) -		-
3. The average national engineer/population ratio taking into account all the countries (column 1 of Appendix 5) is: .....	<u>60 311 000</u> 263	229 000
4. If Ghana is excluded from the figures, the average ratio is:.....	<u>51 935 000</u> 78	670 000
5. The average ratio related to national plus expatriate engineers is:.....	<u>60 311 000</u> 295	204 000
- without Ghana.....	<u>51 935 000</u> 106	490 000
6. The average ratio related to national plus expatriate engineers plus engineers under training is .....	<u>60 311 000</u> 358	167 000
7. Same as (6), however without Ghana ....	<u>51 935 000</u> 129	402 000
8. The ratio related to additional engineers required in the next five years is (in the countries which gave estimates): .....	<u>41 913 000</u> 218	192 000
9. Same as (8) however without Ghana.....	<u>33 537 000</u> 133	252 000

2.2.5 Sub-professional staff

Remarks made under paragraph 2.2.4 are also valid here. As regards future requirements only the countries which gave estimates have been considered (Cameroon, Ghana, Upper Volta, Kenya, Lesotho, Nigeria (Western State) and Sierra Leone) totalling 46 456 000.

Annex 5

		<u>Staff/population ratio</u>
(a) The following countries have the lowest ratio as regards sub-professional staff:		
(i) Mauritius.....	<u>834 000</u> 400	2000
(ii) Ghana .....	<u>8 376 000</u> 2279	3600
(b) the following countries have the highest ratio as regards sub-professional staff:		
(i) Upper Volta .....	<u>5 319 000</u> 7	760 000
(ii) Togo .....	<u>1 835 000</u> 4	460 000
(c) the average ratio related to national, sub-professional staff in all countries is: .....	<u>60 311 000</u> 3297	18 000
(d) Same as (c), but without Ghana ....	<u>51 935 000</u> 1018	52 000
(e) the average ratio related to national sub-professional staff plus those under training is:		
- including Ghana .....	<u>60 311 000</u> 3656	17 000
- without Ghana .....	<u>51 935 000</u> 1287	40 000
(f) the number of additional sub-professional staff required in the next five years is (in countries which provided estimates):		
- without Ghana: .....	<u>46 456 000</u> 2225	21 000
	<u>38 080 000</u> 1025	37 000

Annex 5

2.3 Conclusions

The analysis as presented above reflects the figures received in the questionnaires. It was noted that in some cases figures were missing and in others they did not correspond to what was intended in the questionnaire.

It is, however, possible to arrive at some conclusions as regards the professional and sub-professional staff for which few countries have submitted five years' estimates. Of particular interest are the following:

Professional Staff (29/9)

The additional number of engineers required for the next five years (without Ghana) is 1 for 252 000 of the population.

Sub-professional staff (2.10/6)

The additional number of sub-professional staff for the next five years (without Ghana) is 1 for 37 000 of the population.

Annex 6 indicates the manpower demand estimates for the different countries considering a five-year demand (1972-1976). As already mentioned the population figures are obtained from UN (ECA) estimates and are projected to 1975.

As regards additional staff for the five-year period 1972-1976, the average ratios as described above are as follows:

- (i) additional professional: 1 for 250 000 of the population
- (ii) additional subprofessional: 1 for 40 000 of the population.

For countries which submitted 1970 manpower figures a rough estimate of staff required by end 1976 and the population ratio have been indicated in columns 5 and 6 of Annex 6.

From column 5, Annex 6, the additional total professional staff required based on staff ratios of 1 per 250 000 (professional) and 1 per 40 000 (sub-professional) is as follows:-



Annex 5

	<u>Requirements of additional staff</u>	
	<u>Five years</u>	<u>Average per year</u>
<u>Professional staff:</u>		
(i) French-speaking countries .....	334	67
(ii) English-speaking countries .....	<u>631</u>	<u>126</u>
<u>Total:</u> .....	<u>965</u>	<u>193</u>
<u>Sub-professional staff:</u>		
(i) French-speaking countries .....	1985	397
(ii) English-speaking countries .....	<u>4918</u>	<u>983</u>
<u>Total:</u> .....	<u>6903</u>	<u>1380</u>

The relevant average staff ratios for those countries (population totalling 64 505 000) for which end 1976 staff figures are given are as follows:

Professional staff (including Ghana)	<u>64 505 000</u> 557	= 1 per 116 000
Professional staff (excluding Ghana)	<u>53 892 000</u> 257	= 1 per 210 000
Sub-professional staff (including Ghana & CAR)	<u>56 218 000</u> 5179	= 1 per 13 000
Sub-professional staff (excluding Ghana but including CAR)	<u>55 601 000</u> 2610	= 1 per 21 000

Annex 5

3. SUGGESTED TOPICS TO BE CONSIDERED DURING THE GROUP DISCUSSIONS

3.1 The planning, investigation, design and construction of community water supplies

(Wednesday, 21 April 1971)

1. Possibility of the WHO target being achieved for rural supplies by 1980 based on consideration indicated in the paper. To state revised targets if necessary.
2. Planning for CWS: priorities of the Region - human, material and physical resources - health aspects - planning period. Group water supplies and individual supplies.
3. Use of departmental staff, consultant's services and contracting firms for CWS work. Use of local firms and foreign firms. Tendering and direct labour.
4. Scope and extent of investigations required to develop a rural water supply programme. Crash programmes.
5. Design criteria for African conditions (i) urban; (ii) rural supplies. Points to be considered:  
(i) Water demand; (ii) Standpipes - house connections; (iii) Period of design; (iv) Intakes: distribution system; (v) Materials and equipment (pipes, pumps, etc); (vi) Storage - pressures - power supply; (vii) Intermittent water supply; (viii) Physical, chemical and bacteriological standards; (ix) Standard designs for small water supplies; (x) Building for waterworks; (xi) Standardization.

3.2 Financing of community water supplies in developing countries

(Thursday, 22 April 1971)

1. Sources of funds - community financing - raising funds locally, revolving fund scheme.
2. Influencing Government, politicians, councils, etc., for securing adequate funds with priority for CWS activities.

Annex 5

3. Conditions and criteria that should govern external financing:
  - (a) International; IBRD, IDA, ADB
  - (b) Bilateral.
4. UNDP/SF financing for urban and rural water supply programmes.
5. Financing of Rural Water Supplies. Means to step up funds - subsidies.
6. Depreciation - sinking fund. Interest rates - rate of return.

3.3 The Administration of community water supplies in developing countries

(Friday, 23 April 1971)

1. Sound management - need for water supplies to be self-supporting.
2. Administration: centralized or by local councils. Merits and demerits.
3. Suitable administration for rural and urban supplies:  
Concessions (Regideso) - autonomous - semi-autonomous - integrated  
in public utilities - government control.
4. Responsible Government Ministry - Ministry of Health involvement.
5. Water rates - metering - revenue collection.

3.4 Studies and training

(Friday, 23 April 1971)

1. Health, economic and sociological impact of w/s construction.  
Resettlement of populations.
2. Studies on materials of construction: local manufacture - equipment,  
treatment methods - regional standards.
3. Data collection: hydrology, hydrogeology, demography, topography, water  
consumption, sanitary and medical surveys, etc - sampling and testing  
water supplies.
4. Training for design engineers, water management personnel, hydrologists,  
hydrogeologists, laboratory technicians, waterworks operators, plumbers,  
etc.

Annex 5

5. Crash training programmes - research activities - collaboration among countries in the Region - WHO research centre - adequate salaries for waterworks personnel.
6. Emergency measures (cholera control).

QUESTIONNAIRE FOR THE SEMINAR ON  
COMMUNITY WATER SUPPLY

(Brazzaville, 21-27 April, 1971)

Country:.....

01. WATER SUPPLY FOR THE URBAN AREAS:

1. Name of Town (or community):.....

2. Total Population: .....

Year of Census (or estimation):.....

3. Source of supply:

Surface: ... ..

Groundwater: ... ..

Other: ... ..

4. Treatment:

Complete (sedimentation, flocculation  
filtration and chloration) ... ..

Chlorination ... ..

No treatment ... ..

5. Number or %age of persons served by standpipes: .....

6. Number or %age of persons served by house connections:...

7. Type of management:

Public (Government, Corporation, City, etc.)

Private ... ..

8. Budget for operation:

Year	Currency	For Operation	For Future Investment

9. Cost per cubic meter in 1970:.....

NOTE: For 3, 4 and 7 cross where applicable

QUESTIONNAIRE FOR THE SEMINAR ON  
COMMUNITY WATER SUPPLY

(Brazzaville, 21-27 April 1971)

02. WATER SUPPLY FOR RURAL AREAS:

1. Total rural population served in the country: .....
2. Percentage of total rural population served: .....

Note: Rural areas are communities not included in the Form 1 and supplied for instance by wells, etc.

03. QUALIFIED PERSONNEL

1. Professionals (engineers, etc) responsible for the design, construction, operation and maintenance:

Personnel	Nationals	Foreign	Total
(a) Available ..			
(b) Under trg.			
(c) Number required for the next 5 years			

2. Sub-professionals (auxiliary personnel)

Personnel	Nationals	Foreign	Total
(a) Available			
(b) Under trg.			
(c) Number required for the next 5 years			

Note: Sub-professionals include technicians qualified as water plant operators, mechanics, drillers, pump operators, etc.)

URBAN WATER SUPPLIES - COMPILATION OF DATA FROM QUESTIONNAIRE 1

Country and population (UN Estimates)	Number of communities	Population in these communities (Govt. Ests.)	Average No. of Population per comm.	Sources of supplies			Treatment			Population served in urban communities		Budget in US \$			Price <sub>3</sub> per m <sup>3</sup> (US \$)
				Surface	Ground water	Others	Complete	Chlorination	No treatment	Standpipes %	House connections %	Period	For operation	For future investment	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Cameroon (5 695 000)	19	858 000	45 000	14	3	2	13	2	3	84	16				0.08-0.32
C.A.R. (1 508 000)	1	317 950		1		1	1	1	1	98	2				
Congo (DR) (17 253 000)	5	2 088 981	418 000	4	1		4	1		57	43	1969	3 943 753	938 398	0.08-0.12
Dahomey (2 606 000)	1	150 000			1			1		75	15				0.14
Kenya (10 713 000)	87	606 156	7 000	62	25		44	36	7	41.3	58.7	1969	513 000		0.19
Lesotho (931 000)	9	34 603	3 840	4	6	3	4	3	2	65.5	34.5				
Liberia (1 152 000)	1	137 000		1				1				1969	500 000	550 000	0.22
Madagascar (6 754 000)	31	662 881	21 000	12	18	3	11	20		56	30				0.11-0.14
Mali (5 035 000)	4	322 000	80 000	3	1		1	2	5						0.08-0.13
Mauritius (834 000)				1	1		1	1		10	90	1969/70	(330 000)	(3 240 000)	0.02
Niger (3 774 000)	(3)									80					0.18-0.40
Nigeria (WS) (12 000.000)	28	3 644 755	130 000	23	6		21	4	2	65-100	0-35	1969	1 230 000	35 800 000	0.04-0.12
Rwanda (3 405 000)	2	16 000	8 000	1	1		2						150 000	250 000	0.08-0.09
Togo (1 835 000)	7	245 222	35 000	3	4		1	1	5				282 000	292 000	0.14
Uganda (8 418 000)	21	469 721	22 000												
Upper Volta (5 319 000)	7	280 029 (51 406)	40 000	3	4		1	6		5	13.2	1969	799 000		0.20-0.45
82 618 000	223	9 833 298		132	71	9	104	79	25				7 417 753	37 830 398	

DEGREE OF RURAL WATER SUPPLY

Compilation of data from Questionnaire 2 - Latest UN Estimates for 1970 (medium)

COUNTRY	UN Estimates			% of rural pop served with water (Govt.Est.)	Number of rural population	
	Total pop in million	Urban pop in million	Non-urban pop in million		Served with water	Not served with water
1	2	3	4	5	6	7
Botswana	0.623	0.135	0.488			
Burundi	3.600	0.080	3.520			
Cameroon	5.786	0.425	5.361	20	1.170	4.191
Central African Republic	1.522	0.250	1.272			
Chad	3.706	0.280	3.426			
Democratic Rep. of Congo	17.423	2.230	15.193			
Dahomey	2.686	0.320	2.366	4	0.095	2.271
Equatorial Guinea	0.285	0.095	0.190			
Gabor	0.481	0.055	0.426			
Gambia	0.364	0.035	0.329			
Ghana	9.026	1.575	7.451	11	0.820	6.631
Guinea	3.921	0.420	3.501			
Islands - Réunion, Comoro Seychelles	0.711	0.130	0.581			
Ivory Coast	4.310	0.820	3.490			
Kenya	10.898	0.860	10.038	15	1.500	8.538
Lesotho	1.043	0.025	1.018	10.4	0.105	0.913
Liberia	1.171	0.215	0.956	5	0.050	0.906
Madagascar	6.932	0.730	6.202	3	0.180	6.022
Malawi	4.443	0.183	4.260			
Mali	5.088	0.360	4.728			
Mauritania	1.171	0.020	1.151			
Mauritius	0.861	0.405	0.456			
Niger	3.848	0.165	3.683			
Nigeria	66.174	10.125	56.049	10	5.605	50.444
People's Rep. of Congo	0.936	0.290	0.646			
Rwanda	3.587					
Senegal	3.925	1.070	2.855			
Sierra Leone	2.644	0.350	2.294	10	0.229	2.065
Swaziland	0.421	0.020	0.401			
Togo	1.861	0.195	1.666			
Uganda	8.584	0.465	8.119			
United Rep. of Tanzania	13.236	0.755	12.481			
Upper Volta	5.376	0.225	5.151			
Zambia	4.295	1.035	3.260			
TOTAL	200.938	24 343	173.008		9.754	81.981



DATA FROM QUESTIONNAIRE 2

COUNTRY	Number of engineers responsible for design, construction, operation and maintenance of community water supplies					Number of sub-professional staff				
	Nationals			Foreign		Nationals			Foreign	
	Avail-able	Under training	No. required for next 5 years	Avail-able	No. required for next 5 years	Avail-able	Under training	No. required for next 5 years	Avail-able	No. required for next 5 years
1. C.A.R. (1 508 000)						88				
2. Cameroon (5 695 000)	4	6		4		40	8	130		
3. Dahomey (2 606 000)	5					12				
4. Ghana (8 376 000)	175	40	85	4		2279	90	1200		
5. Upper Volta (5 319 000)	2	7	12	2		7	3	15	1	
6. Kenya (10 713 000)	8		50	19		330	40	570		
7. Lesotho (931 000)	3	1	3			14	1	30		
8. Liberia (1 152 000)	4	3	14		1	20	4			
9. Madagascar (6 754 000)	6	3		3		19	12			
10. Mauritius (834 000)	6		3			400	200	200		
11. Nigeria (WS) (12 000 000)	37	2	27			60		25		
12. Sierra Leone (2 588 000)	10	1	24			24	1	35		
13. Togo (1 835 000)	3					4				
TOTAL (60 311 000)	263	63	218	32	1	3297	359	2225	1	

ESTIMATE OF STAFF DEMAND 1972-1976

Analysis of data compiled from questionnaire 2

	Five year period 1972-76			Additional staff		Total staff avail-		Staff ratio	
	Number of popula- tion en 1973 in millions	National staff available in 1970 including under training		Demand Estimate for 5-yr period 1972-76		able end 1976		end 1976	
		Profes- sional	Sub-pro- fession- nal	Profes- sional	Sub-pro- fession- nal	Profes- sional	Sub-pro- fession- nal	Profes- sional 1 per	Sub-pro- fession- nal 1 per
1	2	3	4	5	6	7	8	9	10
Botswana	0.700			3	17				
Burundi	4.070			16	100				
Cameroon	6.484	10	48	26	(130)	36	178	180 000	36 000
CAR	1.713		88	7	43		131		13.000
Chad	4.194			17	105				
Congo (DR)	19.712			79	490				
Dahomey	3.077	5	12	12	77	17	89	180 000	35 000
Eq. Guinea	0.308			2	8				
Gabon	0.505			2	13				
Gambia	0.405			2	10				
Ghana	10.617	215	2 369	(85)	(1 200)	300	2 569	35 000	4 100
Guinea	4.418			18	110				
Ivory Coast	4.803			19	120				
Kenya	12.789	8	370	(50)	(570)	58	940	220 000	13 000
Lesotho	1.150	4	15	(3)	(30)	7	45	160 000	25 000
Liberia	1.298	7	24	(14)	32	21	56	62 000	23 000
Madagascar	7.993	9	31	32	200	41	231	195 000	40 000
Malawi	5.068			20	127				
Mali	5.764			23	144				
Mauritania	1.321			5	33				
Mauritius	0.976	6	600	(3)	(200)	9	800	110 000	1 200
Niger	4.486			18	112				
Nigeria	75.597			300	1 900				
Congo (PR)	1.055			4	26				
Rwanda	4.166			17	104				
Senegal	4.452			18	112				
Sierra Leone	2.982	11	25	(24)	(35)	35	60	85 000	50 000
Swaziland	0.490			2	12				
Togo	2.131	3	4	9	51	12	55	180 000	39 000
Uganda	9.833			39	250				
Tanzania	15.150			61	380				
Upper Volta	6.008	9	10	12	(15)	21	25	290 000	240 000
Zambia	5.018			20	125				
Islands - Reunion Comoros Seychelles	0.896			3	22				
TOTAL(Average)	229.711	287	3 596	965	6 903	557	5 179		
Total:									
Anglophones	143 227			631	4 918				
Francophones	86 434			334	1 985				

Note: Figures estimated on the demand ratio for additional staff: Professional 1:250 000, Sub-professional 1:40 000, ( ) estimated by the countries.

PLANNING; INVESTIGATION; DESIGN AND CONSTRUCTION  
OF COMMUNITY WATER SUPPLIES

Group A

1. WHO TARGET REGARDING COMMUNITY WATER SUPPLIES

The WHO targets regarding Community Water Supplies can be achieved provided the percentages are weighted heavily by African conditions.

Problems in achieving the targets are:

- 5
- financial
  - manpower
  - nature of African settlements
  - difficulty in bringing water to all houses in urban areas
- 10 (mud buildings in a centre of a modern city).

Participants should impress on the respective governments the need to bear the target stipulated by WHO in mind and make appropriate allocations for the fulfilment of these objectives.

2. THE PLANNING IN THE FIELD OF COMMUNITY WATER SUPPLIES

15 The planning of CWS should take into consideration the following:

- the financial resources available
  - human requirements
  - health aspects
  - economical (agricultural, industrial) aspects
  - the rate of return and financial viability
- 20 - nature of rural settlement.

The planning should be a continuous process and related to the national plan and its implementation.

25 The concept of regional planning as applied to the entire country and individual supplies as applied to large cities was accepted.

.../...

Annex 6

3. USE OF DEPARTMENTAL STAFF, CONSULTANTS, ETC.

The use of departmental staff, consultant services and constructing firms for community water supply works should be left to the individual governments concerned but emphasis will be laid on the use of local (national) consultants and contractors. The training of local staff by foreign firms employed by governments should form part of any contract agreement.

Package deals should be fully condemned.

4. SCOPE AND EXTENT OF INVESTIGATION REQUIRED TO DEVELOP A RURAL WATER SUPPLY

The nature of community water supplies, especially in rural areas in the African Region, does not justify elaborate and time-consuming and expensive investigations bearing in mind the fact that the supplies themselves would have to be as simple as possible.

Every rural programme should be treated as much as possible as a crash programme in order to achieve the WHO target.

Crash programmes would be especially suitable where it is intended to abate or control the incidence of epidemics as cholera, typhoid.

During any crash programme, it is essential to collect data and information which may facilitate future programmes and which may substitute long-term investigations.

5. DESIGN CRITERIA FOR AFRICAN CONDITIONS - WATER DEMAND

On the discussions on the design period for the various components of a scheme, views were expressed about whether the entire scheme should be designed for a definite period or different parts of the scheme should have different design periods.

Group B

## 1. OBJECTIVES

In our countries, it is difficult to distinguish between the rural and urban areas since, apart from a few large population centres, our towns are more like rural communities and, in this perspective, the study of water supply should cover all areas both rural and urban. As most of the participants in the meeting are responsible for the two types of areas concerned, the WHO objective of 40% coverage of the population in urban areas and 10-20% coverage in rural areas should continue to be the ultimate objective; but account must be taken of the special features of each country. It is important to think only in terms of "supplying piped water"; nevertheless any water supply should bring progress in relation to the traditional methods. The problem is still that of providing safe water. The economic impact of any water supply should not be disregarded. The WHO objective is still valid; but account must be taken of the possibilities of the countries concerned.

## 2. PLANNING AND PRIORITIES OF THE REGION

Account must be taken of the "economic resources" to ensure integration of the problems within the overall health context. Planning should take into account the specific features of the regions concerned. It is important not to develop one area at the expense of another. In each country, basic planning is necessary, to ensure that one group is not favoured in relation to another.

Account must be taken of the overall plan for economic integration in the country. Sanitary development should be integrated with the other preoccupations.

Sanitary aspects

The sanitary norms recommended by WHO should be applied in the urban areas; but in the rural areas the norms should be eased, giving priority to bacteriological aspect. Attention must be given to the conditions

Annex 6

of life of the people, and emphasis should be placed on health education of populations in order to maintain safe water supplies. It is particularly important to safeguard the bacteriological quality of the water and to strengthen health education. In discussing planning it is essential to know the resources and needs: agriculture, manpower, etc., aspects which concern health. The WHO norms for the chemical and physical quality of water should be defined, but applied only in accordance with the possibilities of the countries. Sanitary engineers and officials responsible for water supplies should ensure progressive application of the norms.

Planning period: 10 years, taking into consideration the programmes for the economic development of the country. The long-term planning could cover a period of 30 years. This provision does not exclude taking into consideration the immediate programme, conditioned to the needs as follows:

- master plan for 30 years: long-term objectives;
- planning for 10 years: short-term objectives,

to be carried in phases according to the possibilities of the country.

Emphasis should be placed on community water supplies rather than on individual schemes, and on a collective approach which provides an economic solution - many communities may benefit from a simple investment to give due consideration to an efficient scheme. The grouping of supplies makes it possible to consider the viability of the schemes and their implementation an efficient health education programme.

### 3. USE OF STAFF OF THE MINISTRIES, AND GOVERNMENT AND PRIVATE BODIES CONCERNED WITH WATER SUPPLY

The group strongly recommends to ensure greater efficiency, that collaboration be established at the same level between medical officers and sanitary engineers. The latter are requested to advise on all public health problems (water supply, sanitation, etc.). The recommendations of consultants of countries outside the Region are frequently not applicable directly. As it is often difficult to act on some of the recommendations of such consultants, WHO should give increasing

Annex 6

assistance to nationals, to enable them to implement methods developed in the African Region and suitable for application in the other countries.

Before requesting an external consultancy, the skills and experience of the nationals should be studied. Priority should be given to using local skills before calling on external consultants. However, if a study is entrusted to a foreign consultant he should work in close collaboration with the national counterpart.

When a problem is faced in a country of the African Region, it is desirable, when a qualified specialist is not available in the country, to call on a technician from another country of the African Region. The group recommends that the assistance agencies (WHO, EDF, "FAC", ECA, etc.), maintain records of the different specialists available in the Member countries.

Inventories should be made of all the human resources of the other ministries to permit the implementation of a sound programme, in collaboration with the sanitary engineer.

It is also important to ensure collaboration among all the technical staff concerned with water supply problems. It is essential that a single authority be responsible for co-ordination of all the water supply and sewerage programmes. The group recommends the establishment, in each country, of a "national water supply committee".

The present large number of services is prejudicial to performance and is sometimes detrimental when co-ordination is lacking.

The ministries concerned with water supply problems should obtain the views of a sanitary engineer or any other sanitary technician in regard to all the projects to be carried out.

The integration required at the local level should also be ensured at the level of the international organizations, under the auspices of WHO in regard to sanitation.

Annex 6Water demand

The average requirement of water is 50 litres/person/day in rural areas and 100 litres in urban areas. Standpipes may be regarded as a first stage solution; but the trend should be towards a system of house connections. Account should be taken of the density of population in regard to the siting of standpipes. Regular hours for use of the standpipes should be envisaged and, if possible, valves should be fitted. Peripheral standpipes in areas with house connections should be removed. It is recommended that a standpipe serve an average of 500 population.

Design period

The plans should be drawn up as soon as possible, and any way within three years to avoid the need to update the projects. The most unfavourable period should be taken into consideration. The distribution system should be as safe as possible: house connections should be regarded as a long-term solution. To meet the immediate needs, groundwater should be used whenever possible. If surface water is used, it should be suitably treated.

Supplies and equipment

PVC piping, which meets the technical specifications, should be used; it is of low cost and may be laid without qualified technical staff. Rugged pumps, requiring a minimum of maintenance and, if possible, manufactured locally or in the Region, should be used. It is important not to use several different types of pump (a maximum of two or three). After-sales services should be ensured.

Storage

This problem should be studied locally, taking into account the quality of the water, and the civil engineering staff available. It is essential that water be available to the population at all times. The minimum pressure in the taps should be 0.3 kg, and the average 0.5 kg. The power supply will vary according to the community concerned. The water supply should be as



Annex 6

steady as possible. The bacteriological norms should be the main preoccupation at present; physical and chemical factors will be studied later, at least in rural areas. Standard plans are appropriate for small-scale systems, but the engineer should endeavour to study any type of system, if required. Standard plans should be prepared for waterworks. Account must be taken of the topography and specific problems of each community. The building should allow for subsequent extension and be in conformity with the overall plan. For the purpose of standardization, account must be taken of the specific problems of the locality and the various components. As far as possible, the establishment of monopolies should be avoided.

Wastes disposal should be studied at the same time as the problem of water supply. The group recommends that WHO organize a regional seminar on environmental sanitation, in view of the importance of the matter and its implication for water supply.

Annex 6

Group C

It was decided to answer the question directly. This, however, commenced with descriptions of the various methods already in use in the various countries represented by the participants.

Question 1

The WHO target was felt to be rather too high at this stage and could not be realized. There were smaller schemes in operation but as these appeared not to have been planned on the magnitude and long-term target similar to those of WHO, the participants were wary.

Question 2

The long-term planning was not favoured. In fact smaller planning already exists in a number of the countries of the participants. It was explained that this small-scale planning was guided by the availability of funds and as these funds were in some cases overseas aids or grants, planning based on such finance was difficult. Emphasis was placed on the need for the improvement of the already existing but ill-constructed community water sources, e.g. wells.

The availability of human resources for the undertaking of community water projects was dependent on the availability of trained personnel but this seemed to vary from country to country. The employment of consultants was helpful in that work could be expeditiously carried out.

As regards group and individual supplies, it was felt that group supplies were ideal. In the areas where the settlement was rather sparse, individual supplies should not be overlooked.

There appeared clearly during the participation the fact that no such schemes could be effectively implemented unless:

- (a) preliminary investigation into the water resources of the country was carried out and the problems clearly identified;

(b) guaranteed financial resources were available;

(c) planning was then carried out.

#### Question 3

In answer to question 3, it was decided that whilst every effort should be made to employ indigenous staff and indigenous contractors and consultants, under certain circumstances this was not always possible. It might be that there is a lack of suitably trained professional manpower available or that the funding agency, such as the World Bank, might insist on the use of their own consultants and contractors or certain specified foreign firms who had expertise relevant to the work in hand.

Wherever expatriate firms had to be employed however, it should be a part of the formal contract, that these firms should follow a formal and specified programme for the training of indigenous professional and technical manpower whenever this was available.

The various ministries and water undertakings should use their own staff wherever these are available for the design of new projects.

#### Question 4

The essential prerequisite is a programme of investigation in the field to determine the nature, the amount and the reliability of the various sources of water. At the same time social and demographic studies are needed to determine population densities and requirements.

Existing water supplies must be tested for available quantities and for purity. Possible extensions to existing supplies must be determined. The types, reliability and cost of various types of equipment must be determined and finally the economics of each type of supply must be examined.

It was emphasized that wherever and whenever possible the emphasis should be on the supply of relatively sterile potable water and this implies that methods of treatment must be considered. A crash programme may be required and some water standards may be lowered somewhat but not to the extent that the supply becomes a definite health hazard.

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Question 5

Because of time limit, only the following points were discussed:

- (i) The minimum water demand for rural areas, to maintain health and life, was set at 15 litres per capita per day.
- (ii) It was established that both standpipes and house connections will be necessary for some time to come although house connections are to be preferred. These, however, cost much more than most people can afford. To eliminate some of the health hazards that accrue from the use of standpipes it was recommended that an agent should be used to distribute the water.
- (iii) Intermittent water supplies are not to be condemned although there is the problem that people will store the water when it is available - often in contaminated containers. Intermittent supplies certainly cut down the wastage of water.
- (iv) Whilst some physical contamination can be tolerated it is essential that all supplies should be potable and relatively sterile, i.e. free from bacteria. The threat of chemical contamination should be borne in mind.
- (v) Standardization is worthwhile on a limited scale as it greatly improves efficiency and cuts costs. Sometimes however it is not possible to standardize as donors may specify the type of equipment.

FINANCING PUBLIC WATER SUPPLY SYSTEMS  
IN DEVELOPING COUNTRIES

Group A

Question 1

Sources of funds

It was considered that in general multilateral external finance should be restricted to urban supplies due to the level of sophistication in management required by donors, and that in general a central water authority would be essential to provide the independence of financial management demanded by donors.

Bilateral finance normally is subject to less control and is thus suitable for rural water supplies, and is particularly suited to government-managed supplies or to local authority supplies subsidized by government.

Revolving funds, fund-raising from communities, local bond issued, etc. are most suited to local authority, and to some extent central water authority supplies.

Where supplies are owned by government, the difficulty is in ensuring that water supplies are given adequate priority in the budget, and this may well be due to lack of consideration being given to all of the relevant factors within government when preparing development plans.

If there is a central water authority it must have borrowing powers to be able to obtain government guaranteed loans, and be able to float bond issues. Unfortunately a central water authority is rarely autonomous and is controlled to a degree by the government. Only greater freedom from government control can solve this problem, and where tariffs are restricted by government control, only subsidization by government to recompensate for this can ensure that the central water authority will be able to operate efficiently.

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Where water supplies are run by local authorities it is an almost universal experience in Africa that the job is badly done as the local authority seldom has the staff and finance needed. If, however, the local authority must do this job, then all means should be used to support it and enable it to do its job. The local authority has the advantage of being in close touch with the consumers, it has access to self-help, and it should be able to force government to appreciate its need for help and subsidy including subsidies from the health budget on socio-hygenic grounds. Water supply systems in such cases should be as simple as possible.

Question 2Influencing government, politicians, councils, etc.

There was general and immediate agreement that the best way to influence people from lowly consumers to heads of state is through intelligent publicity. There was a considerable body of opinion that water supply staff, particularly at management and professional level, should be involved in this, as their views will be given more weight than those of politicians or non-technical publicists.

It was also felt that international agencies, particularly WHO, should help by improving the real needs and priorities in favour of water supply projects.

Question 3Conditions and criteria(a) International

The various types of loans were considered, and the general opinion was that they were too expensive to be supported by viable water supply systems - with the exception that large urban schemes, particularly where these have a major industrial consumption content, may be capable of supporting this type of finance.

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It was noted that IDA and IBRD conditions differed to the extent that IDA loans through the government to a water authority normally left a "profit" available to the government for development financing. The object should be to ensure that this "profit" from a water supply loan should go to further water development.

IDA loans were considered to be the best type of international finance discussed, but in all cases it was considered that the lending agencies should take a more sympathetic approach to viability criteria.

(b) Bilateral

Bilateral loans usually have strings attached, but on the other hand there may be a political bargaining position involved. Opinion was that they should be most carefully studied and that they can be very good or very bad.

Question 4

UNDP/SF

There was general agreement that UNDP/SF finance is to be encouraged, and it was noted that one of the benefits invariably attached to such projects is the inclusion of provision for counterpart training and scholarships for local staff.

On the other hand there is a tendency for there to be protracted delays in getting a project started due to the requirements for often a number of pre-investment feasibility studies, and the United Nations "Experts", even if individually competent, may not work well in a team and are of necessity, unproductive for a period whilst obtaining local knowledge and the working ability with the language needed for the success of their assignment.

Question 5

Financing of rural water supplies

The general concensus of opinion was that rural water supplies could not be operated as commercially viable water undertakings due to the low

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per capita income of consumers, and that some form of subsidy is essential if these supplies are to be operated efficiently. The most suitable form of subsidy is a capital grant for expansion, and if necessary, also for renewal of assets, and it was felt that governments could justifiably use, for this purpose, any excess profits from national organizations such as national security, crop stabilization or power generation funds.

As the need for subsidy would vary from case to case depending on individual circumstances it was also considered that WHO should compile and publish data relating to the ability of low income consumers to pay for water and to the savings in health programmes and other allied government activities due to the introduction of a potable water supply to a community.

Question 6Depreciation, etc.

It was considered that this subject was intended to apply to urban supplies operating as commercially viable entities, and that the question posed is basically "should the assets be renewed and extended by means of sinking funds or not?"

The main argument against the use of sinking funds is that the "consumer of today" is paying for the assets which will benefit the "consumer of tomorrow", and it was generally considered that both expansion and renewal of assets (bearing in mind that these often occur simultaneously) should preferably be financed by loans as and when needed.

There was no objection to the use of national depreciation as an accounting tool to calculate the rate of return.



Group B

1. SOURCES OF FUNDS

The group distinguished the different sources of financing and divided them into two main categories:

A. Financing from the country's own funds

- (i) government financing, which may take the form of a subsidy or a loan;
- (ii) financing by communities, in the form of subscriptions and human investment;
- (iii) pre-financing by an undertaking - a means to be avoided if possible, in view of the very high cost of this source of financing.

B. Financing from external sources (loans or subsidies)

The group placed particular emphasis on the necessity of ensuring that the people who benefit from the facilities should help defray their cost, whether by financial support or otherwise.

This participation is necessary from a psychological point of view: in this way all the users will feel involved and will take more care in maintaining the facilities.

2. HOW TO INFLUENCE GOVERNMENT IN ORDER TO OBTAIN THE NECESSARY FUNDS

Since water is an important element in the field of public health and thus has an influence on economic and social development, it is the duty of governments to make it available to everybody in the best possible conditions.

Water supply programmes should not be established according to criteria of a political nature, if funds are to be found and put to the best possible use.

The group stressed that lack of water has a restrictive effect on a country's development.

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3. CONDITIONS AND CRITERIA WHICH SHOULD GOVERN EXTERNAL FINANCING

(a) International sources: IBRD, IDA, ADB

Water supply systems (research and installation) required large sums of money which are beyond the means of States. The latter must therefore seek external financing.

At the present time financing conditions are onerous and insufficient account is taken of the state of development of the countries in the Region. Profitability criteria should be modified and made more flexible. The fundamental profitability justifying these projects is improvement in the health of the people, which necessarily leads to improvement in socio-economic conditions.

Furthermore, water supply has social implications which call for easy conditions of financing.

Some of the international financing bodies offer more favourable conditions. The other bodies should also adopt these arrangements.

(b) Bilateral

The bilateral assistance agencies should take into account:

- national development plans;
- water supply and sewerage projects (they should not disperse their financing);
- the qualifications of the national staff running the systems;
- the training to be given to the staff as necessary.

The group emphasized that bilateral assistance agencies should take into account the priorities defined in the national plan and should not impose their own views.

The attention of those providing funds should be drawn to the importance of small-scale, unspectacular measures which nevertheless have a considerable impact on health and the economy.

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## 4. UNDP/SF FINANCING

The group expressed its appreciation of the assistance given by the Special Fund component of UNDP to the countries of the Region.

It was hoped that:

- the assistance would be extended beyond the sphere of studies to include practical undertakings;
- the assistance would also cover small communities (mini-projects);
- UNDP would give attention to studies concerning the country as a whole;
- in its assistance, UNDP would take into consideration the competence of the countries in selecting contractors and consultants.

## 5. FINANCING OF WATER SUPPLIES IN RURAL AREAS

The group recognized that, in view of the limited purchasing power of the population in rural areas, the government should:

- finance the engineering studies;
- give technical and financial assistance in installing and maintaining the facilities.

The group stressed that total subsidies should not be given and that in any case participation of the community benefiting from the installations should be required in the form of money or human investment.

A number of views were expressed as to the means of raising funds (lotteries, insurance).

## 6. DEPRECIATION

Provision for depreciation may or may not be necessary, depending on the scale of the services using the water supply facilities.

Low rates of interest must be sought for the investments. The group felt that the return of 8% required by some financing bodies is too high. A longer period should be allowed for repayment of capital.

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Group C

Question 1

It was generally agreed that sources of funds had to be established for the implementation of the Community Water Supplies. Urban areas were in a more favourable position in that, larger schemes could be implemented and there was a certain amount of guarantee that could be expected in the form of rates payable by consumers and this would enable urban areas to raise loans.

The question of Community Water Supply in rural areas could not be dealt with without having to be realistic about the economic, well being or otherwise of the rural populace. Generally, the economic standard of the rural community would not warrant the raising of loans by such communities. It was however, felt that it would not be in the interest of the rural community in the long run to give them grants by Government without any contributions coming from the community to meet such grants. Suggestions made as reasonable contributions by the rural communities were those in the form of labour, housing for technical assistance staff and possibly cement. It was felt that this contribution by the community would enhance the value of the scheme in the eyes of the community concerned.

The idea of loans for rural communities was also considered and no hard and fast rule on this was laid down. Communities that were economically on a sound footing could proceed to raise loans. Subsidies were not considered a viable proposition.

The contractor financing a community project and also undertaking the actual construction was not favoured. Where possible it was considered better for the community to raise a loan directly from the bank and avoid the "middle man". There were, however, exceptional emergency cases in which case communities could not but resort to contractor financing and carrying out the construction work.

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It was recommended that governments should be persuaded to establish Revolving Loans and an Authority be established to run such Community Water Schemes with finance from such revolving loans. Communities (rural) could contribute up to 20 per cent.

While lotteries were considered a source of fund raising, the implementation of State lotteries was not to be encouraged and in any event the responsibility of finding the finance for Rural Community Water Supplies was the responsibility of governments.

Question 2

To stimulate governments to give priority to rural water supplies, it was decided that the consciousness of the public to the need of a safe/potable water supply, there was great need for mass health education and it would then be incumbent on the rural communities to make representations to their respective constituency/region government representative to provide the required finance through central government.

A very important consideration was to make provision in all national development plans to incorporate provision for water supplies especially in rural areas where there has been a lamentable neglect in the past. This National Development Plan involves all government ministries.

Question 3

In general the Group considered that they would prefer to do without external financing if this could be managed. However, it is usually the case on large schemes that the capital required is not available internally, and external agencies have to be approached. This can lead to considerable difficulties unless the recipient is extremely careful to quantify the terms and conditions laid down by the donor.

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IBRD loans are considered to be exceptionally stringent as far as terms are concerned but they do have the advantage that the Bank is so careful in guarding its interests that there is little likelihood of the recipient engaging in an unfavourable investment. The great disadvantage is that often the Bank insists on using its own experts who assess the scheme without resort to the opinions of the internal technical experts and further, the Bank's consultants may not be familiar with the country, conditions and politics which could have a considerable bearing on the problem.

It was stated that IDA often offered softer terms. Bilateral aid is suspect as the donor is always concerned with furthering his own interests which might not be those of the recipient.

In general therefore it was thought that there was a great need to draw up a series of conditions and terms which have to be agreed to before external aid can be accepted. Finally it was also suggested that an arrangement should be attempted where the recipients of such aid should endeavour to present to the donors their views and their conditions. In this respect, the services of the UN and its agencies might be employed as neutral advisers and observers.

Question 4

It was emphasized that UNDP Special Funds were for pre-investment studies only and not for the implementation of such projects. The procedures to be adopted were carefully outlined and it was especially noted that the government of the recipient country had to contribute in cash and kind i.e. buildings, services, professional personnel, etc. As a result of this, a master plan would be prepared but this was the limit of the support from this area. As a result of a question, it was also indicated that as there was a growing awareness of rural problems, submissions concerning rural areas were to get more attention.

Question 5

This had been considered in some detail in response to an omnibus edition of Question 1. In general, it was agreed that the financing of rural schemes must be, initially, the province of Government which must provide the expertise, the know-how, the investigation, the equipment and, perhaps, tools and materials. It was very definitely stated however that except in the most desperate cases, all rural communities should be expected to contribute considerably to the labour demands of the project and as much more as could be expected. They would also have to be largely concerned with the maintenance of the supply.

It was suggested that revolving loans and state lotteries should be considered as means of augmenting direct government expenditure.

Question 6

The answers to this question depend so much on the attitude of government to the supply of water to communities and on the state of development of the country concerned. If the supply of water is regarded as a social service, then this question, by and large, does not apply although it was stressed that this could lead to intermittent supplies if funds were withdrawn or held up.

It was generally recommended that rural supplies should be regarded for some time to come as, mainly, a social service although, wherever possible the community should contribute to the construction, to the running and to the maintenance of a supply. This implies the levying of some form of water rate as payment but the level depends upon the degree to which the supply is regarded as a social asset.

Urban supplies, in general, should be, at the very least, self-maintaining. This implies that all the maintenance, depreciation, operation, supervisory, replacement and distribution costs must be borne by the water undertaking.

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Elsewhere the need for the establishment of water undertakings organized at national or state level has been emphasized. This implies that the water board must make a careful assessment of all of these items and the cost of the water supplied and the consumers must pay this semi-economic rate.

If the construction of the water supply plant has been financed by some form of loan, then this must also be allowed for, both the capital and interest repayment. It was not possible to specify rates of interest or return in view of these divergencies but two final points were made:

- the ultimate aim of any water undertaking should be that the consumer pays a fair and economic price for his water that will ensure not only the present operation but also future supplies;
- even if the provision of water is regarded as a social service, it still has to be paid for by the people through indirect levies of one kind or another.



THE ADMINISTRATION OF COMMUNITY WATER  
SUPPLIES IN DEVELOPING COUNTRIES

Group A

1. SOUND MANAGEMENT - NEED FOR WATER SUPPLIES TO BE SELF-SUPPORTING

The members felt that the aim of any administration is sound management, which implies that the management of any water supply undertaking should be self-supporting. In the present state of development in the African Region, the primary aim is to supply potable water to a majority of the people. This cannot be achieved from rates and funds collected from the consumers and that for sometime to come, the administration of many water supply undertakings would have to be subsidized. The main objective is that the water supply undertaking should aim at viability i.e. the revenue derived from the sale of water should be sufficient to pay for the capital costs as well as the running costs with a little profit for expansion and improvements.

While supporting the concept that water supply undertakings should be self-supporting, it was felt that in some rural areas, due to the distribution of population, the relative high cost of construction, equipment, water distribution and plant operation, it would be difficult if not impossible to construct self-supporting schemes for such areas.

Based on the concept in paragraph 2 above, it is an established fact that people pay directly or indirectly for the water they consume and therefore as long as the water supply undertaking is functioning properly, it is assumed that it is also being subsidized directly or indirectly.

2. ADMINISTRATION: CENTRALIZED OR LOCAL COUNCILS' MERITS AND DEMERITS

On the whole the group agreed that the administration of a water supply undertaking is best performed by a central water authority.

(a) Merits: Some of these are:

(i) the pooling of professional staff which can be used centrally;

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- (ii) bulk purchase of stores;
  - (iii) operation of standard charges.
  - (iv) it is easier to recruit competent personnel
- (b) Difficulties: have been identified as follows:
- (i) resistance to change in the patterns of administration by civil servants;
  - (ii) resistance of local councils to the take-over of the water supply undertakings;
  - (iii) liabilities likely to fall on the Central Water Authority by taking over poorly managed water undertakings.
- (c) Solutions: From the above it was agreed that before a Central Water Authority is established, member-states should have a comprehensive plan which will take care of the above-mentioned difficulties.

After discussing local participation in the administration of water supply undertakings, the Group came to the conclusion that at every stage, there should be local participation.

### 3. SUITABLE ADMINISTRATION FOR RURAL AND URBAN WATER SUPPLIES

It was agreed that a semi-autonomous organization is the best. It was felt that the ultimate aim by member countries should be the integration of the administration and management of water and sewerage undertakings, particularly in urban areas.

Where the central organization of water supply is country-wide, the merger of the administration of water and sewerage is bound to cause difficulties.

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4. RESPONSIBLE GOVERNMENT MINISTRY - MINISTRY OF HEALTH INVOLVEMENT

It is the consensus that the ministry which houses a majority of professional technical staff knowledgeable in the implementation of water supply schemes should be the supervising ministry. The ministry of health should primarily be concerned with the control of water quality standards and health education.

5. WATER RATES, MEETING, REVENUE COLLECTION

The group discussed this subject at length and agreed that the employed method for charging for water should be dictated by the prevailing circumstance of each water undertaking and local conditions. Each method of charging for water has merits and demerits. Finally the group considered that this was highly controversial although an important topic which could be the subject of another seminar.

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Group B

Question 1

Water resources are a national asset. The government should inventory them, plan their use and prevent pollution of them. It should set up administrative machinery suitably adapted to the various uses made of the supplies. This presupposes uninterrupted and trouble-free distribution.

Question 2

The advantages and disadvantages of entrusting the administration to a central body are as follows:

Advantages

- Better service is provided as competent staff, under better supervision, are available.
- Maintenance is facilitated through improved supply of spare parts and treatment substances.
- Co-ordination is better.
- The service is more effectively represented.
- Greater liberty of action is possible (in relation to political pressure).

Disadvantages

- The administration is more cumbersome.
- The costs are higher.

The advantages and disadvantages of entrusting the administration to a local authority are as follows:

Advantages

- The administration functions more rapidly.
- The local authority is made aware of its role, in exercising the responsibility of administering the system.

Disadvantages

- Competent staff are difficult to recruit.
- Maintenance is difficult.
- Inappropriate use is made of funds for operations unrelated to water supply.
- Favouritism is shown to persons with political or other influence in the water distribution and the recruitment of staff.
- Difficulty is encountered in ensuring rapid payment for water by users.
- Operating costs are high in some localities.
- Integration of the facilities within the framework of regional planning is difficult.

Question 3

In an urban area: autonomous administration. In a rural area: semi-autonomous administration, in view of the role the government must play in providing investment funds or subsidies for these areas.

In any case, whatever the form of administration, the government must have the right of inspection.

Question 4

In view of the various techniques involved in water supply, it is difficult for a single ministry to exercise responsibility for all water supply projects. The group proposed that an inter-ministerial body be established in each country to assume sole responsibility, henceforth, for all projects concerned with water supply. This body should collaborate with the ministry of health. For greater efficiency, the committee should be directly attached to the office of the president.

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Question 5

Water should always be priced at its actual cost. Rural communities, however, should receive a government subsidy in the form of a preferential rate.

All house connections should be metered.

Each country should develop a suitable formular for collection of water revenue in rural areas.

Group C

Question 1

In view of the rivalries, conflicts of interest and lack of collaboration which result from the existence of several departments dealing with water supply, the group advocated the establishment of a single body comprising:

- a design department
- an executive department
- an inspection service provided by a public corporation

The body should be self-sufficient.

Question 2

The group recommended that the body be a central one (at the national or federal state level).

Advantages

It is possible to plan:

- design
- professional training
- supplies, and
- economies of means

Disadvantages

- cumbersome administration
- one sector may be given preference over another (urban areas may be given preference over rural areas or vice versa).

Question 3

On the question of management of the system two possibilities were considered:

- (i) a single, semi-autonomous administration, i.e. subject to government control in financial matters only;
- (ii) a totally independent management.

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Advantages

The first solution safeguards the social aspects of water distribution.

The second avoids political pressures and ensures dynamic and uninterrupted operation.

Disadvantages

The first leads to a cumbersome administration and is liable to be affected by political change.

In the case of the second solution, economic considerations take precedence over social aspects.

Question 4

Government contact is considered essential. Which Ministry should be responsible?

Several ministries were suggested to take control of the administration of community water supplies. Of those suggested were the Hydraulic, Health and Economic Development. In view of the fact that there were technical involvements in the execution of such schemes, the Group agreed that the Ministry of Works should be the responsible authority with the proviso that the Ministry of Health should be kept in the picture to safeguard the health of the community.

Question 5

Should there be a uniform rate or should there be variation?

It was agreed that there should be variation in the water rates in urban and rural areas. Two recommended rates for adoption in urban areas guided by the type of usage were: proportionate rate for domestic purposes and degressive for industrial utilization. It was agreed that as far as rural areas were concerned a flat rate was ideal. Metering of water in rural areas could be done but this would be purely for statistical purposes.

The collection of revenue was the responsibility of the agency operating the project and this could either be a Corporation or Council to whom powers were delegated by the Central Authority.



## STUDIES AND TRAINING

### Group A

#### 1. HEALTH, ECONOMIC AND SOCIOLOGICAL IMPACT OF WATER SUPPLY CONSTRUCTION - RESETTLEMENT OF POPULATIONS

The Group discussed this question and the general opinion was that quite often, the health and social aspects of water and sewerage systems are not given due consideration during the studies. This is particularly the case where the study is being made as a pre-investment exercise in which case economic viability of the project tend to be paramount.

It is felt that such studies should be carried out both before and after the implementation of the project. This would facilitate the collection of data which would be beneficial not only to that particular country, but can be used in exchange of data and ideas within the region.

The main difficulties in such studies are:

- lack of statistical data to guide the study;
- lack of trained personnel from the country to undertake such studies;
- lack of funds to finance such studies;
- dealing with the population which may have to be moved and resettled elsewhere, thereby destroying their traditional way of life and social institutions and also their occupation.

However, these difficulties are almost universal in the African Region and ways must be found to overcome them. In this connection, any meagre data which may have become available during a crash programme can be used, but with caution. The group suggest the use of consultants where local qualified staff is not available but this must be tied up with training programmes for indigenous staff, and public education to prepare people for any necessary resettlement because of a real need. Resettled people should be helped to acquire new occupation where necessary.

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## 2. STUDIES ON CONSTRUCTION MATERIALS: LOCAL MANUFACTURE (EQUIPMENT, TREATMENT METHODS) AND REGIONAL STANDARDS

With the growing development programmes in the Region, it is also becoming increasingly important to keep down the level of foreign exchange which is so badly needed in all sectors in the economies of Member countries.

For this reason, the group felt that it should be the aim of every water supply undertaking and other related government organizations to invest in the study and research of local construction materials. It was noted that in some countries, this is already being done for some civil engineering materials, even to the extent of setting up a local materials and testing laboratory. The problems of water supply materials, however, have not met with similar degree of research, although some countries are now experimenting with PVC pipes with varying degree of success. This is due to the fact that quite often these pipes are put into the market before adequate research and tests are carried out.

Other equipments for water supply work come mainly from other regions. In this connexion, apart from the disadvantage of being expensive, they are usually not tested with the type of water in certain localities in the Region. In one case, a borehole was fitted with electric submersible pump which kept breaking down, and it was only after the third pump was lost that it was realized that the water was corrosive to certain metals forming part of the pump.

These problems can only be dealt with adequately by the setting up of regional centre for data collection and research.

The type of treatment works should conform to the level of operational staff available and to avoid lowering of standards careful study and research should be directed towards the adoption of treatment works made of local materials.

## 3. DATA COLLECTION: HYDROLOGY, HYDROGEOLOGY, DEMOGRAPHY, TOPOGRAPHY, WATER CONSUMPTION, SANITARY AND MEDICAL SURVEYS, ETC. - SAMPLING AND TESTING WATER SUPPLIES

The group discussed the question of data collection in detail. It was felt that this cannot be the responsibility of the water authority alone.

In fact the scope of some of the study may go beyond the boundary of any State. The group therefore recommended regional studies for the collection of hydrological or hydrometeorological data, medical surveys and the exchange of data on the other topics.

The difficulties for individual States to carry out these studies are considerable and the group appreciated the assistance quite often rendered by United Nations agencies in this field. A case in point is the hydrometeorological survey of the East African drainage catchment areas draining into the Mediterranean Sea, being executed by WMO and sponsored by five countries.

This takes care of the high cost of such studies. The other problems are those connected with trained staff, which again is usually taken care of by United Nations scholarships or fellowships; equipment in this case is usually covered by grants under the same assistance, leaving only the local cost to be borne by the recipient governments.

4. TRAINING FOR DESIGN ENGINEERS, WATER MANAGEMENT PERSONNEL, HYDROLOGISTS, HYDROGEOLOGISTS, LABORATORY TECHNICIANS, WATERWORKS OPERATORS PLUMBERS, ETC.

During the discussions, it was evolved that training of technical personnel for water supplies falls under three headings:

(a) Senior engineers: These can be trained in any university or college of advanced technology. Because of the comparatively few numbers required, the difficulty of setting up a faculty in each university in the present African conditions make the training of them locally difficult. However, arrangement should be made to have one or more universities or institutions set up in the Region to cater for this cadre.

(b) Junior engineers: For carrying out day-to-day supervision of construction work connected with water supply work. It was agreed that whenever possible these should be trained locally, as it is essential that they should be fully conversant with local conditions for the proper understanding of the materials of construction and efficient management of the waterworks.

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(c) Water supply operators: These range from plumbers, treatment works attendants to shift mechanics in charge of treatment works. Every treatment works vary one from another thereby requiring somewhat different number of staff. In any case, this cadre is required in great numbers and must be trained in a local institution.

Other countries in the Region are now seeking bilateral agreements or with United Nations agencies for assistance to set up such institutions. Here again there is plenty of opportunity for pooling resources within the Region in order to have quicker results.

5. CRASH TRAINING PROGRAMMES, RESEARCH ACTIVITIES, COLLABORATION AMONG COUNTRIES IN THE REGION, WHO RESEARCH CENTRE, ADEQUATE SALARIES FOR WATERWORKS PERSONNEL

In the opinion of the group the immediate problem connected with crash training programmes, particularly that of research and recruitment of the right personnel due to lack of adequate funds, can be taken care of by the setting up of a central water authority. It will also be possible through this medium to exchange ideas and data from research with other countries in the Region and perhaps outside.

For this reason, the group felt that the setting up of a WHO research centre in the Region to act as a clearing house for the exchange of data is recommended.

6. EMERGENCY MEASURES (CHOLERA CONTROL)

The study takes the form of a survey of available materials, equipment, drugs, qualified personnel, transport facilities, etc.

Unfortunately, the amount of equipment and other requirements are so great that it would be unrealistic to keep all these standing by with the hope that one day there may be an outbreak of cholera epidemic. The best that can be done is to take inventory of these materials available locally or within the Region, and to have a "drill" planned out in case of an outbreak.

Co-ordination is very important since this will involve many departments within the Member countries.

Group B

Question 1

All water supply systems must be planned taking into account the health, economic, and sociological implications.

Movement or resettlement of population should always be preceded by specific studies with regard to water supply facilities.

Question 2

For economy, research should be undertaken concerning the use of materials. Collaboration is desirable at the regional level in order to standardize the materials and equipment by pooling experience.

Question 3

Every water supply project should comprise:

- hydrological, hydrogeological and topographical studies;
- demographic, sanitary and medical surveys;
- assessment of the needs;
- sampling of supplies, for analysis.

Question 4

Until specialists in the various fields are available, all engineers or technical staff at the same level should be taught elements of hydrology and hydrogeology relevant to their region.

Similarly, the training of the managerial staff should include elements of administration and finance and aspects of human relations appropriate to their responsibilities.

Other specialists should also follow special courses in fields connected with their work.

In all cases, provision should be made for regular refresher training appropriate to each specialty to enable the staff to keep abreast with the latest technical developments in their field.

Annex 9

The cost of the training should be provided for in the project studies.

Initially, staff training should be geared to solving the problems of maintenance of the facilities and improving the administration of existing systems. Courses of further training at different levels should be set up in each country.

There should be constant exchanges of information at the regional level among the various technicians dealing with water supply problems, particularly sanitary engineers. Arrangements should be made among the countries of the African Region to facilitate practical training of staff.

WHO should provide fellowships and promote the establishment, in the African Region, of a centre for research and information on water supply. Every country should consider means of improving the social status of water-works operators, in order to attract recruits for the service.

Emergency measures (cholera control) - urban areas

Short-term measures

- Establishment of a national standing committee on cholera control.
- Establishment of a national sanitation service.
- Inspection of water treatment.
- Disinfection of latrines.
- Inspection of public places (markets, schools, hotels, restaurants, bars, etc.).
- Hygienic disposal of wastes (water, excreta, household refuse, etc.).
- Disinfection of dead bodies.
- Better education at all levels.

Long-term measures

- Extension or installation of facilities for water supply and hygienic wastes disposal.

Annex 9

- improvement of markets, provision of environmental health facilities;
- health legislation.

Emergency measures (cholera control) - rural areas

Some of the measures mentioned above should be applied in the rural areas, particularly:

(1) Short-term

- boiling of water
- use of latrines
- personal hygiene
- burial of household refuse
- health education of the population.

(2) Long-term

- water supply programme (sinking of wells, improvement of springs)
- latrine construction programme
- organization of local health committees.

Annex 9

Group C

Question 1

All water supply systems have health, economic and sociological implications, i.e.

- economic aspect: establishment of industry
- sociological aspect: stopping or slowing down the exodus from rural areas; improvement of welfare.

A good water supply attracts population; it is essential to provide water supplies before any movement or resettlement of population

Question 2

Local materials should be sought to replace imported products, and manufacturing methods applicable by the local staff should be developed. The equipment should be sturdy and easy to maintain. Simple treatment methods are recommended for rural areas.

Question 3

Basic data are very important, but water supply programmes should not be delayed if they are lacking. Arrangements should be made for permanent collection of data.

Sampling and testing should be standardized at the regional level.

Question 4

The Group recommended the establishment of norms to permit assessment of the needs for staff in different fields. For training purposes, three categories of staff were distinguished:

- sub-professional (technicians)
- professional (engineers)
- research.

Training should preferably be carried out locally, with further training abroad, particularly for staff of the last two categories.



Question 5

The Group expressed a feeling that where proper planning was implemented there was no need for a crash programme. If, however, circumstances demanded such a programme, this could be done only in the sub-professional cadre by attachment to relevant establishment and the on-the-job training principle would apply.

Research activities were very desirable. The consensus of opinion was that such research should be practical research.

Collaboration among countries in the Region would promote better understanding and WHO promoting such collaboration was desired by the Group. A suggested move in this direction would be a leader-exchange programme.

Though the establishment of a WHO Research Centre was not in existence this was planned.

The question of salaries for waterworks personnel was considered to be a matter that could be better handled by autonomous organizations responsible for the executive aspects of community water supplies.

Question 6

Whatever measures were taken it was considered that the most basic one was health education and this should be a continuous operation.

Emergency measures suggested were:

- (a) The formation of a
- (b) Mass immunisation and treatment
- (c) Sterilization of all water supplies used for domestic purposes
- (d) Improvement of environmental health conditions where these are unsanitary.
- (d) Mass propaganda by way of radio programmes.

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