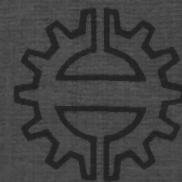


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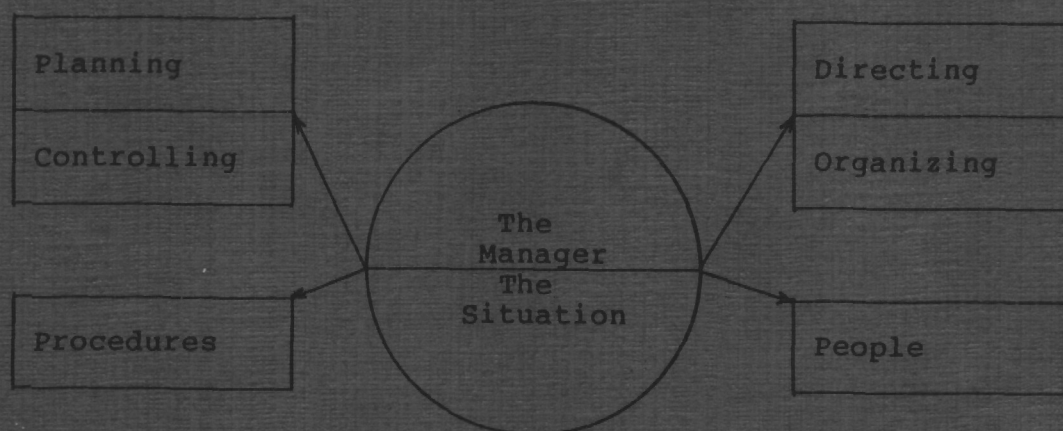
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## Management of Rural Water Supply Systems in Ethiopia



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MANAGEMENT OF RURAL WATER SUPPLY SYSTEMS IN ETHIOPIA

by

AYELE, HAILE MARIAM

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## MANAGEMENT OF RURAL WATER SUPPLY SYSTEMS IN ETHIOPIA

## ACKNOWLEDGEMENT

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**ABSTRACT**

The definition of management is stated as the basis of the analysis of the functions of rural water supply systems. It is clear that most rural schemes upon completion of construction fail to give service to the community or they become difficult to operate and maintain. This is often due to the inefficiency or lack of suitable management systems.

Improving the management of the rural water supply schemes requires a thorough study on the root causes of the failures. The purpose of this paper is to give a better understanding on the existing situation in Ethiopia and to identify the ways and means of tackling the problems.

Good planning with functional organizational structures including contented operation and maintenance facilities form the basis for successful rural water supply management.

## 1. INTRODUCTION

There has been an appreciable progress made, in particular in developing countries with regards to management of water supply system. Ethiopia being one of them, to be in principle as well as in practice with the decade programme, International Drinking Water Supply and Sanitation Decade (IDWSSD), has put special emphasis on rural water supply development.

In this research paper, relevant background information about the country with a review of the development of rural water supply systems is given with applied technologies and institutional framework. The need for more and better managerial efforts directed to the successful implementation, operation and maintenance of the schemes has already become clear to many involved in the sector.

Management of rural water supply schemes is presented in order to provide an insight into the demands of the community.

Management functions must be utilized to efficiently accomplish the tasks of supplying potable water to the rural communities. The techniques used, planning, organizing, directing and controlling will help to optimize the use of labour, material, equipment, knowledge and the available fund. Since transfer of responsibility of schemes operation and maintenance has been on progress, planning and organizing for a sound organizational structure with the necessary manpower is very vital.

The existence of lack of proper study, design and construction has resulted in operational failures to most of the schemes.

Many of the faults due to the deficiencies in manpower, transport, technical support, training and management systems are received by operation and maintenance. Therefore, in attempting to minimize the failures it is

important to focus effort on these areas which represent the greatest potential of improvement.

The success of virtually any rural water supply system management lies in its ability to meet its intended goals. Supplying potable water to the rural community with the necessary operation and maintenance facilities is essential to the development of the country. Therefore, if the management is to be improved operation and maintenance must be given priority on all sources.

A significant improvement in data, organization and management is needed to provide regional offices with reliable current information on the systems including identification where remedial work is needed. Moreover, to make good use of the standard of services from the existing schemes and to prepare the basis for the increase required to meet the future demands, rehabilitation of rural water supply systems is of a very great importance.

In the successful implementation of rural schemes, the basic requirement is entirely dependent on the degree of its human resources development. Proper planning, training and management are indispensable components of effective management.



## 2. COUNTRY BACKGROUND

### 2.1 Relief, Climate and Geology

Ethiopia, one of the largest countries in Africa, covers a total land area of about 1,2 million km<sup>2</sup>. The country comprises 14 Administrative Regions; Arsi, Bale, Eritrea, Gamu Gofa, Gojam, Gondar, Hararghe, Illubabor, Kefa, Shewa, Sidamo, Tigray, Wollo and Wollega.

According to Population and Housing Census Preliminary Report the population of Ethiopia as of May 9, 1984 was 42 million. Of this the rural population was 37 million or about 89 % and the urban population is 5 million or about 11 % (Water Supply and Sewerage Authority (WSSA) 1985a).

The country is dominated by central highlands which have several mountain peaks reaching an altitude of more than 4000 m, surrounded by lowlands. The lowlands which are mainly in the north-east and south-east of Ethiopia, include, the Danakil Depression which has many points more than 100 meters below the sea level (Hancock et al 1983). The Great East African Rift Valley divides the country centrally, roughly tending north-east to south-west. The topography is generally highly incised by rivers that originate from the central plateaux.

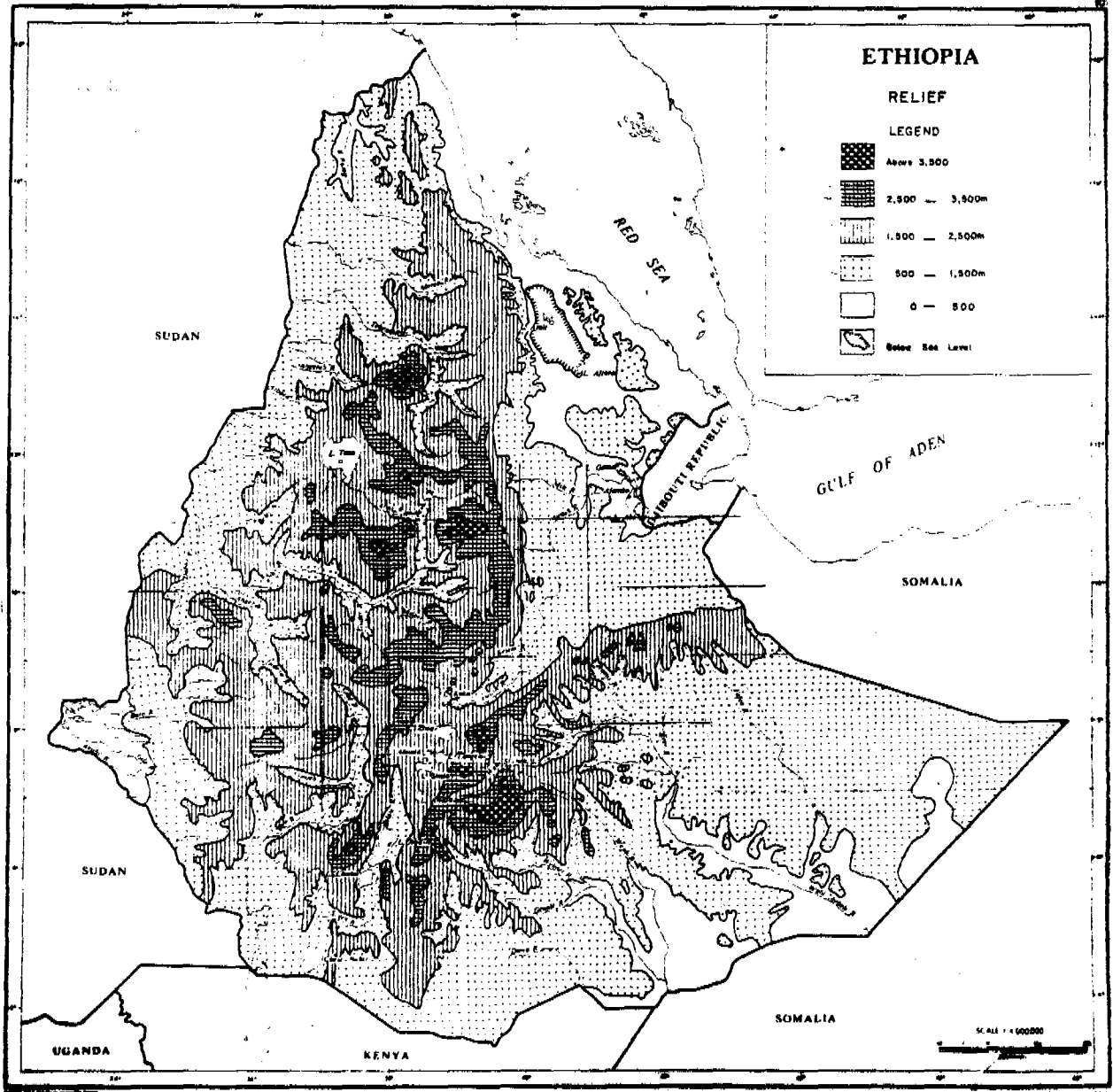


Fig. 2.1 Relief Map of Ethiopia (Relief and Rehabilitation Commission 1985).

Though Ethiopia lies between latitudes 3°N and 18°N and as such is tropical, the climate in most parts of the country is influenced by the high altitude. It varies from the Apline conditions existing between 3500 to the scorching desert of the Danakil Depression.

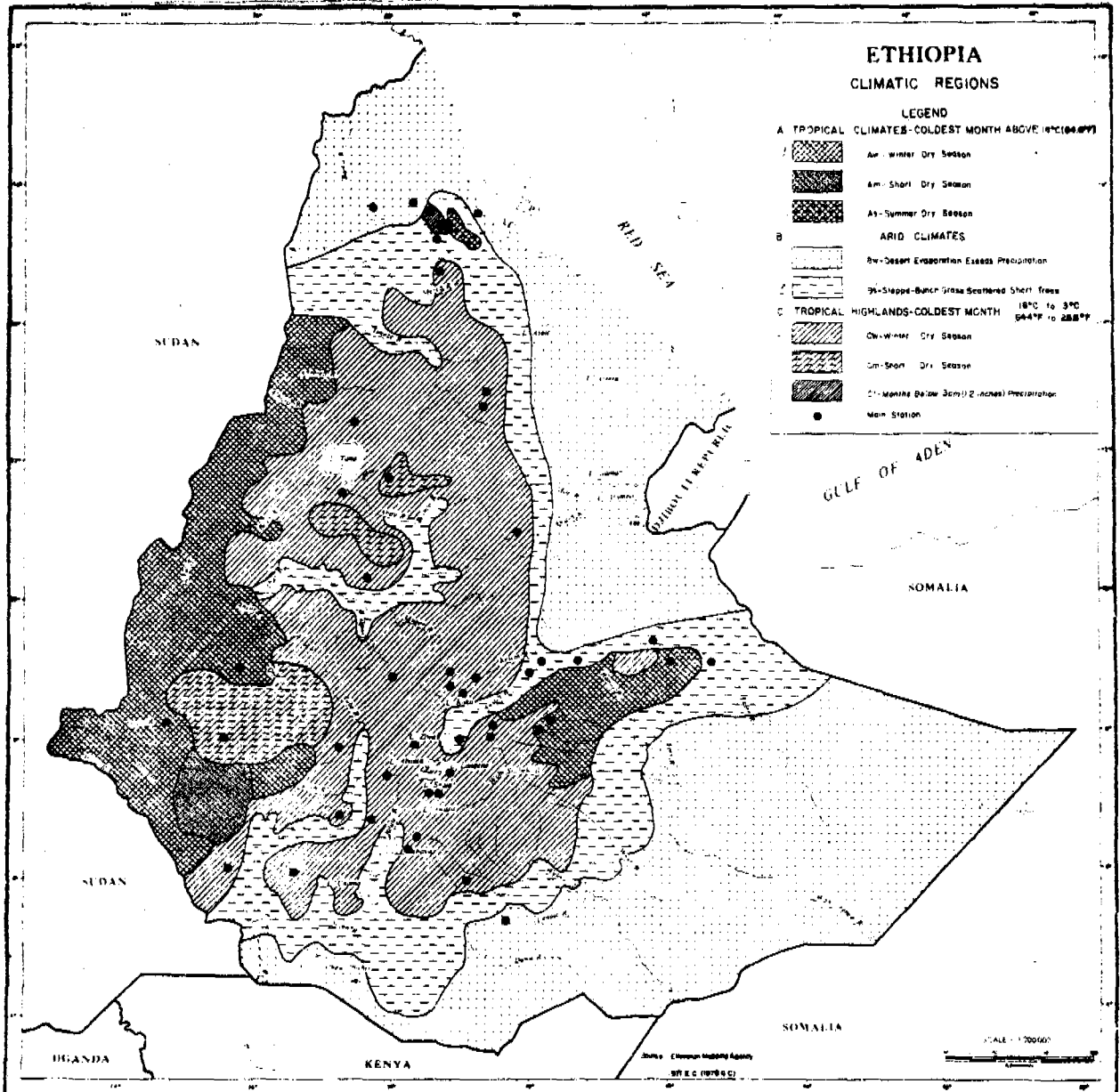


Fig. 2.2

Climatic Conditions of Ethiopia (Relief and Rehabilitation Commission 1985).

The annual rainfall varies from 2200 mm in the south-western part to less than 200 mm in the north-eastern and south-eastern regions.

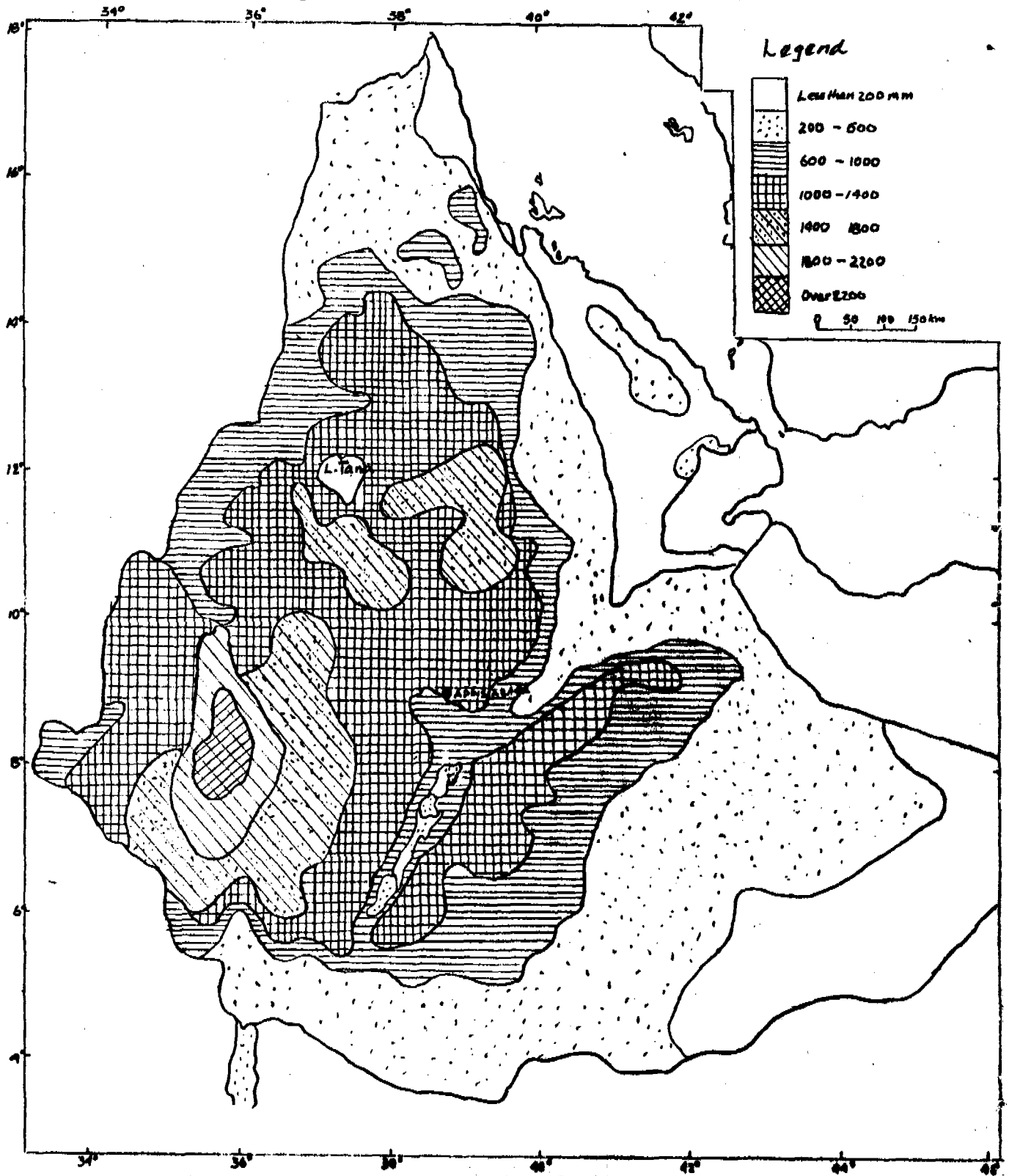


Fig. 2.3 Annual Amount of Rainfall in Ethiopia (WSSA 1985b). (Modified by the author.)

Rainfall in most parts of the country is concentrated to two rainy seasons, mid-June to mid-September ("Big Rains"), and April-May ("Little Rains") with prolonged drought in between.

Geologically, Tertiary Trappean Lava dominates the central upland areas. Extensive marine sediments underlie the south-eastern plains, old crystalline rocks are exposed in the north, south and western periferies.

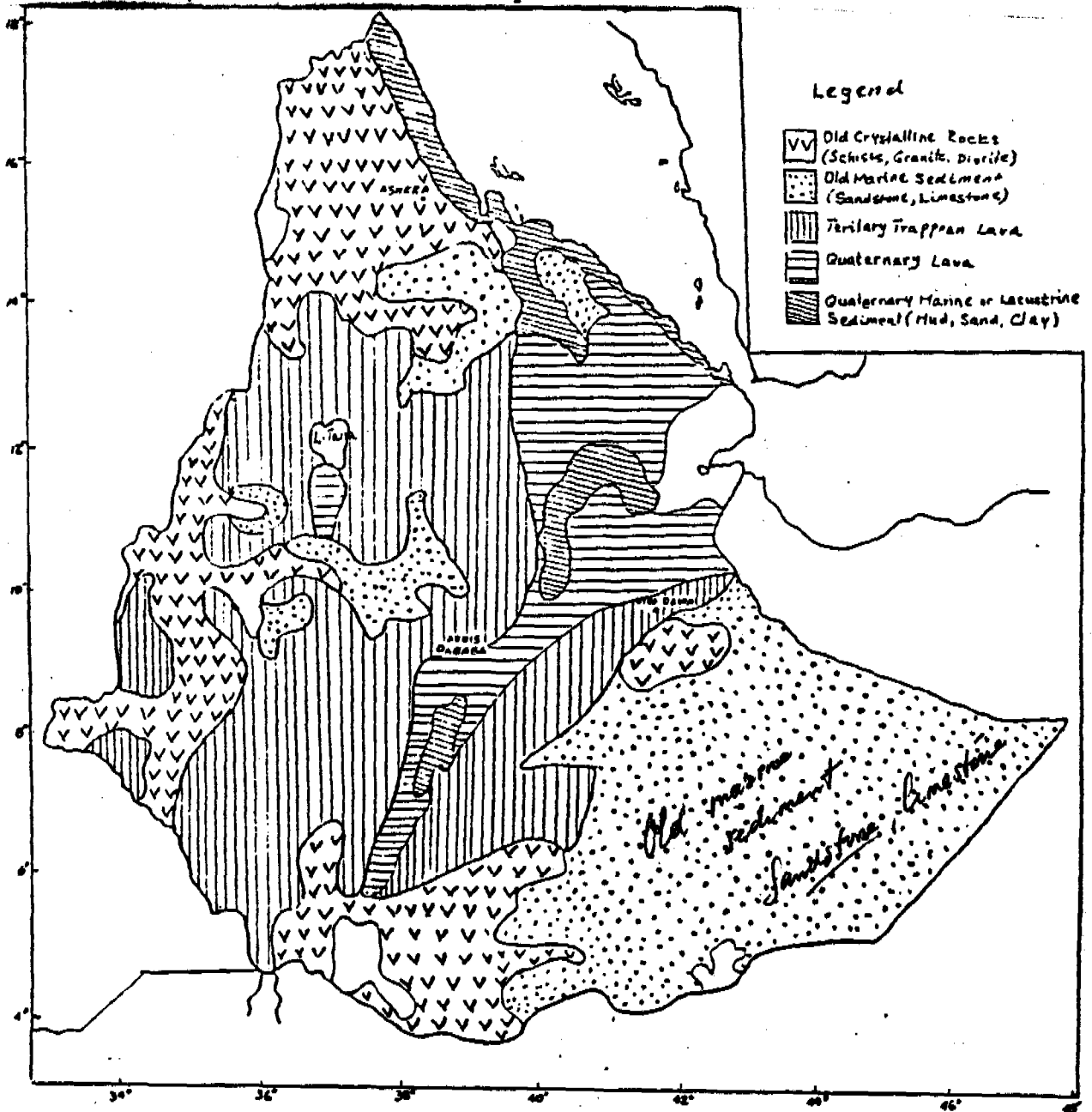


Fig. 2.4 General Geological Map of Ethiopia (WSSA 1985b). (Modified by the author.)

The Rift Valley is underlaid by quaternary lava and lake sediments.

The vast majority of the people live in the upland areas where the temperatures are moderate and rainfall is adequate for their mixed subsistence farming. The lowland areas are populated mainly by semi-nomadic herds men. The vast majority of the rural population lives in scattered homesteads or small nucleated settlements of less than 500 people each (WSSA 1985b).

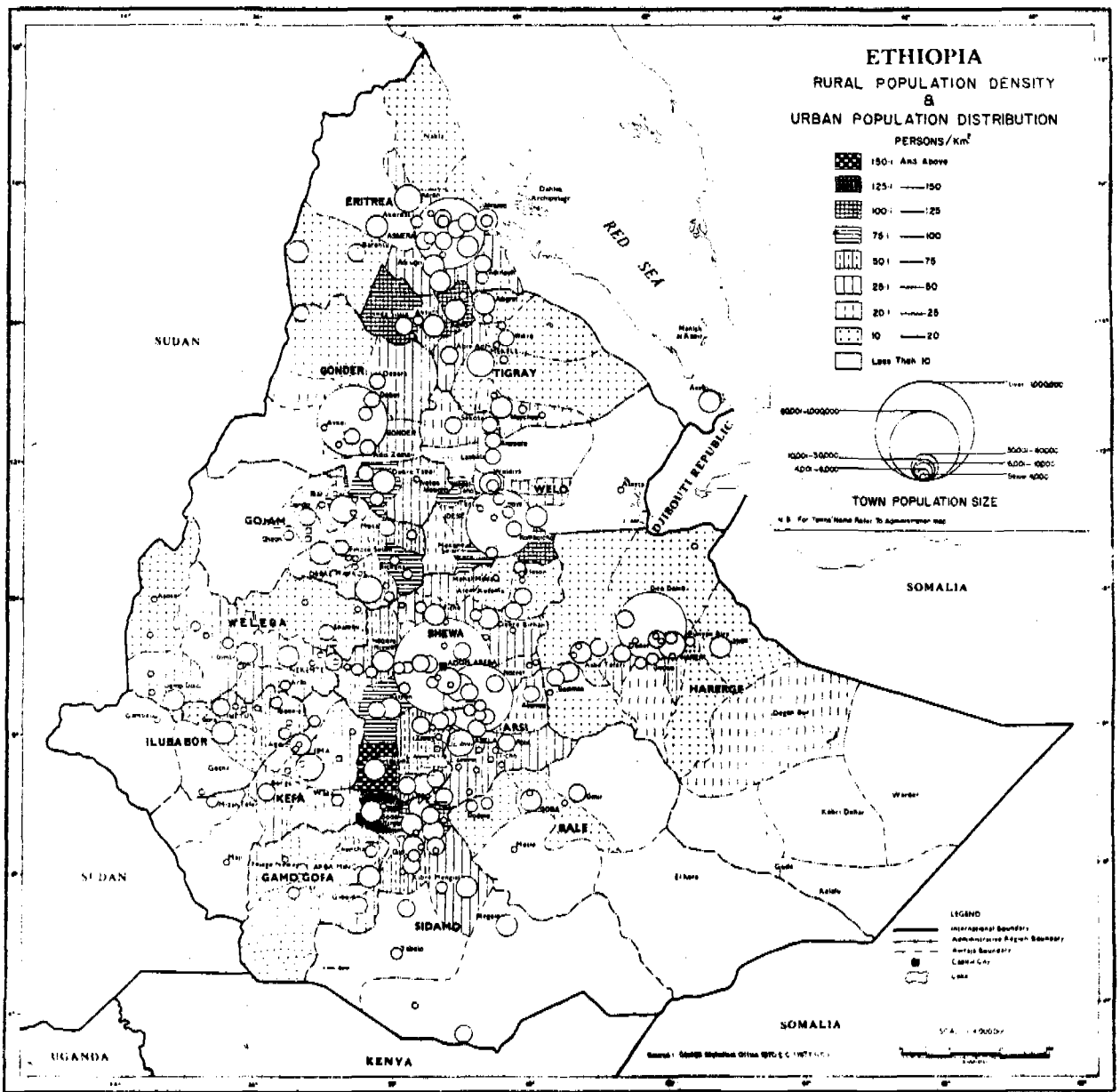


Fig. 2.5 Population Distribution in Ethiopia (Relief and Rehabilitation Commission 1985).

The physical features of the land, habitation pattern and level of development have direct influence on rural water supply activities.

The rugged mountains make land transport very difficult. This combined with limited road network means that the vast majority of the rural population cannot be reached by vehicles. Mountain springs and streams offer good opportunity for gravity supplies, but such sources are very limited, highly variable seasonally both in quantity and quality. Due to the prolonged drought, widespread deforestation and concentrated rainfall, the turbidity is sharply raised during rainy season.

The situation is made worse by the habitation pattern. Most settlements in the upland areas are on higher grounds, above suitable water sources. However, the scattered nature of habitation is of even great importance in relation to the management of water supply. It makes per capita cost for water supply exceedingly high.

The ground water potential in most parts of the country though limited, is adequate for rural water supplies. The depth of the boreholes range from about 40 m to 250 m by far the majority of wells being between 60 m and 100 m. Yields of the boreholes on the plateau range from low to moderate. Lacustrine deposits in the Rift Valley have good to high yields. The yields in the sedimentary deposits also vary. The great variability of well yields makes careful hydrogeological investigations very important. The ground water quality is generally good on the plateau. High fluoride occur commonly in the Rift Valley. High salinity is a problem in some areas in the Rift Valley and in some marine sediments of the south-eastern part.

## 2.2 Water Supply Development

Out of the different social and economical sectors, the water sector is one that attempts to contribute to the fulfillment of the objectives of the International Drinking Water Supply and Sanitation Decade (IDWSSD) through its various branches of activity. The main idea of the programme is to make a special effort to overcome lack of adequate and safe water supply and sanitation facilities for the population of the less developed world. In spite of the fact that Ethiopia is endowed with vast water resources only a very small portion of this resources has been utilized for rural and urban water supply as well as irrigation and other development purposes.

Communities that will have less than 10 000 inhabitants in the year 1993 have been considered to be rural in this context (WSSA 1985a).

Rural water supply activities were started in the early 1950s with the introduction of borehole drilling for small road side towns and government outposts and the construction of ponds for the semi-nomadic people and their livestock in the southern part of the country. There was very little improvement in rural water supply for the next twenty years. Accelerated growth in the sector started in mid 1970s due to the devastating drought condition in the country. During the twenty years from early 50s to mid 70s some 200 boreholes were completed serving an estimated population of half a million by the end of the period.

Before the year 1980 the Ethiopian Water Resources Authority (EWRA) has been the responsible government organization for the resources studies, project preparation, construction as well as operation and maintenance of the rural schemes. During this period, EWRA to undertake its task established a number of regional offices.

In July 1980, the Ethiopian Water Works Construction Authority (EWWCA) was established to carry out the



construction of rural water supply schemes. From there on EWWCA has been carrying out all rural water supply construction through the eight regional offices established by EWRA.

In the years following, however, a remarkable improvement especially in hand-dug wells has been made. This is shown in graphical form in fig. 2.6

Though rural water supply has a long history no yearly workplan and performance document has been prepared upto June 1974 (WSSA 1985a).

Presently some 1 100 boreholes, 1 300 hand-dug wells and about 150 protected springs are provided for the water supply needs of an estimated rural population of about 2,5 million out of about 38 million. This gives the rural water supply coverage of about 7 %.

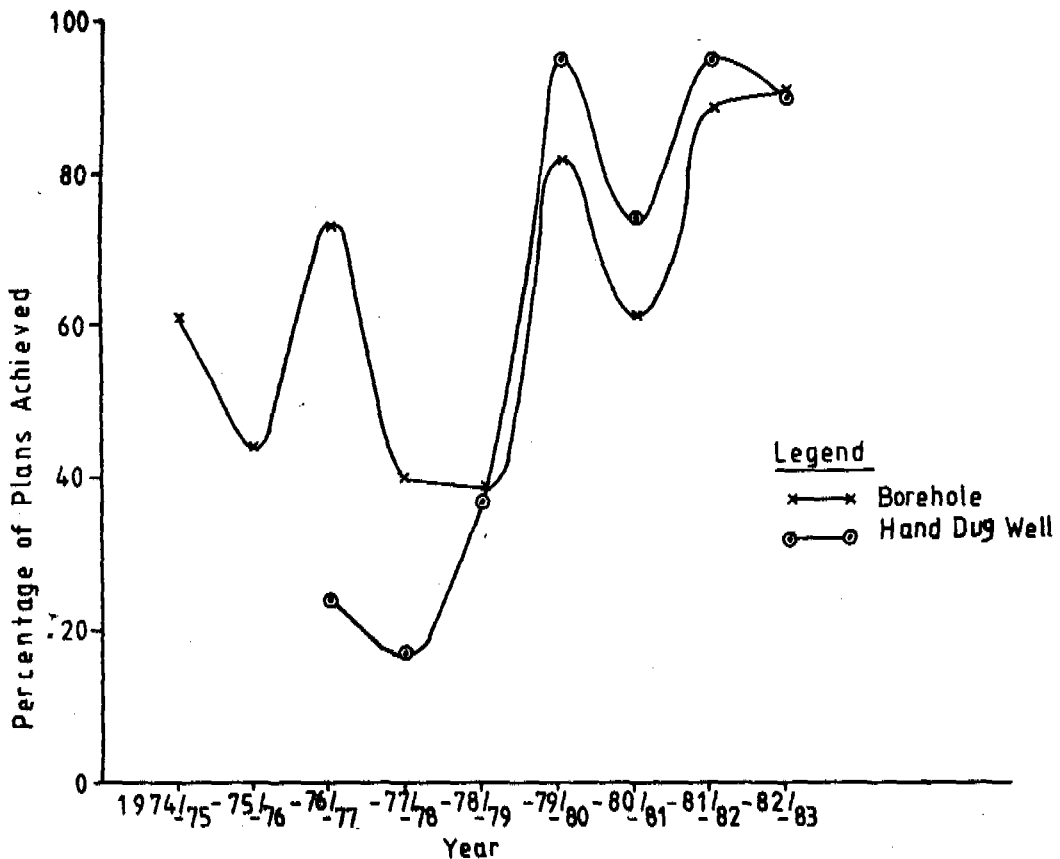


Fig. 2.6 Rural Water Supply Plan Achievement in % Versus Time (WSSA 1985c).

Despite the accelerated construction during the past few years, the general performance and coverage of rural water supply is still weak, inefficient and very low.

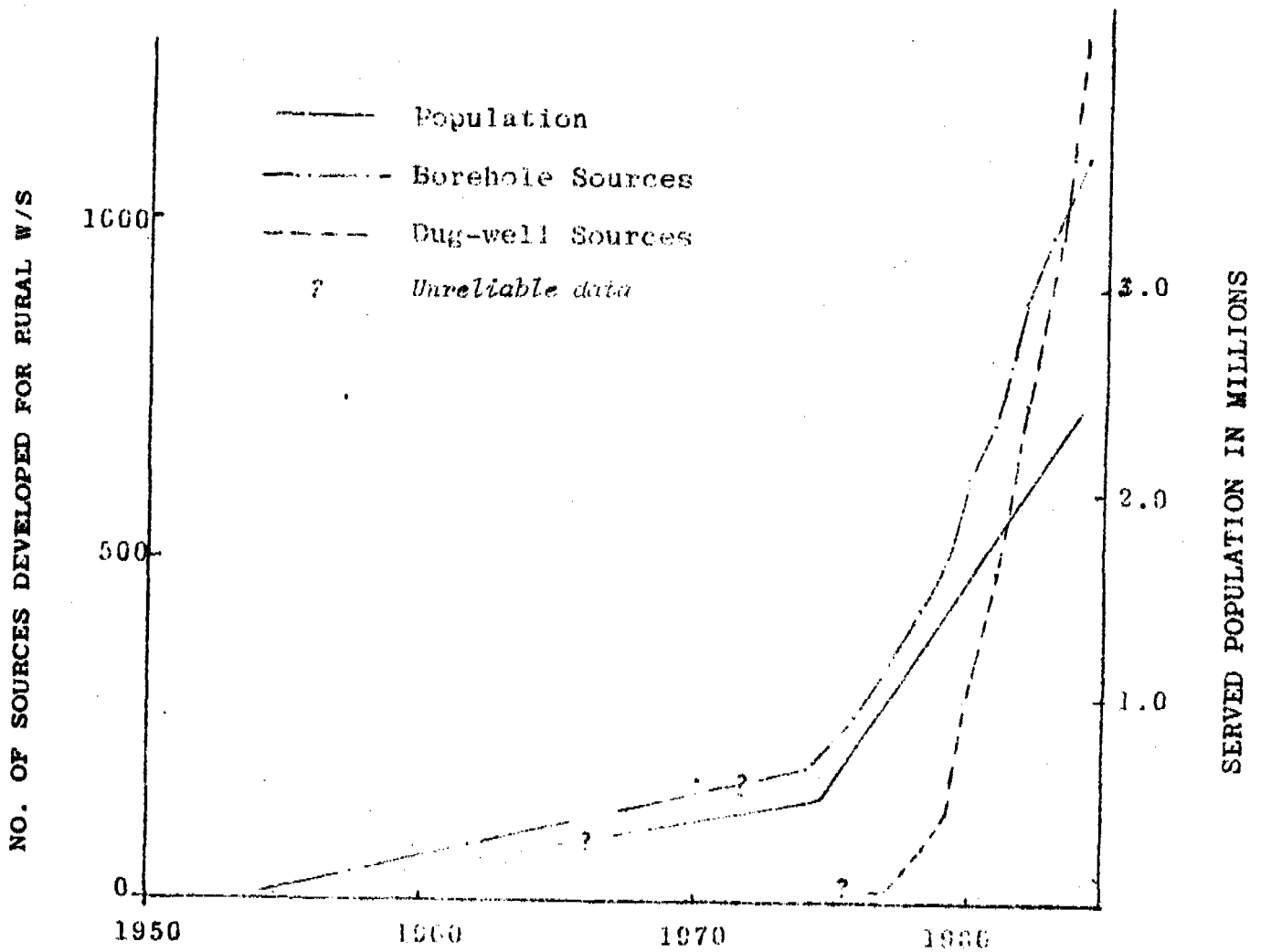


Fig. 2.7 Growth in Rural Water Supplies (WSSA 1985b).

The figure indicates the growth of rural water supplies within the limits of data availability, specially for the period before mid-1970s.

The development of the water resources of Ethiopia is an essential prerequisite for the development of agriculture and industrial potential, besides being basic to the survival of human life.

One branch of the sector is the water supply and sewerage in which Water Supply and Sewerage Authority (WSSA) has been given the responsibility of supplying water for both urban and rural population and sewerage services for the urban centers. The responsibility of rural sanitation has been given to the Ministry of Health.

Though the potential of water resources in Ethiopia is considerably high, the level of supplying safe drinking water to the population is very low. The ever flowing rivers, springs and the promising ground water potential are some of the main sources of water supply that need to be exploited to give easy access of safe water to the population. Although at present rural areas are given relatively much less service in water supply than the urban areas, the new national policy is encouraging the development by taking into consideration and putting emphasis on all its needs.

## 2.3 Concerned Organizations

### 2.3.1 Government Organizations

The National Water Resources Commission (NWRC) is an autonomous government organization which was created in August 1981 (Proclamation No. 217/1981) to be the overall organization responsible for the protection and development of the national inland water resources. Three Authorities and one Agency were organized under the NWRC as its executive bodies.

- I The Water Resources Development Authority (WRDA)
- II The Water Supply and Sewerage Authority (WSSA)
- III The Ethiopian Water Works Construction Authority (EWWCA)
- IV The National Meteorological Service Agency (NMSA).

The Water Resources Development Authority (WRDA) is responsible for all water related studies, and designs

including water supply, hydropower development and irrigation.

The Water Supply and Sewerage Authority (WSSA) is the owner and operator of water supplies in all rural and urban areas, except the city of Addis Ababa which has its own water supply and sewerage authority. WSSA is also responsible for sewerage disposal services in all other urban centers.

The Ethiopian Water Works Construction Authority is organized as a public constructing agency engaged in all types of water works and sewerage system construction including water supply systems and irrigation works.

Presently rural water supply construction is undertaken by EWWCA as a contractor under yearly contractual agreements with WSSA, employer in the eight regions covering the country.

Table 2.1 EWWCA's Regional Offices for Rural Water Supply Schemes.

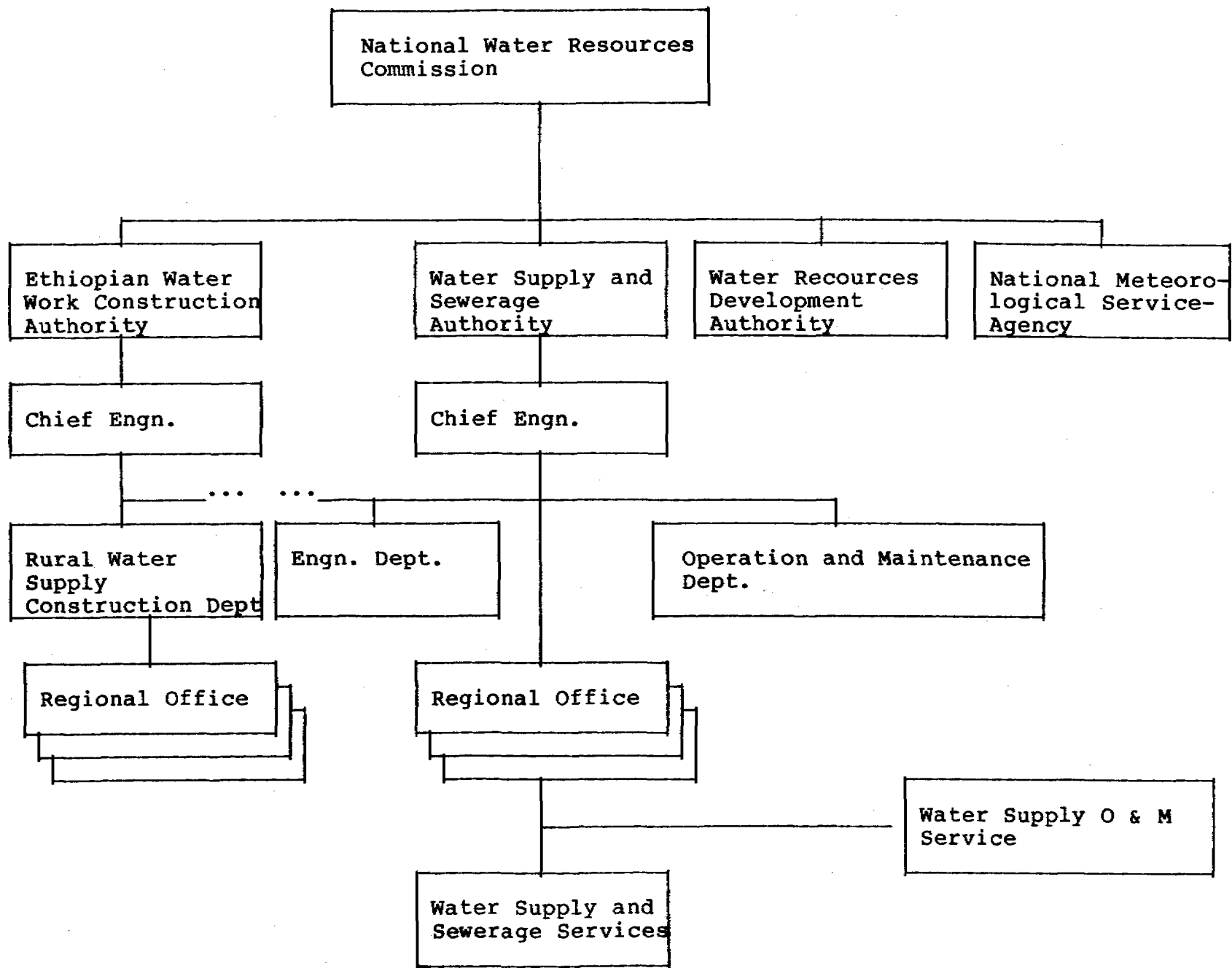
| No | Regional Office  | Administrative Regions Covered    | Location of the Regional Office |
|----|------------------|-----------------------------------|---------------------------------|
| 1  | Central          | Arsi, Shoa and part of Wollega    | Addis Ababa                     |
| 2  | Eastern          | Hararghe                          | Dire Dawa                       |
| 3  | North-Eastern 1. | Tigrai                            | Mekele                          |
| 4  | North-Eastern 2. | Wollo                             | Combolcha                       |
| 5  | Northern         | Eritrea                           | Asmara                          |
| 6  | North-Western    | Gojam & Gondar                    | Bahir Dar                       |
| 7  | Southern         | Bale, Gamu Gofa & Sidamo          | Awassa                          |
| 8  | Western          | Illubabor, Kefa & part of Wollega | Jimma                           |

The operation and maintenance part of the rural water supply is also the responsibility of WSSA. But, as of date, EWWCA still undertakes operation and maintenance activities in six out of its eight regions, the two regions, central and southern regional offices have been handed over to WSSA. The process of handing over this responsibility is to be completed by the end of 1986.

As in the past, studies and design for the rural water supply schemes are still being made by EWWCA. It is also planned to transfer this aspect of rural water supply activities to WSSA. EWWCA is engaged only in construction work through its eight regional offices in Contractor-Client relationship with WSSA.

Though at different stages of development all EWWCA regional offices are operational and they have basic facilities, equipment and personnel to carry out rural water supply construction activities including drilling of boreholes, digging wells, spring protection, reservoir construction, installation of pipeline and pumping equipment. Operation and maintenance activities are minimal. That is construction of new schemes have unduly dominated budgetary, personnel and back up service allocations at the expence of operation and maintenance activities.

Fig. 2.8 Organizational Set-up of Rural Water Supplies within the National Water Resources Commission.



Presently WSSA being the responsible organization is in the process of establishing eight regional offices to cope up with studies and design of schemes, operation and maintenance of water supplies in urban and rural areas as well as urban sewerage disposal services.

WSSA's regional offices of urban and rural water supply systems are the same as that of EWWCA's regional offices for rural water supply schemes with an exception that the regional office of the Central Region is located in Nazareth.

It is believed and hoped that with such an arrangement independent organization for construction on one hand, and operation and maintenance on the other hand will contribute to improve efficiency in construction and more importantly enhance operation and maintenance activities of rural schemes.

Other Government organizations are indirectly involved in rural water supplies. The Ministry of Health, promotes the protection of springs and dug wells with full local participation as part of its environmental health activities.

The Institute of Geological Surveys of the Ministry of Mines and Energy undertakes hydrogeological mapping and drilling of test wells but with a minimum capacity.

### 2.3.2 Donor Agencies

The water sector is highly dependent of foreign aid and loans. Rural water supply development is supported by various bilateral and multi-lateral grants or soft loans. Individual donors usually concentrate on supporting water supply activities in distinct regions. At the time of reporting this study the following donors were engaged.

Table 2.2 Examples of Main Donors at the End of 1985.

---

| Donor                                | Fund Type | Area of Support and Region   |
|--------------------------------------|-----------|--|
| 1. Swedish Government (SIDA)         | Grant     | Eastern Region and support of national training programme abroad and at home   |
| 2. Canadian Government (CIDA)        | Grant     | Southern Region and support of national training programme abroad  |
| 3. European Economic Community (EEC) | Grant     | North-Western and Western Regions  |
| 4. UNICEF                            | Grant     | Different parts of the country concentrating in Bale (Southern Region), Eastern, North-Eastern and Northern Regions and support of training at home. |

---

In the past UNDP, the British Government, The Chinese Government, UNICEF and UNCDF have made significant contributions to rural water supply development as well.

Non-governmental organizations such as OXFAM, Norwegian Save the Children fund, Norwegian Church Aid, Swedish Red Cross and various Missionary groups have also been engaged in limited rural water supply activities.



### 3. IMPORTANCE OF MANAGEMENT

No universally accepted definition of management exists. For our purpose management is defined as the process of planning, organizing, directing and controlling the efforts of the authority's members and of using all other organizational resources to achieve its goals. As Carlisle (1979) puts it management is considered as a body of knowledge that relates to human process of directing, coordinating and influencing the operations of an organization so as to obtain desired results and enhance total performance.

Managers achieve organization goals by arranging for others to perform whatever tasks may be necessary not by performing themselves (Stoner 1982).

The goals of the Authority concerning rural water supply are:

- a) to supply safe and wholesome water for the community
- b) to supply water in adequate quantity
- c) to make water readily available to the users in order to encourage personal and household hygiene.

The degree to which a water supply system fulfills its public health function varies directly with the efficiency and effectiveness of its management. Good management of a water system includes a number of functions (Wagner and Lanoix 1959).

- 1) provision and maintenance of adequate facilities
- 2) good and smooth operation
- 3) provision of satisfying service to consumers
- 4) efficient maintenance
- 5) establishment of sound fiscal methods
- 6) development of equitable water rates
- 7) efficient organizational structure and procedure

- 8) development of technical and financial plans for future expansion
- 9) supervision of personnel and
- 10) control of equipment and supplies.

Managers, regardless of their particular aptitudes and skills engage in certain interrelated activities in order to achieve their desired goals of management functions.

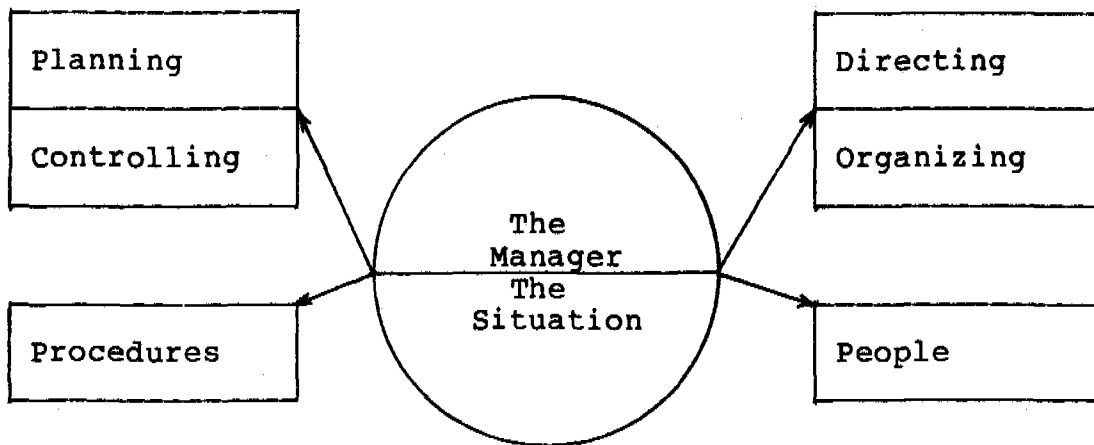


Fig. 3.1 The Management Functions (Caskey 1972).

It is the responsibility of managers not only to provide for the needs of the present but also for those of the future generation. It is known that people are the key to the well operated organization, and that a competent manager with a dedicated staff of associates can make practically any type of organization successful (Kuranz 1968).

Management has had to meet the dramatic change in society's attitude toward utility operations. They must now coordinate water supply development with the planning functions of communities (Sieger 1974). It is important in the promotion phase of rural water supply development, to decide the responsible body for management after construction of different schemes is completed.

In Ethiopia today the most widely used rural water supply schemes are springs, hand-dug wells, boreholes, sub-surface

dams, ponds and cisterns. Experience so far indicates that the local community, through their own peasant associations bear the responsibility of small schemes.

The sizes of the schemes are decided by the Authority considering the degree of difficulties in operation and maintenance and the need of skilled manpower.

Schemes are said to be small if they operate smoothly, by the local community without requiring skilled manpower, like spring protection, hand-dug wells with or without handpumps and the like. But for such schemes when necessary, assistance is given from to regional office.

Schemes like boreholes that consist of electrical (diesel) pumps, generators and which require high running cost with skilled manpower are considered as large. For such type of schemes the regional offices take the full responsibility of operation and maintenance in their respective regions. Although in all of the regional offices except the Central Region revenues have not been collected to overcome the management problems that arise in running the schemes.

Management of rural water supply schemes have been the responsibility of different authorities since 1950. But from 1984 onwards, WSSA has started to take the responsibility of these schemes and has begun transfer of ownership. Since rural communities in Ethiopia are relatively large and scattered, the schemes serving these communities are also many in number and require close follow up to efficiently manage their smooth running.

The transfer of rural water supply system results in changes in the organization. Amending the authorities organizational procedures are thus necessary. Due to shortage of people capable reviewing and making proposals to improve the Authorities operation, inefficiency in management is inevitable.

To overcome the inefficiency it is necessary to understand the various tasks essential to the running of the works.

From past experience of the organizations that managed these schemes, an analysis has to be made for the different type of works required to run the systems smoothly. Moreover, the standard of skills required by each category of work has to be assessed.

### 3.1 Planning

Of all techniques used by modern management, planning more than any other, describes every action of management including, of course the most important action of all the action of decision.

Planning is one of the corner stones upon which successful organizations depend.

Management does not have the choice to plan or not to plan. Management must plan if it is to survive and keep the organization growing and successful in achieving its goals. Even so, planning is by no means the whole answer to success. Plans without decision and decision without action make meaningless the best plan ever conceived (Maynard 1960).

Plans are needed to give the Authority its objectives and to set up the best procedures to reach them. In addition plans permit:

- 1) the Authority to obtain and commit the resources required to reach its objectives,
- 2) employees of the Authority to carry on activities consistent with the chosen objectives and procedures, and
- 3) the progress toward the objectives to be monitored and measured, so that corrective action can be taken if the rate of progress is unsatisfactory.

It is also necessary to have relevant, reliable and readily available data. Without such data, planning remains guess work. Therefore, adequate information must be collected upon which decision can be made and plans built.

Planning work also involves thinking ahead-setting goals and then deciding how to achieve these goals (American Water Works Association (AWWA) 1982).

The first steps in planning involve the selection of goals for the organization. The objectives are established for the subunits of the organization - its divisions, departments and so on. Once the objectives are decided upon, programmes are established for achieving them in a systematic manner (Stoner 1982).

Ascertainment and assessment of all relevant facts, outside and within the organization are essential factors in sound planning. Sound planning requires the determination of the various activities by systematic analysis and assessment of relevant facts (Brech 1963).

Successful planning requires above all people. The right kind of people who act on the planning are more important than the plan itself (Maynard 1960).

Ethiopian budget year starts from 1<sup>st</sup> of July and ends the 30<sup>th</sup> of June of the following year. Before the end of budget year 1982/83, the rural water supply in the country was planned and implemented by different authorities, from 1950 to 1980 by EWRA and from then onward by EWWCA. But now according to the Proclamation for the establishment the Water Supply and Sewerage Authority (No. 219/1981) which states that "the Authority shall have the power to provide water supply services and to cause the establishment of sewerage system services throughout Ethiopia except the City of Addis Ababa"; all the responsibility of rural water supply planning implementation, operation and maintenance are given to WSSA.

Planning in EWWCA for rural water supply schemes were done in the head office of the Authority based on the decade plan and some insufficient information from regional offices. No consideration was taken on the capacity of the availability of manpower, equipment, material and financial sources of the regional office.

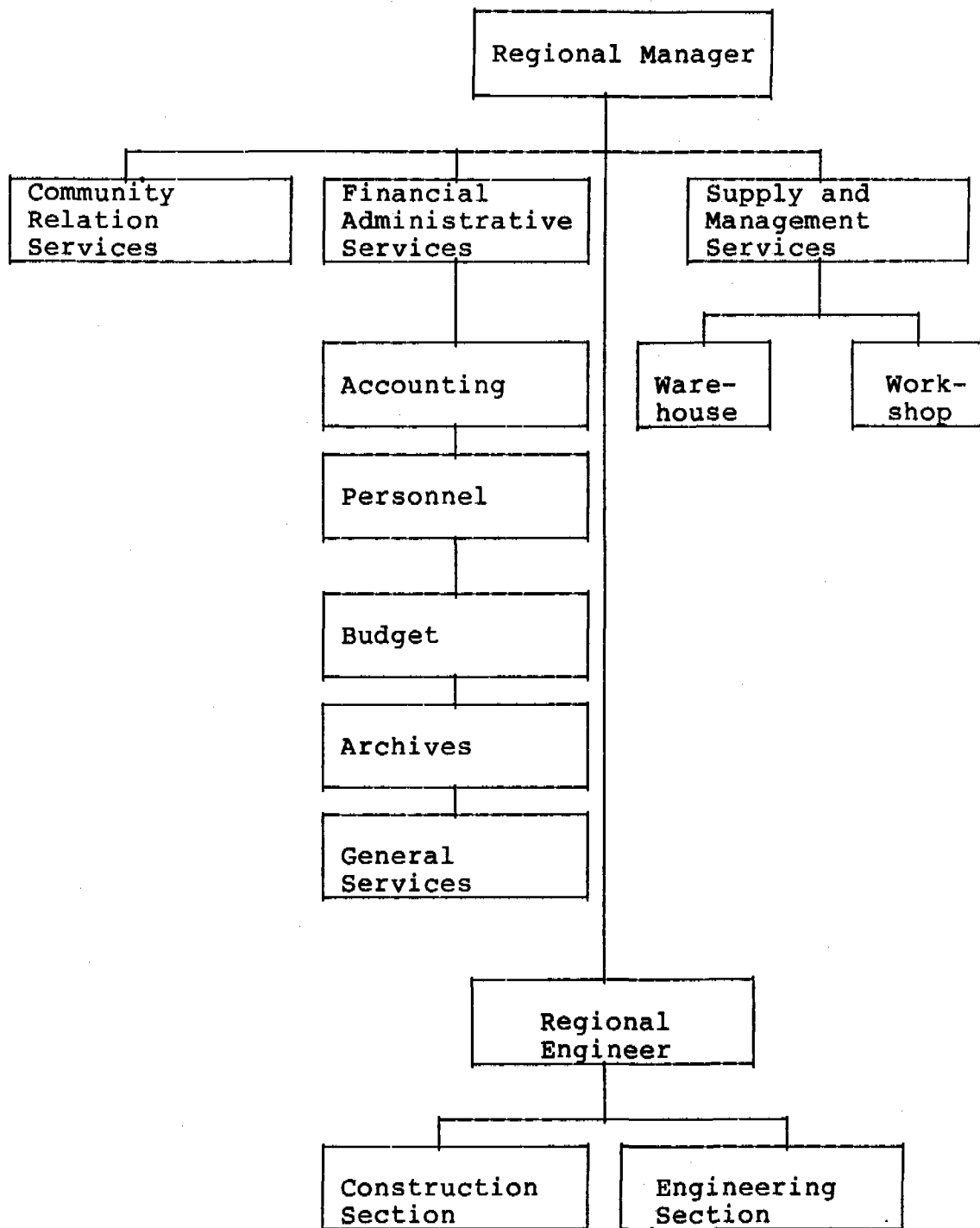


Fig. 3.2 EWWCA's Organizational Chart of the Regional Office (Public Administration Service 1982).

Even though, investigation of the places where construction is going take place were not made, sometimes the names of places were not identified properly, only the number of schemes to be constructed in the region were given. Moreover, in

the organization structure of the regional office, all sections and services do not have the necessary equipment and supplies, i.e. operational facilities were not sufficient enough to execute what was planned.

Therefore it is very important to see what the previous authorities have done during their years of service in order to improve the performance of WSSA after the rural schemes transfer. Better planning helps to achieve the desired goals. High emphasis has to be put to maximize the effort on the planning aspect of management.

Planning is always the first function performed.

We have to decide what goals and objectives we want to accomplish. What service are we going to give? How are the services brought about? Where will the fund be obtained? Who will be the user? What resources (men, materials, machines) will be required? When should the resources be obtained? Many such type of questions have to be answered prior management can intelligently move ahead.

For rural water supply managerial planning the following steps have to be taken into consideration in the determination of the set future conditions, and the strategies needed to achieve the needs.

- Determine where you stand today and make forecasts of what is likely to happen in the future.
- Develop goals and decide what results you want to attain.
- Establish some strategies for accomplishing the goals.
- Decide what activities have to be undertaken to achieve the goals.
- Determine what resources will be necessary to attain the goals and decide if these resources are available.

- Move into the execution or implementation phase of the plans.

### Advantages of planning

Planning gives the Authority a sense of direction, without plans and goals, organization merely reacts to daily occurrences without considering what will happen in the long run. Plans avoid this drift situation and ensure that short range efforts will support and harmonize with future goals.

Planning focuses attention on objectives and results. Plans keep those people who are involved in their implementation concerned with the anticipated results.

Planning establishes a basis for teamwork. The purpose of planning is to interrelate the resources and activity of an organization so that common goals are attained.

Planning provides guidelines for decision making. Decisions are future oriented. If there are no plans for future, guidelines do not exist for arriving at decisions.

Planning serves as a prerequisite to employing all other management functions. Without goals and plans, no guidelines exist for performing any other management functions such as controlling, organizing and directing (Carlisle 1979).

### 3.2 Organizing

Organizing work is an important part of successful management. It involves grouping work into logical tasks or functions and assigning certain responsibilities to each group in the organization (AWWA 1982).

To efficiently accomplish our tasks of the rural water supply services we have to organize our jobs, people and facilities.

Organizing is the central task of all managers. Without good organization the rural water supply system



- the schemes, its tools and equipment, its materials and supplies cannot be used efficiently. Without it, too, the employees and individuals who are responsible for its operation and maintenance cannot perform to the best of their skills and abilities. No service giving body lacking good organization in depth, can hope to achieve its short and long range objectives. These are the principal reasons why organization along logical and clearly defined lines of authority and responsibility is so very important to water supply system operation (Maynard 1960).

As the rural water supply schemes grow, its organization needs to grow with it. There are more things to be done and greater number of matters requiring attention especially in a country like Ethiopia where rural water supply system is in its infancy. Therefore we have to use some procedural tools to meet our goals of organizing (Caskey 1972).

1) Organization tools

- a) Clear cut objectives for the whole unit.
- b) Objectives divided into responsibilities for each subordinate clearly defined.
- c) Standards of performance to measure results.
- d) Authority and responsibility defined.
- e) Communication channels and procedures clear.
- f) Charts and manuals up-to-date.

2) Organization problems

- a) Understanding one's position in the organization.
- b) Staffing all positions with able people.
- c) Training the staff in the jobs.
- d) Span of control - how many subordinates?
- e) Clustering like duties in proper slots.
- f) Centralization versus decentralization - which one?
- g) Responsibilities distribution is logical.

Answering the questions and solving the problems helps one to give structural form as how the organization is to operate.

Large and rapid expansion causes strains in an organization because of increase in recruitment rates and training needs. The financial requirements of the expansion may also contribute to the strains experienced.

Since rural water supply systems are being transferred to WSSA, a sound organizational structures with the necessary manpower has to be organized. The operational management of rural schemes in Ethiopia as it is seen through experience was very inadequate. Additional investment for organizing, strengthening the regional offices and eleminating the inadequacies is very essential. Consideration of the operational requirements of the large expansion of the Authority is necessary at an early stage. This will enable more satisfactory arrangements to be made for any organization.

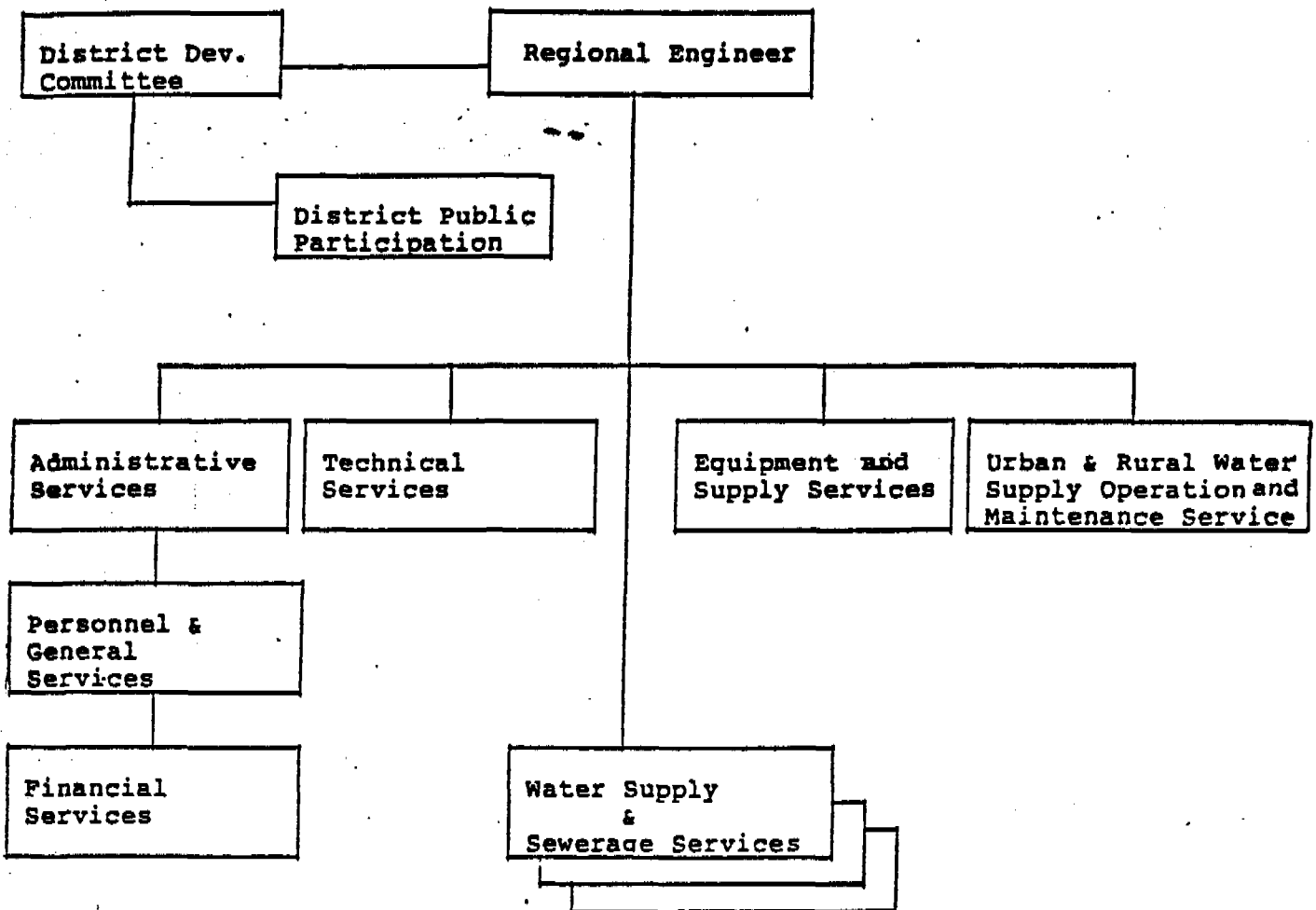


Fig. 3.3 WSSA's Regional Office Organizational Chart.

As shown in this organizational set-up rural and urban water supply operation and maintenance section is set under one section.

Although rural water supply schemes are more simple than urban systems, the rural Communities are relatively large and scattered. To operate efficiently and manage properly the system needs a separate section within the Authority with sole responsibility for rural schemes. The existing organizational set up has to be modified in such a way that rural operation and maintenance has its own section or else there will always be a tendency for the rural water schemes to take second place.

### 3.3 Directing

It is often stated that management is knowing what needs to be done (in terms of making the organization successful). Directing is getting others to do it (Stoner 1982).

The working environment of most supervisors is complex having no definite path of relationship. There exists a confused mass of ambitions, abilities, systems, materials and equipment. Good planning and organizing will fail if the directing function is not skilfully accomplished.

The most effective way in maintaining quality-quantity of work and sound employer-employee relation is to know the people well. To establish a proper relationship with subordinates or others in the organization is the most important ingredient of all sincerity. Until we know people - and know them well, it is next to impossible to be sincere with them (Caskey 1972).

In order to operate and maintain the rural water supply schemes successfully the responsible person assigned must provide the necessary leadership. Directing is execution phase of planning. It is a day to day process of direction in on going activities (Carlisle 1979).

Directing work involves using schedules, assigning work to people and supervising work. A great deal of time is spent in scheduling, rescheduling, assigning work and checking the work being done in any water supply schemes (AWWA 1982).

Using schedules helps managers to set priorities and to assign work.

In assigning work the employees have to be given clear instructions so that they can perform the work as expected to be done.

Once the activities in the organization are energized decision making and providing leadership are required to keep it moving toward the established goals. This involves many activities and skills. Thus the manager as supervisor has to provide on-the-job assistance to help improve the work of the subordinates. If one does not take time to correct little problems on time while supervising and checking, they might be big problems which at a later stage will be difficult to solve.

Supervision is the effective direction of employees along organizational lines. Through supervision we can see whether the organization really functions or not. The secret of effective leadership is not ordering people, but creating an atmosphere where they perform their assignments because they want to perform them (Maynard 1960).

Developing people, or more simply stated helping subordinates to grow in their jobs, is an essential element of good management.

### 3.4 Controlling

Controlling is the manager's or supervisor's responsibility to see that work proceeds according to the plan. Will the goals be reached? Are the operations being performed in relation to established standards? Is the service being given on time, within cost limitation, and in quality and quantity desired? Control consists of all of the performance measurements and other actions taken to assure that plans are accomplished.

Managerial control is the monitoring and modification of organizational activity and resources utilization to ensure that predetermined standards are met and plans are carried out. The steps in control phase are:

- To measure the performance against the plan or standard.
- To evaluate this performance or progress
  - If the performance is not upto standard or which is satisfactory, to take corrective action.

Control deals more with the end results of planning. It is considered the "other half" of planning, because without control plans are mere hopes or dreams. Control fulfils the following four vital functions of management.

- Control guides behaviour into useful organizational ends. It monitors and directs the activities of the people and the operations of the organization into useful channels.
- Control ensures that resources are efficiently utilized. One of the more critical controls is over the allocation and use of resources. All organizations use resources, and one of the purposes of control is to measure and evaluate how effectively they are being used.
- Control focuses attention on factors essential in achieving organizational effectiveness.

- Control encourages the action necessary to maintain performance.

In Ethiopia the organizational objectives of the rural water schemes have not been accomplished to the desired degree due to lack of proper control. Therefore emphasis has to be placed on the fulfilment of the objectives by introducing proper control system. In orders to achieve the desired organizational goals the necessary facilities have to be fulfilled such as human and financial resources which have been the main obstacles.

Managers have thus to assure that resources are obtained and used effectively and efficiently.

#### 4. STUDIES, DESIGN AND CONSTRUCTION

##### 4.1 Studies and Design

Presently water supply studies and designs are prepared basically by professionals stationed in EWWCA Regional offices with support from the head office. Community selection is made in consultation with the regional planning committee, a government body responsible for development planning in the regions and the local administration. Priority is mainly based on felt need of the people. Other considerations are technical feasibility, population pattern (scattered or nucleated) accessibility, growth potential, administrative role of the area and equity in distribution of services within the region.

Generally detailed planning, including community selection, resource studies and designs are made only for annual program implementation. Whatever design work is done very often proceeds along with the construction work. The need for more forward detailed planning source investigation and design is required before implementation period approaches.

##### 4.1.1 Studies

Potable water investigation for rural areas includes monitoring, site observation, community meeting and participation, consultation with older people in the area with experience of local problems and laboratory examination (IDRC 1981).

The investigation for a rural water source should cover the topography of the site, the location, the number of users, the maximum service radius and the seasonal volume. A knowledge of all these items is essential in rural water management.

## Source Selection

Ethiopia being a socialist country, the water resources are the property of the people. Sources are selected according to political as well as economic and technological benefits. The following characteristics are pertinent in source selection.

- **Abundance:** The source must fulfill the requirements of consumption - the selection taking the weather and local patterns of water use into account.

The quantity of water must satisfy not only current consumption but also future demands. Water should be available during both dry and rainy seasons. Knowledge about the hydraulic properties of the major aquifers is almost completely lacking. Therefore, when the source is being chosen, hydrologic and hydrogeologic studies should be strictly and accurately carried out. Moreover, test pumping of the new and existing wells have to be made properly in order to enable aquifer property evaluation more successful.

- **Quality:** The water should meet water quality standard set by EWRA.
- **Hygienic environment:** The source should be easy to protect from contamination.

### 4.1.2 Design

In view of the relatively large number of communities to be provided with access to improved water supply and the need for common approach to design practices in the various regions, EWRA has established and supplied design criteria guidelines put out in November 1976 to all regional offices (WSSA 1985b).



Table 4.1 Guidelines for Design Period.

| Description   | Time in Year |
|---|--------------|
| Calculation of demand and capacities  | 15           |
| Main line capacity of the maximum day demand with a minimum of 8 h of delivery        | 15           |
| Distribution system capacity of the maximum day demand with a minimum of 8 h delivery | 15           |

Table 4.2 Guidelines for Population Growth.

| Range of Population | Accepted Rate of Growth in % per Annum* |
|---------------------|---|
| 0 - 2 000           | 2                                       |
| 2 000 - 5 000       | 3                                       |
| 5 000 - 10 0000     | 4                                       |

(\* Rates are subject to revision after 2 years.)

Table 4.3 Guidelines for Water Demand.

| Design Population Range | Design Demand l/cap/day |
|-------------------------|-------------------------|
| 0 - 2 500               | 20                      |
| 5 000 - 10 000          | 25                      |

## Water Quality

Until now the National Drinking Water Standards for rural areas have not been established. The requirement for drinking used was:

Water supplies should be biologically pure of acceptable color and taste and free of harmful concentrations of toxic substances such as nitrate, fluoride, lead, selenium, arsenic, chromium, cyanide. Standards which have little bearing on health (such as the amount of hardness or the presence of chlorides) but which cause technical problems such as encrustation or corrosion must be checked.

The regional offices have also been supplied with a limited number of recommended standard design drawings including:

- public water point,
- elevated 8 m<sup>3</sup> reservoir,
- 50 m<sup>3</sup> and 100 m<sup>3</sup> stone masonry reservoirs,
- cattle trough,
- generator house, and
- pump house.

But in practice, these standard designs have been sometimes altered slightly but the regional offices to other materials and/or capacities to satisfy the local situations and water use pattern.

## Water Use Pattern

Out of estimated about 37 million rural people only about 7 % have access to improved water supply. The rest about 35 million depend on traditional sources: unprotected open dug-wells, unprotected springs, rivers, ponds, etc (WSSA 1985b).

In areas where surface water is scarce during the dry season, a very common situation, women and children spend hours in fetching water essential for the mere survival of

the whole family. From the discussion with regional office employees during the authors field visit, it was indicated that the water use even from improved water source with public water points was only about 10 l/c/d.

Water use from improved sources is intense during the dry season. Whereas in the rainy season it drops sharply. The rural common people are satisfied with the seasonal springs that outflow during the wet season. This pattern of water use shows that distance from source is the overriding criteria for people's choice of water source and that water quality considerations seem to be insignificant at this awareness level. This indicates that the high need for health education on the one hand, and the need to bring improved water source as close as possible on the other. Therefore, WSSA has to take high consideration on selection and design of the rural schemes. Moreover, the awareness of the community has to be increased through its community participation promoters. This will help to improve the existing situation of the water use pattern, and the health of the rural community. The government of Ethiopia also has started a new programme that brings together the scattered rural population into villages. This may in the long run decrease the difficulties of study, design and improve the water use pattern of the community which is very essential for the well being of the population.

#### 4.2 Construction

EWCA has about 36 various types of rigs engaged in rural water supply construction. They operate from the eight regions. Of these 14 are more than 20 years old. Only 11 rigs are less than 10 years old and fairly operational (WSSA 1985b).

Older rigs are cable tool and mud rotary. Recent purchases are almost all combined, air-mud rotary. The fleet consists of 14 different makes of rigs which makes it very

difficult for maintenance where shortage of skilled mechanics of rigs is predominant.

Wells are drilled open hole using generally surface casing. Almost all wells are packed with river gravel. Most wells are finished with 200 mm and 150 mm casing (with locally slotted black steel casing at the end) instead, and the small annular space gravel packed with selected river gravel. Since good hydrogeological study is lacking with hydrogeological map, it is usually difficult to locate the aquifer exactly, thus gravel pack is filled to above the static water level. This shows lack of proper study and design which will result in loss of money during construction and cause failure for most of the rural water supply schemes.

However, since mid 1970's not only have rural water supply activities been accelerated significantly but also appropriate low cost technologies have been used more and more.

Now each region has two or more dug-well construction crews with some necessary vehicle backup and tools even though they are not sufficient for the work load that exists.

In non-caving soils wells are dug open hole to the required depth mostly less than 20 m. They are lined usually with precast concrete tube of 100 cm internal diameter. But this method is not used in caving soils when caissoning is required.

Besides the drilling and dug-well construction crews, other crews in the regions produce annually 50 spring protection works and 100 various size distribution systems with reservoirs. The distribution systems are typically

- 1) "On-the-spot" with an elevated 8 m<sup>3</sup> steel tank and a public water point and occasionally a cattle trough.
- 2) "Small distribution" with 50 mm diameter and pipe length of 500 m (transmission line) from source to a village,

a reservoir, and a distribution system with one or two public-water point.

- 3) "Large distribution" with 100 mm or 80 mm diameter about 2 km of transmission main, a reservoir, a distribution system with four to six water points in the village. Although much larger systems with about 10 km of transmission line have been successfully completed, such schemes are very few (WSSA 1985b).

In the construction of rural water supply schemes the items that must not be forgotten especially in Ethiopia after Client Contractor relationship has started are plans and specifications.

Plans and specifications provide the basis for all contract work and are the most important features of good contract administration. Poorly drawn contract documents and skimpy, conflicting incomplete specifications will almost certainly result in arguments (Anderson 1970).

In Ethiopia, since the Contractor and the Client are under one Commission this has not been looked properly which may result in failure of the schemes. Therefore, in order to eliminate all resulting complications the design and specification of the rural schemes must be properly and clearly done before construction begins. The engineering service of all the regional offices have to be well organized with the necessary manpower and equipment.

Good specification and qualified inspectors are a must in obtaining high quality work. Although inspectors are assigned to six of the eight regional offices to obtain the quality called for by the specifications, they are not well equipped with what is required for inspection. This is one of the difficulties of inspection of rural water supply schemes in Ethiopia today. Moreover, experience is the most important qualification of a good inspector. The inexperienced inspectors should have to be given limited

## 5. OPERATION AND MAINTENANCE

### 5.1 Need for Operation and Maintenance

Maintenance has to do with keeping and nursing what has been constructed, and sustaining it so that it will provide the required service. It is the art of keeping equipment, structures and other facilities in a suitable condition to perform the services for which they are intended. Proper maintenance is needed for water supply installation as for other engineering systems (Hofkes 1983).

Nearly everything built by man begins to deteriorate as soon as it is built. Normal everyday use - normal wear and tear - creates the need for maintenance. Regular maintenance is necessary to keep all equipment in good working condition.

Proper maintenance consists of inspecting, lubricating and repairing equipment in accordance with manufacturer's recommendations and cleaning, repairing or replacing items when they fail (AWWA 1982).

An essential part of good rural water supply management is an appreciation of the necessary operations to ensure that water reaches the community consistently at the rates of the quality and quantity previously determined (Franklin 1983).

Problems of initial planning and construction are usually slight when compared with problems of operating and maintaining rural water supply systems after they have been constructed. In almost all developing countries with viable water supply programs, it is not difficult to find villages where the water supply system is either not working as planned (either technically or financially) or not functioning at all (Saunders and Warford 1976).

Among the complaints which the author have gathered concerning operation and maintenance of rural water supply schemes during the field visit include broken pumps or

public taps or batteries not charged, inadequate tanks, lack of assistance personnel from the regional office, lack of knowledge about the system operation and too low salaries for guards and operators.

It is not uncommon to find that attention is mainly or exclusively focused on the construction of new water supply systems. Frequently no provision is made for operation and maintenance of the existing supplies. In fact maintenance is one of the most neglected aspect of rural water supply projects and the number of inoperative systems remain discouragingly high (Hofkes 1983).

The financial burden on the Government of Ethiopia from the maintenance cost of rural water supply systems is rapidly increasing because water is supplied freely to the community in all regions except the Central Region. Even though in Central Region revenues are collected, 90 % of the schemes are not able to cover their expenses by their income. Government is subsidizing the expenses for operation and maintenance.

International and bilateral agencies often offer funds for new construction but are not so readily prepared to finance maintenance costs, considering this to be the responsibility of the recipient country (Hofkes 1983).

In developing country like Ethiopia, it appears that at least the direct cost of maintenance must be born by the beneficiaries, or water supplies will be going out of service almost at the same rate as they are being installed.

## 5.2 Organization

Theoretically over 2,5 million people have access to potable water. Unfortunately the actual number to whom potable water is available is not known. This is because a large number of rural water supply points are no longer functional. However, it was the Government's aim to supply an additional 9 million people during the 2<sup>nd</sup> Decade Plan Period (1984 - 1993) through 900 springs, 10 400 hand-dug wells, 200 sub-surface dams, 150 slow sand filters, 2 000 bore-holes, 80 ponds and cisterns (WSSA 1985b).

In order to ensure that such development efforts are not wasted it is necessary to efficiently maintain the large number of existing and planned supplies. Unfortunately at present operation and maintenance of rural water supplies are poor. Theoretically the responsibility rests with the eight regional offices, but they are unable to perform effectively, due to lack of skilled manpower, financial and transport resources. Lack of resources means that regional offices are not able to do very much. Therefore, maintenance of rural water supplies is sometimes non-existent and even when breakdowns occur repairs take a long time and are often not done at all. If there is to be an improvement in the existing highly unsatisfactory situation then far reaching changes are needed in the organization and management of rural water supplies.

The operation and maintenance requirement should be a major consideration when selecting or developing appropriate water supply technologies and organizations for rural areas. If the technology chosen is relatively complex, involving for example motorized pumps and treatment plants operation and maintenance in rural areas is likely to be a major problem. Although, no system is maintenance free a careful provision has to be made even for the simplest systems (protected dug-wells, handpump systems and springs) by using simple technologies of low maintenance requirement (Glennie 1983).



The organization of the rural water supply schemes, at the regional level and at the head office level should not remain static and functions should be shifted to sub-regional office and to lower levels too as soon as manpower is sufficient. The need for improved planning and budgeting for operation and maintenance has to be emphasized.

A significant improvement in data organization and management is needed to provide regional management with reliable current information on the schemes including identification where remedial work is needed. Moreover supporting crew which is able to carry out major improvements or increase of schemes is required. With a substantial number of schemes coming on line either through construction or rehabilitation, the operation and maintenance service of the regional office must ensure that construction is suitable and that as many of the faults as possible are eliminated prior to commission.

In order to decrease the problems of the operation and maintenance, the existence of peasants associations in the rural areas is definitely a favourable institutional feature, full use of which should be made of in the setting up of operation and maintenance system for smaller schemes. Nevertheless, for systems that require skilled technical manpower like boreholes with submersible pumps and generators the regional office has to take the full responsibility.

Agreement between WSSA's regional office and the local peasant associations or similar organization (water supply committee) should be made for each water supply scheme. The agreement should stipulate the delegation and duties of each party to the agreement in respect of the maintenance and operation of the rural water supply schemes.

One of the duties, amongst others of the water supply committee should have to be to select and to employ operators whose work will be daily to start and to operate the schemes and to keep the necessary records.

In most of the regions which the author has visited during the data collection trip, the necessary data are not collected properly or data are not available at all. But for the problem which arises during operation or during breakdown the regional office is called by the community to repair.

Sufficient budget for operation and maintenance is not allocated neither by the community nor by the concerned government body. This is one of the main causes of failures of the rural water supply schemes in Ethiopia. Therefore, increased power must be delegated by the head office to the regional office to efficiently manage the operation and maintenance of all schemes by themselves.

The maintenance organization of any water supply system develops gradually over a period of time. The maintenance organization is designed as a result of this development.

### 5.3 Preventive Maintenance

Preventive maintenance is the planned maintenance of plant and equipment resulting from periodic inspections that disclose faulty conditions. Its purpose is to minimize breakdowns and excessive depreciation resulting from neglect (Newbrough 1967).

The purpose of scheduled inspection is to discover conditions that could lead to breakdown or harmful deterioration of the equipment, and to correct such conditions while they are in the incipient stage. A preventive maintenance system helps the operator to administrate and implement scheduled inspection.

The general parts of a preventive maintenance system are:

- Equipment identification system
- Record of facts on each piece of equipment
- A schedule documentation or services performed
- A format for monitoring inventory of spareparts.

Preventive maintenance is nothing more than a management tool which assists the operator or mechanic to handle data, monitor the operation of pieces of equipment simultaneously, maintain a constant inventory, check on spareparts and advise the user to order (Dahl 1982).

In practice in Ethiopia, preventive maintenance of rural water supply schemes is very rare, and the regional offices that are responsible for maintenance merely send out repair teams when a breakdown occurs. This is regrettable, because considerable economic savings can be achieved if preventive maintenance is provided instead of repair after breakdown.

Once a water supply scheme is provided, it is important to ensure that the community continues to rely upon it. Thus it is essential that the system is kept continuously operating. If it breaks down, and remains inoperative for long periods of time (like most of the rural schemes in central region on the road to Shashemene from Mojo) due to poor maintenance, people will return to their traditional water source. The opportunities for improving the attitude towards safe water supply will be lost, probably for years. Furthermore, where the water supply system is installed with contributions from the community, like in Bale administrative region under Southern Regional Office, they may view its failure as evidence that their contribution has been wasted.

The psychological impact of inoperative water supply systems consequently will be very negative.

The maintenance function has frequently been neglected. In many regional offices, maintenance has been and is still considered a necessary evil that must be tolerated.

Unfortunately this attitude causes a downgrading of the maintenance function. Most of the failures were due to

- not allocating the necessary funds
- frequent emergency work
- lack of equipment replacement programs
- insufficient preventive maintenance

- shortage of skilled manpower
- inadequate training of maintenance personnel
- poor workshop and store facilities.

The maintenance function has been given poor treatment. The lack of management tools has retarded the development of maintenance organization. Few or none of the management techniques in maintenance, organization planning, written procedures, performance measurement, planning and scheduling, training programs, motivation techniques, cost control, etc., have been regularly used.

#### 5.4 Rehabilitation

Rehabilitation comprises those additional constructions, operation and maintenance procedures that will permit the schemes to

- 1) deliver the volume of water with acceptable quantity and quality according to the standards for which the scheme is designed and constructed,
- 2) distribute the produced water, and
- 3) replace or adjust valves, clean different units, install master meters, prepare operation and maintenance procedures, provide tools and transport facilities.

Throughout Ethiopia there are many rural water supply schemes installed by different government organizations and various international and bilateral donor agencies (CIDA, SIDA, UNICEF, etc.) providing various state of services.

Due to financial, skilled manpower and similar limitations attention is mainly focused on construction of schemes. Maintenance after construction and rehabilitation are always given less priorities. Wells, like all other engineering structures need regular scheduled maintenance in the interest of high level performance and maximum useful life or rehabilitation after breakdown has occurred.

Most of the rural schemes in all the regions are given no or very little attention after commissioning. Consequently problems that could otherwise be solved with limited expenses and skill develop to cause serious failure over the whole system thus demanding high repair and rehabilitation costs. Out of the frequent failures, the cause for most of them is poor operation and lack of good sense of ownership.

Therefore, as a part of the effort to alleviate these problems, WSSA has to take a long-term and short-term maintenance program throughout the eight regions. The objective of the rehabilitation being:

- 1) Identification and correction of faults in the existing schemes and improvement of services to cover existing demands.
- 2) Carrying out engineering studies to prepare a revised preliminary design, design for major rehabilitation work; and construct under appropriate supervision.
- 3) Establishing user groups to take and pay for water for communal water points.
- 4) Reassessment of the organization and management of the operation and maintenance activities of the Authority so as to establish the conditions necessary to maintain the rehabilitated schemes.

To fulfill the objectives of the rehabilitation program manpower as well as financial resources requirement has to be met. Moreover, since schemes rehabilitation without improved operation and maintenance is fruitless, it is essential that bottlenecks in the operation and maintenance have to be broken down and maintenance organization strengthened.

## 6. IMPROVING THE MANAGEMENT

The organization necessary for the administration of rural water supply depends chiefly on the size and complexity of the system and on the method of collecting water fees.

A certain amount of administrative work is necessary with the simplest water supply system; payments for supply of materials and equipment must be completed regularly. The management should be aware of the administrative requirements of the organization to eliminate the administrative failures of the system (Wagner and Lanoix 1959).

In order to accelerate the study, design and implementation of the rural water supply projects as well as to maintain and smoothly run the existing schemes in the country, development of the planning system and reorganizing the Authority is very important.

Reorganization of the Authority by changing it from one centralized control to a form of decentralized operation requires careful planning. Answers must be found to such questions as:

- 1) How should regional offices best set up?
- 2) How should we manage them?
- 3) What should be the limits of authority and responsibility granted to each regional office?
- 4) What degree of control should be maintained at the head office level?
- 5) When should the change be placed into effect?
- 6) Should the change be made all at one time or introduced gradually?

A thorough job planning is required with functional organizational set-up to smoothly manage the rural water supply schemes.

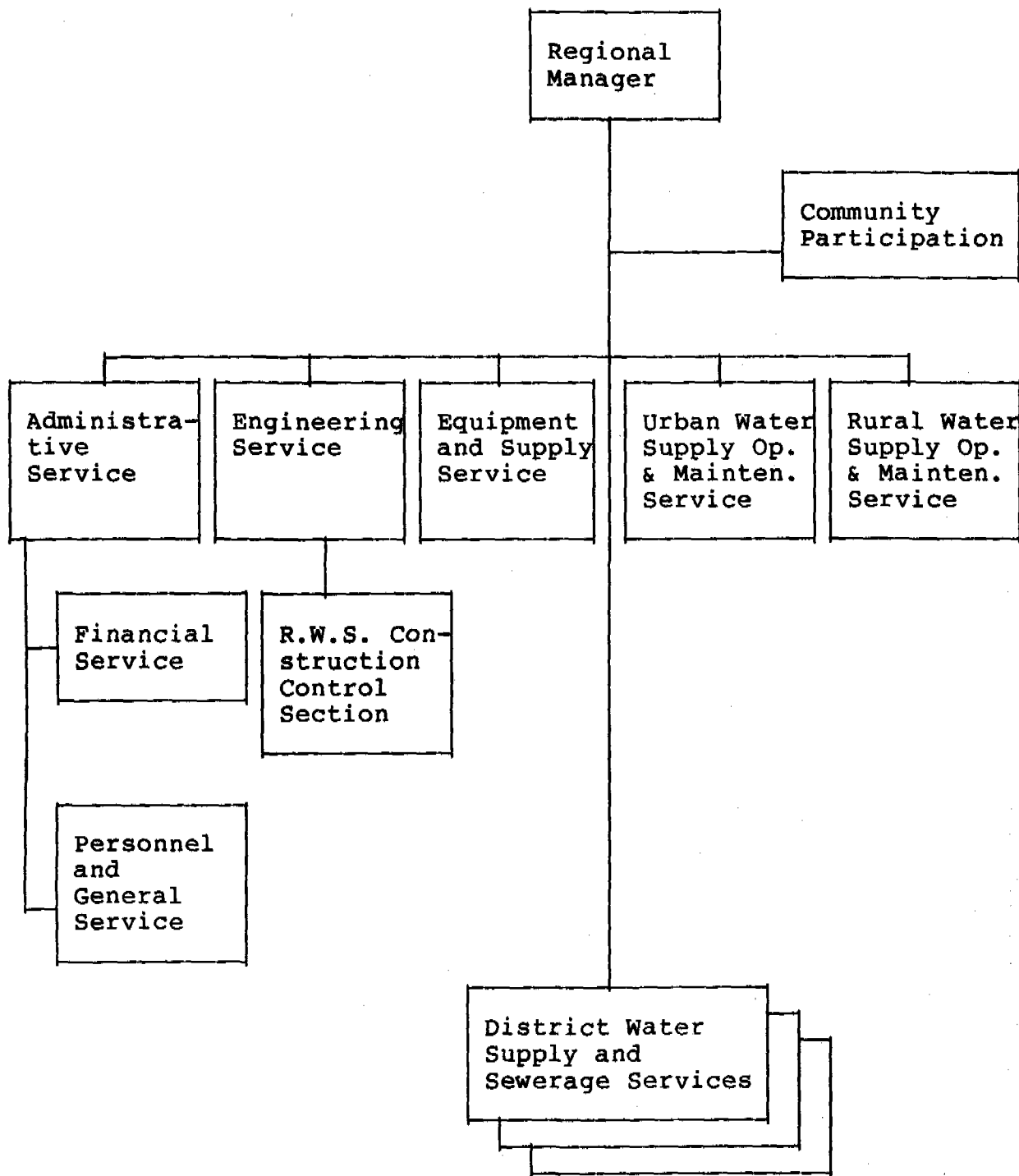


Fig. 6.1 Author's Proposal for Organizational Set-up of Regional Office.

Based on previous organizational set-up of EWCA's regional office and WSSA's present organizational chart, the author has proposed a modified and functional organizational

set-up of the regional office as shown in Fig. 6.1. In this proposal more emphasis is put on operation and maintenance and construction control of rural schemes.

#### 6.1 Personnel Administration

Personnel administration is the manpower aspect of the management process. It has an impact on nearly everything. The regional manager himself is influenced by everyday personnel policies and practices. Personnel department at the head office level or at the regional level have to establish and handle the problems associated with personnel actions.

Effective personnel administration starts with reasonable policies and effective supervisory skills. It includes a variety of activities designed to make sure that people at work are treated fairly and provided with the knowledge, skills and opportunities required to satisfy the needs of operation and maintenance as well as each employee.

Personnel administration activities may be classified into four categories (AWWA 1982).

- 1) Describing and classifying work by developing job description, establishing qualification and goals to each position and developing wage and salary structures.
- 2) Recruiting and selecting employees by evaluating and hiring people based on certain qualifications.
- 3) Training employees by providing instructions that is needed to help for the proper performance.
- 4) Evaluating employees by making decisions about how well employees are doing their job.

Since WSSA is a new authority and is now only starting the personnel administration aspect of the rural water supply system from scratch, it has to do a lot to develop a good and functional organizational structure to fulfil its intended goals.



Rural water supply schemes study, design, construction, operation and maintenance involve a wide variety of activities. Hiring and training employees should be based on these activities. In addition the work to be performed has to be described and classified.

Job description for all positions in the regional office have to be prepared so that the duties and responsibilities, working relationships and working conditions associated with a certain kind of work are described. This helps in clearly understanding what the duties and responsibilities of the employees are and also helps in recruiting and selecting applicants for available positions which satisfy the requirements.

WSSA should have its own office in every region and field personnel for the rural schemes in such a number that the employees are kept fully busy and productive.

## 6.2 Accounting and Budgeting

### 6.2.1 Accounting

Accounting is the process of recording and summarizing business transactions that affect the financial status of an organization. It is an important tool for analyzing and monitoring revenue and expense activities for interpreting the financial condition of the organization (AWWA 1982).

The basis for good water system administration is keeping of suitable records and accounts. In Ethiopia, although rural water supply has a long history, no yearly work plan and performance document has been prepared up to year 1974/75. This tells us that to obtain management accounting information of the rural schemes in almost all of the regional offices is very difficult. Therefore, since management of financial resources is a major key to successful operation, there is a need to adapt a more comprehensive and adequate accounting system. Cost

accounting techniques for use in construction, operation and maintenance are absolutely essential for providing accurate and meaningful cost estimates and expenditure data.

The accounting systems employed even by urban water centers were devised many years ago for conditions which no longer exist. They are particularly inappropriate where financial self sufficiency is required.

Therefore the accounting procedure of the rural schemes should be simple and it must be able to give accurate up-to-date information including proper valuation of the system, operating expenses, cash position and requirement for new capital improvements etc.

#### 6.2.2 Budgeting

Budgeting is the act of interpreting the operation and maintenance of the organization goals in meaningful monetary terms. It is used to control the financial activities of the organization (AWWA 1982).

The finance and administrative service of the regional office does little work in budgeting other than processing reports to the head office. Records of budget allotments and commitments certification of funds available are not adequate to provide information for good budget management. The present budgeting system even at the head office level needs improvement.

No budget forms or guidelines are given to the regional offices as a preliminary to the budget preparation process. The budget process should be more structured and formalized. Regional offices need guidelines and directions indicating organizational goals and objectives as well as possibilities for financing work progress. Information concerning predictable trends in costs of supplies, materials and equipment or costs of personal services would enable those preparing budget estimates to calculate program expenditures realistically (Public Administration Service 1982).

Budget preparation should be a group project, involving the regional manager, key operation and maintenance staff with key personnel from administration and finance service. All phases of construction, operation and maintenance should be carefully examined in order to prepare an accurate and realistic budget.

To effectively monitor and control operation and maintenance organizations there must be a realistic well conceived financial plan of action, that improves the performance standards and raises the quality of services. Therefore the Planning and Programming Department, the Finance Department at the head office level and Finance Service at the regional level should be well organized with qualified manpower and necessary facilities.

### 6.3 Development of Equitable Water Rates

The task of developing an equitable water rate is an attempt to establish and design rates what will be fair to all customers and to the utility as well (Ide 1980).

Water supply, whether large or small, requires funds for its management, operation and maintenance. It is impossible for a water utility to render satisfactory service and meet the requirement of future expansion without adequate funds. No matter how poor the community may be, some fee can and should be collected from the consumers. It has been said that the day when people start to receive water free of charge from a water supply system marks the beginning of the downfall of the system except a few desert areas where water should not be denied to thirsty traveller and his animals (Wagner and Lanoix 1959).

However in Ethiopia except Central Region where revenue is collected from bigger rural schemes, all regions supply water free of charge to all schemes. That is why most of the rural schemes are in severe shortage of finance for operation and maintenance and are deteriorating.

The government of Ethiopia is not fully able to allocate money for all rural schemes' operation and maintenance. Although donor agencies often contribute funds to capital assistance, rarely are operation and maintenance costs funded externally.

Therefore rural schemes have to be self sufficient for smooth running of the system.

No favours should be granted and no exceptions should be made in collection of water fees to guarantee revenues and a satisfactory service (Wagner and Lanoix 1959). A water utility functions better if operated on an independent self sustaining basis by revenues derived through the sale of water (Kuranz 1968).

In establishing water rates for rural water supply systems it is necessary to compile data on expenses for (a) the production (costs of labor, energy, supplies), (b) the distribution of water (costs of labor, operation, maintenance, supplies), (c) the administration of the system (Wagner and Lanoix 1959).

Water tariff in Ethiopia has not been properly studied and set but there are different tariffs which are randomly set by municipalities and various organizations at different time. The tariffs even today being in use in urban towns have been set without any detail study of the water supply systems requirement for future expansion, operation and maintenance needs.

The tariffs for the urban towns with adequate water supply system vary from Ethiopia Birr 0,50/m<sup>3</sup> to 1,0/m<sup>3</sup> where as for towns with low water supply system vary from free supply to Ethiopian Birr 2,0/m<sup>3</sup> (WSSA 1985c).

Tariffs in towns with a population of less than 10 000 having different water supply systems are listed in table 6.1.

Table 6.1 Tariffs of Different Towns in Ethiopia with a Population Less than 10 000.

| Water Supply Region | Administrative Region | Name of Town | Population in 1984 | Water Source | Tariff Birr/m <sup>3</sup> |
|---------------------|-----------------------|--------------|--------------------|--------------|----------------------------|
| Central             | Arsi                  | Abomssa      | 4863               | Well         | -                          |
|                     |                       | Derra        | 4949               | River        | 1,00                       |
|                     |                       | Huruta       | 5231               | Spring       | -                          |
|                     |                       | Kofelle      | 5181               | Spring       | 0,50                       |
|                     |                       | Robi         | 9303               | Well         | 0,50                       |
|                     | Shoa                  | Alaba Kulito | 8902               | Well         | 1,00                       |
|                     |                       | Awash        | 4195               | River        | 1,00                       |
|                     |                       | Debre Sina   | 5058               | Spring       | 0,50                       |
|                     |                       | Sendafa      | 2482               | Well         | 0,75                       |
|                     |                       | Zeway        | 6505               | Well         | 0,50                       |
| Eastern             | Hararghe              | Alemaya      | 6731               | Lake         | 1,00                       |
|                     |                       | Bedessa      | 6654               | Spring       | 0,50                       |
|                     |                       | Gelemso      | 7271               | Well         | 1,00                       |
| Northern            | Eritrea               | Gode         | 1766               | River        | 0,50                       |
|                     |                       | Adikeyi      | 8691               | River        | 0,30                       |
| N-E 2               | Wollo                 | Akordat      | 5948               | Well         | -                          |
|                     |                       | Deke Mehari  | 7290               | Well         | 0,60                       |
|                     |                       | Asayita      | 6859               | Well         | 1,25                       |
| N-Western           | Gojam                 | Hayik        | 5055               | Well         | 0,50                       |
|                     |                       | Korem        | 9231               | Well         | 1,25                       |
|                     | Gondar                | Bichena      | 8287               | Well         | 1,25                       |
|                     |                       | Dejen        | 6760               | Spring       | 1,00                       |
|                     |                       | Addis Zemen  | 9093               | Well         | -                          |
| Southern            | Bale                  | Kola Diba    | 6837               | River        | -                          |
|                     |                       | Dodola       | 8287               | River        | 0,50                       |
|                     | Gamu Goffa Sidamo     | Gidole       | 8399               | Spring       | 0,50                       |
|                     |                       | Aleta Wondo  | 9685               | Well         | 1,00                       |
|                     |                       | Wonago       | 3493               | Well         | 1,00                       |
| Western             | Illubabor             | Yabelo       | 5985               | Well         | 0,50                       |
|                     |                       | Bedelle      | 6988               | River        | 1,00                       |
|                     |                       | Gambella     | 4492               | Well         | 0,50                       |
|                     | Keffa Wollega         | Limu Genet   | 4224               | Well         | 1,00                       |
|                     |                       | Mendi        | 3778               | Spring       | 0,50                       |
|                     |                       | Shambu       | 8252               | Spring       | 0,50                       |

From table 6.1 we can see that small towns in regions where regional offices are located have some type of tariff set. But revenue collection performance is poor. The money collected is used for other purposes by individuals or committee since strict control system does not exist. In order to operate efficiently a water utility must be able to

generate adequate revenues at the proper time with the necessary control measures put into effect.

In Ethiopia since equitable water rates have not been developed till now, it is necessary to make a study in the eight regions and come up with a rate schedule that is reasonable and equitable to the rural community. The price of water that will be developed should be such that all communities can afford to pay and to cover local operation and maintenance costs.

Of course all the parties involved should realize that producing and storing safe water and pumping it into the public taps is a very big process that has costs that need to be paid. If revenues are not at all or not sufficiently generated from the beneficiaries, national efforts to provide the entire population with community water supply services will remain hampered by lack of financial means.

As a result of investigations made in the Central Region, the only region where revenue is collected, 90 % of the rural schemes are not able to cover their operation and maintenance expenses. Although the author has not been able to obtain definitive set of revenue data, there are deficiencies in the present revenue collection system. Master water meters are not installed in almost all schemes which is one of the deficiencies that has a major effect in revenue collection. Moreover, the majority of the schemes water rate is only Eth. Birr 0,50/m<sup>3</sup> although operation and maintenance expenses are high. Therefore, the author would like that immediate reform be made in the deficiencies.

Since the development of equitable water rate will take time till proper study is made, the author proposes water tariff for rural schemes to be set to Ethiopian Birr 1,00/m<sup>3</sup> and be subsidized by the government as necessary to cover operation and maintenance expenses.

Some contribution in cost in rural water supply systems is realistic and essential both to the community and the Authority because

- a) it is desirable for beneficiaries to contribute toward the cost of service they receive,
- b) it will enable the Authority to expand its programme,
- c) it will help to ensure that funds are available to meet operation expenses and the cost of minor repairs,
- d) the communities' sense of responsibility for the system will be increased, encouraging good maintenance and careful use of facilities.

Therefore management and institutional arrangement have to be made in order to devise equitable water rates for the rural community to overcome the deficiencies that exist in operation and maintenance.

#### 6.4 Procurement of Materials and Equipment

Procurement of materials and equipment, when taken in its broader meaning of comprising manufacturing transportation, storage and distribution, is an essential element for a successful implementation of rural water supplies as well as for their maintenance.

Construction materials and equipment account for 50 to 60 % overall project costs for the average water supply project. For implementation of rural water supply schemes, a large proportion of the project cost is spent on materials and equipment (DHV Consulting Engineers 1981).

Without a properly functioning procurement system severe set-backs will be experienced in the construction and maintenance of rural water supply schemes. Therefore, the equipment and material supply department at the head office must take the responsibility of organizing the procurement operations of all regional offices concerning the rural schemes. It must prepare and give procedural guidance for the regional procurement.

#### 6.4.1 Procurement

Procurement procedures are time consuming. A substantial amount of pre-job analysis has to be performed prior to execution or maintenance of rural water schemes. Several planning studies in construction materials, spare parts for maintenance, manpower and equipment have to be concluded if success is to be attained in supplying the rural community with uninterrupted service. Therefore, a well defined and structured method of concise procurement planning must be executed.

Procurement has to provide assurance that materials are specified, ordered and delivered to the site to meet the requirements (Parsons 1980). In order to determine what is required to safe-guard the procurement of items that are essential for the construction and maintenance of rural water supply schemes, it is necessary to obtain an impression of the quantities of equipment and materials by different rural schemes.

In Ethiopia, as in most of the developing countries the procurement of all required materials and equipment for the rural water supply schemes follow the respective government procedures.

In practice the following supply possibilities within the country exist

- local (private shops),
- government stores,
- large supplies of special items, and
- main stores or regional stores of the water sector.

But since most of the rural water supply schemes construction in Ethiopia are funded by donor agencies, materials are imported directly from abroad by respective donor.

The problem of procurement arises for the project that are not funded by donors and for the spare parts in operation



and maintenance. This is due to the non-existent of procurement procedures combined with lack of qualified manpower and high shortage of funds. Even when there are funds due to unorganized procurement procedures and lack of inventory controlled purchases of fast moving materials, rural schemes are not giving proper services to the community.

No supply system in developing countries can afford to stock to meet every possible need. The more commonly needed items are part of a continual inventory that revolves fairly regularly and must be purchased on regular basis. But in almost all regional offices and even at the head office level this is not well controlled. No effort has been made till now to purchase common supplies in bulk quantities which result in lower unit prices and reduce the number of purchase orders and related processing that they require.

The time of procurement is crucial as it is essential that projects are not delayed through lack of supplies. Ideally stock of materials should be built up at main or regional stores to cushion the effects of inevitable delays in delivery (Glennie 1983).

#### 6.4.2 Preparation of Specification

Careful preparation, procedures and methods to produce better specifications will minimize errors and reduce cost of delays and claims for extras for the materials and equipment to be procured. Before beginning a job specification, the plans of the schemes have to be studied so well that one has to become familiar with the work that will be specified. All useful information has to be stated. It is important that there exists no discrepancy between the plans and specifications. It is critical to identify those items which require a long lead to manufacture. Such items must be ordered long in advance before construction begins (Abdallah 1982).

The standards and specifications for the rural water supply systems should be uniform as far as possible to facilitate interchangeability and to reduce the problem of import (Glennie 1983). The specifications should be such that the customer will only receive prices on equipment that is compatible with his requirements from construction, materials and performance standpoint.

While analyzing the quotations that the equipment or materials offered comply with the specifications one has also to take into consideration not only the equipment cost but the life expectancy, ease of maintenance and availability of spare parts.

#### 6.4.3 Equipment Selection

The selection of any equipment must include considerations of the following factors: the quality of the product which generally relates to its length of lifecost of parts over its lifetime, the efficiency of the product when operational and performance costs are involved, the estimated costs of annual maintenance, the availability and expediency of spares and services, the quality and degree of installation supervision (Grunwell 1972).

Upto now in Ethiopia, specific limitations have not been placed on the type and quality of items which are to be purchased for rural schemes. Moreover the standards of equipment to be purchased by the authorities responsible have not been made to reduce requirement of specialized tools because most of equipment for rural schemes were given or brought by donor agencies. Therefore it was difficult to make proper selection. But in the future the Authority has to try to convince donor agencies to limit the types and standards of equipment and spare parts so that operation and maintenance difficulties are reduced.

#### 6.4.4 Material Supply

The inefficiency of procurement, storing and dispatching of materials, equipment and spareparts is negatively influencing several important activities in rural water supply schemes.

Construction is directly hampered by shortage of construction materials and equipment and indirectly by shortage of spare parts for drilling rigs, heavy construction equipment and trucks. Operation and maintenance of water supplies is severely hampered by shortage and delays in delivery of spareparts for pumping and transport equipment.

Utilization of transport equipment is very low as it is in many developing countries, partly because of shortage and late delivery of spare parts.

Transport capacity is a basic prerequisite for efficient utilization of manpower and materials in implementation of new water supplies and maintenance of existing ones. (Allmänna Ingenjörbyrå AB 1980).

#### 6.5 Control of Equipment and Supplies

The basic purpose of control is to detect problems while they are forming so that adjustment can be made before breakdown occurs. The objective is to watch enough and keep track of what is happening without going to expense of watching everything. The aim is to pick strategic points that will at least indirectly reflect the total operation (Ozone 1972).

WSSA is expanding by the transfer of rural schemes in addition to the increment of urban water supply systems. This increase will bring about additional equipment control and maintenance problems. Therefore, the management has to realize the importance of proper control of equipment, spare parts, materials and supplies in advance to reduce the difficulties that may arise.

All equipment should be maintained according to the engineer's and manufacturer's recommendations. In addition to the obvious benefits, maintenance will assist the operator in becoming thoroughly familiar with the system so that any change can be detected and investigated early, before a minor malfunction becomes a major problem. The first step is to compile a list of every piece of machinery and equipment in the system to secure manuals on each one. The manuals must contain detailed parts list, recommended lubricants and frequency of application. This is lacking in most of the rural water supply schemes.

Preventive maintenance gives the management a more positive control of works and equipment. Maintenance records have to be kept properly as they are of great assistance in the determination of the necessity of expanding and improving the water supply systems.

#### 6.6 Record Keeping

Although effective and efficient record system is an integral part of any water supply system program, the current record system of the rural water schemes in Ethiopia is not yet fully developed. Records either do not exist or are not sufficiently systematized to permit easy and timely access to information that might be required.

In the establishment and operation of sound and effective supply systems record keeping procedures are virtually important. Record keeping procedures which are presently used within the regional office are far from adequate or satisfactory. A review of the stock control records at the regional stores and central stores indicates that they are not serving the purpose for which they exist (Public Administration Service 1982). Therefore, to improve the operation and maintenance of the rural schemes with simultaneous increase in the efficiency of the regional office, proper record keeping procedure has to be introduced.

#### 6.6.1 Inventory Records and Control

An inventory consists of the supplies the operation and maintenance body needs to keep on hand to operate and maintain the community water systems. The supplies may include repair parts, spare pipes, spare valves, electrical supplies, tools and lubricants. System failures need to be corrected without unnecessary delays. Most failures in rural water supply schemes require repair parts or supplies to put the schemes back in working condition. The inventory of the schemes and the details of the repair parts necessary for successful functioning of schemes is very essential. In Ethiopia inventory control of rural water supply schemes have never been done till lately. This has caused many difficulties in operation and maintenance of the schemes.

The purpose of the inventory control is

- to provide needed parts and supplies quickly, thereby reducing delays
- to maintain accountability by providing records of what items were purchased, how many are in stock and when and how they are issued.

Therefore, for the smooth running of the rural schemes proper inventory control in all regional offices is very vital.

#### 6.6.2 Stores and Store Keeping

Stores are meant to keep materials required for day to day operation of schemes. Storing of supplies includes receipt, putting in a warehouse, and issuing of various types of items (spare parts, equipment). If store keeping is to be effective supplies must be located in the position within the storage that records indicate. They must also be in a serviceable condition and available to be issued.

But storage facilities in the regional offices and at the central store in Addis Ababa indicate that warehousing of supplies and materials is performed without order or plan.

## 7. HUMAN RESOURCES DEVELOPMENT

It is a sad fact that the developing world contains many examples of water supply schemes which upon completion fail to reach more than a small fraction of expected levels of performance. The true causes of many failures relate more to deficiencies in human resources i.e. the way in which human resources of the water sector are developed and deployed (Spencer 1985).

Human resources development is a systematic approach to develop the people needed to do a job properly.

Human resources development is a process which involves three independent components; planning training and management (Carefoot and Gibson 1984).

The traditional approach to human resource development has often been to set up short training schemes of water supply staff, timed to coincide with completion of physical works. This approach fails to take account of the fact that training is not a once-and-for-all event, but especially for managerial staff, is a continuous process of development. Furthermore, the activities necessary to create a full competent water supply organization go far beyond the relatively narrow confines of on-the-job training. It involves a combination of the three components planning, training and management. As Carefoot and Gibson (1984) put it, management is not only management of human resources planning and human resources training, but it is also the management of human resources in the fullest sense. It requires a close and careful look at each of the three components.

Rural water supply development is a field requiring the combined technologies of most disciplines of engineering. Professional personnel such as hydrologists, civil engineers, sanitary engineers, mechanical engineers, and electrical engineers are indispensable.

At the sub-professional level surveyors, geology assistants, engineering assistants, draftsmen, construction foremen, drillers, mechanics, welders and electricians are needed.

In economic and social development the key factors that govern the pace of progress are natural resources, capital and skilled manpower. In Ethiopia, rural water supply development suffers from the chronic problem of lack of financing. The prevailing general shortage of skilled technical manpower in the country makes it difficult to acquire new staff. The water sector has less attractive salary scales than most other competing organizations thus, has not attracted an adequate number of qualified staff. These factors coupled with others make special training necessary in order to obtain additional manpower (Achamyeleh 1980).

In Ethiopia deficiencies exist in all areas of planning and developing training programs. In most cases management of water supply systems are not aware of the needs and give only token support to program development and participation.

### 7.1 Planning

Manpower planning involves forecasting and planning for the right number and the right kinds of people at the right places at the right times and at the right costs to perform activities that will benefit both the organization and the individuals in it (Carefoot and Gibson 1984).

Lack of up-to-date data of the present and future requirement of manpower in the water supply and sanitation sector is a major constraint in the human resources development process.

Therefore, the first step in manpower planning has to be the compiling of an inventory of the existing manpower. This can be arranged according to the job categories.

**HUMAN RESOURCES INVENTORY**  
**WATER SUPPLY & SANITATION\***

COUNTRY: \_\_\_\_\_ DATE: \_\_\_\_\_  
 AGENCY/MINISTRY: \_\_\_\_\_  
 POPULATION SERVED BY: HOUSE CONNECTIONS/SEWERS: \_\_\_\_\_  
 STANDPOSTS/ON-SITE DISPOSAL: \_\_\_\_\_  
 COMPLETED BY: \_\_\_\_\_

| JOB CATEGORY | Job Classification   | Grade | Presently Appointed Current Establishments | Number in Post -- According to Age |         |         |  | Total | Remarks |
|--------------|--|-------|--|------------------------------------|---------|---------|--|-------|---------|
|              |  |       |  | Under 25                           | 25 - 35 | Over 35 |  |       |         |
| A            | DIRECTOR-GENERAL<br>DIRECTOR<br>GENERAL MANAGER<br>CHIEF ENGINEER<br>CHIEF LEGAL OFFICER<br>CHIEF CHEMIST<br>CHIEF   |       |  |                                    |         |         |  |       |         |
| B            | ENGINEERS (Civil & Sanitary)<br>ENGINEERS (Mechanical)<br>ENGINEERS (Electrical)<br>HYDROLOGISTS<br>HYDROGEOLOGISTS<br>TRAINING OFFICERS<br>SENIOR SANITARY INSPECTORS<br>ADMIN./FINANCE OFFICER   |       |  |                                    |         |         |  |       |         |
| C            | TECHNICIANS - Water Resources<br>- Water Supply Design<br>- Laboratory<br>- Operation/Maintenance<br><br>DRAFTING/SURVEYING<br>SANITARY INSPECTOR/SANITARIAN<br>TRAINING STAFF<br>ACCOUNTING/BOOKKEEPING<br>PURCHASING<br>STENOGRAPHERS<br>CHIEF OPERATORS/SUPERINTENDENT<br>SECRETARY |       |  |                                    |         |         |  |       |         |
| D            | TECHNICAL OFFICERS<br>JUNIOR SANITARIANS<br>LIBRARY ASSISTANT<br>STORE KEEPER<br>CASHIER<br>TYPISTS  |       |  |                                    |         |         |  |       |         |
| E            | ELECTRICIAN<br>MECHANIC<br>PLUMBER/FITTER<br>CARPENTER/MASON<br>WELDER<br>PAINTER  |       |  |                                    |         |         |  |       |         |
| F            | WATERWORKS OPERATOR<br>SEWERAGE-WORKS OPERATOR<br>SANITARY AIDS<br>DRIVERS   |       |  |                                    |         |         |  |       |         |
| G            | LABOURERS<br>GUARDS/WATCHMEN<br>OTHER  |       |  |                                    |         |         |  |       |         |
|              | Total  |       |  |                                    |         |         |  |       |         |

EXAMPLE

(\*) In the "Number in Post" columns -- (5)(6)(7)(8) -- indicate in brackets the number of expatriates including volunteers, contract employees, etc. working for the agency.

|        |               |   |  |
|--------|---------------|---|--|
| Legend | Job Category: | A - Senior Management                                 | B - Junior - Technical/Admin./Clerical |
|        |               | B - Profession - Senior Technical/<br>Admin./Clerical | C - Operator                           |
|        |               | C - Intermediate - Technical/<br>Admin./Clerical      | D - Unskilled and Semi-skilled         |
|        |               |   | E - Community-based personnel          |

\* It is intended that separate forms be utilized by the water supply and sanitation sub-sector agencies and ministries.

Fig. 7.1 Sample Form for Inventory of Manpower (Carefoot and Gibson 1984).



A manpower inventory is a tabulation of human resources placed by grade and by job classification into job categories assigned to the Head Office and Regional offices.

Existing manpower of the rural water supply schemes in the regional offices in Ethiopia is shown in table 7.1.

Table 7.1 Manpower of the rural water supply schemes in Ethiopia.

|       | Region                       | Number of Employees |          |       |
|-------|------------------------------|---------------------|----------|-------|
|       |                              | Permanent           | Contract | Total |
| 1     | Central Region<br>(Nazareth) |                     |          |       |
|       | a) office workers            | 20                  | 11       | 31    |
|       | b) Rural schemes employees   | 30                  | 82       | 112   |
| 2     | Eastern (Dire Dawa)          | 19                  | 1        | 20    |
| 3     | North Eastern<br>(Combolcha) | 11                  | 1        | 12    |
| 4     | North Western<br>(Bahir Dar) | 15                  | -        | 15    |
| 5     | Western (Jimma)              | 12                  | 3        | 15    |
| 6     | Southern (Awassa)            | 20                  | -        | 20    |
| Total |                              | 127                 | 98       | 225   |

Since Central Region is the oldest and the only region to implement revenue collection for the services that they give for the customers, the number of employees is more than 50 % of the total employees in all the regions. This does not give sufficient information on the available manpower in the regional offices.

A current staff inventory is an essential tool for sector managers and planners. It identifies the current staffing

situation and focuses attention on the current staff requirements. In addition it provides an indication of the distribution of manpower between the head quarter and the regional offices of the Authority. The data that will be provided in the inventory must be used to develop manning ratios and staffing patterns, which can be used as a basis for determining future human resources requirements and possible re-distribution of staff.

Manning ratio is simply the ratio of current employees to population served. Manpower requirement for water supply agencies (developing and developed countries) fall generally into broad range of one employee for 600 to 1 600 people served. A commonly accepted "range" used by planners in developing countries is one employee per 600 to 1 000 people served (Carefoot and Gibson 1984).

In Ethiopia the manning ratio of rural water supply schemes is one employee per 11 000 people served calculated from total regional office employees of rural schemes 225 and number of rural people served 2,5 million.

It is recognized that in many developing countries as in Ethiopia the baseline data for human resources planning is frequently incomplete. The water supply and sanitation plans are prepared without adequate human resources planning, with the result that planned services are either not delivered or are distorted due to lack of qualified staff.

## 7.2 Training

Human resources training development is a step that uses analysis to classify what and how much training and development is needed and appropriate for the organization and the trainees.

It is necessary to determine needs in order to assist the water supply and sanitation sector to meet its goals of extending the coverage and improving the quality of service that it gives.

WSSA like its equivalent organization in most developing countries, has immense task of supplying clear water to the country's rural population. To do this, however, it must overcome many shortcomings: organizational, financial and human resources development to name but a few. Training in water supply sector is geared toward alleviating the shortages of skilled manpower, its most pressing need at present.

To achieve the goals of the water sector in Ethiopia NWRC has started training programs that cover all relevant positions from pump attendant in its training institute at Arba Minch to postgraduate courses outside of Ethiopia.

During the author's visit to the regional offices, it was found out that training was generally accorded low priority within the regional offices. This is because of lack of time and incentives. Training was not available to operators in remote areas and often was poorly located to serve those who needed it most. For this and other reasons, training is found to be reaching only a small percentage of the operators judged to be in need of upgrading their skills. The deficiency is magnified when the sometimes poor quality of courses now offered is taken into consideration. But to assure a reasonable probability of success a water supply program that is to be implemented in rural areas must have a specialized personnel training functions. There must be a program designed to train lower level employees of the system. The program must include all sorts of maintenance training including the maintaining of the technical operations of local systems (Saunders and Warford 1976).

The single most important element in ensuring water sector's success is the training of adequate manpower. If one wants to gradually upgrade water quality and install new systems, then trained manpower is at the heart of the requirement (Falkenmark 1982).

Most of the water supply programmes are adversely affected by shortage of managerial, supervisory and technical skills.

Therefore, training of executive personnel should not be limited to technical matters. It should also include management and financial issues sociology and public relations.

The skill requirement for rural water programmes vary from simple (repair of village handpumps) to more complex ones (complete overhaul of drilling rigs). Therefore, the Authority must have viable plans for training of technicians, engineers and managers who should be responsible for the planning, organization, administration and supervision of the national water system. Training should be dynamic and flexible to cope up with equal relevance and effectiveness, with the skills requirements throughout this range. But priority should be given to training of

- workshop personnel who should carry out specialized repair, overhaul of pumps, engines and ancillary equipment;
- mobile maintenance and repair mechanics who should carry out periodic maintenance, over-all inspection of installations and supervision of records;
- village caretakers who will be responsible for the care, operation, maintenance and simple repair of equipment.

The guiding principle in selecting the type of training must be to keep the training as job related as possible. Systematic on the job training is appropriate for the development of most skills, particularly manual and supervisory skills (Carefoot and Gibson 1984).

Therefore to satisfy the rural population demand and to fulfill its objectives NWRC has to increase its capacity of the training facilities. It has to strengthen and expand the organizational framework as needed to keep abreast with expanded implementation programme of the rural water supply

schemes. The newly established water institute at Arba Minch has to be well equipped with the necessary training equipment and qualified trainees in the field.

### 7.3 Management

It has been said that good staff can make any system function reasonably well but that even with the best organizations effective management will not occur if the staff is not motivated or it is incompetent (Austin and Batchelor 1981).

The efficiency with which any organization can be operated will depend to a very considerable extent upon how effectively its personnel are managed. Since all organizations, regardless of their size, must operate with and through people, the management of such organizations is basically a process of managing people.

Reorientation of human resources development, in water and sanitation, to achieve the goal, requires radical changes in the attitudes and skills of managers. Motivating employees and enhancing their job satisfaction are essential elements of good management. The concern of those who manage human resources should include: the formulation of policies with respect to the recruitment; employment and retention of human resources; the monitoring of requirements for various skills, the appropriate distribution of the workforce; bearing in mind the needs of underserved population and the skills required to serve these needs; the supervision of employees and the provision of continuing education and training to help improve their performance; the provision of material incentives; the provision of career development opportunities; the evaluation of performance of employees and the provision necessary logistical support (Carefoot and Gibson 1984).

Human resources management includes all managers who manage people whether they are designated as training personnel,

staff, operational or general managers. It also embraces those who, whilst not given the title of manager, nevertheless manage people e.g. supervisors, foremen.

Managers have a two fold responsibility for task management, on the one hand, and for the people management, on the other. But in most of the rural water supply schemes too much emphasis is given on the task side and not enough on the people management side. (Carefoot and Gibson 1984).

Balancing the needs of the organization with the needs of the employees is one that makes up the organization. Therefore, individual managers need to understand not only the needs of the organization in technical and operational sense but also the needs of the employees.

Since rural water supply in Ethiopia is still in its infancy a lot has to be done to develop a well and functional management system that will improve performance of the employees.

## 8. RECOMMENDATIONS

Rural water supply system management has reached a stage whereby it has to be given greater emphasis to fulfill the identified objectives. Due to the various problems which were not taken seriously enough during planning, organizing, directing and controlling stage, the management has never been functional enough to meet the set requirements. This has led the rural water supply schemes not to attain their intended goals. Thus the recommendations of this study are not the only solutions to the problems but deemed, if carefully given full attention, to reduce the constraints or bottlenecks which hinder the implementation, operation and maintenance of the rural schemes.

To strengthen the activities in all regions the following main actions should be taken.

### 1. Organization

Organizing is the central task of water supply managers. Without good organization, the physical assets of the schemes, the different units, its tools, equipment, material and supplies cannot be used efficiently. The employees responsible for the implementation, operation and maintenance cannot perform to the best of their skills and abilities without the requirements are first met. Rural water supply schemes lacking good organization in depth will not achieve their long range objectives. It is also important to provide more resources for the maintenance of the schemes in line with the theme of making most of the existing assets.

Therefore it is recommended:

- (i) The Authority organizes a sound organizational structure with the necessary manpower taking into consideration the operation and maintenance requirements of the large expansion of the Authority.

- (ii) Regional offices should be strengthened and constituted primarily as operation and maintenance body assuming responsibility for all public water supplies within their region. The necessary resources have to be allocated for efficient management of the schemes.
- (iii) The Authority should include in its organizational set-up a logical and clearly defined lines of authority and responsibility for the implementation operation and maintenance of the rural schemes as shown in the proposed regional office organizational set-up.
- (iv) The development of new rural water supply systems should be temporarily reduced until a high proportion of existing supplies are well maintained.
- (v) The resources and finances saved by the reduced development programmes should be devoted to the improvement of operation and maintenance.
- (vi) The schemes that are still working and only requiring minor repair receive priority over supplies where rehabilitation is required.

## 2. Manpower

The manpower requirement for the rural water supply systems largely depends on the type of schemes constructed or to be constructed and the type of maintenance selected. Many deficiencies in administration, quality of work in construction, operation and maintenance can be traced to inadequate supervision and lack of proper human resources development.

Therefore, it is recommended:

- (i) The Authority enforces much stricter supervision of working procedures.



- (ii) The Authority obtains staff who could deal with
  - management supervision and training
  - general inspection
  - preventive maintenance
  - administration of equipment, materials, supplies and stores
  - vehicle maintenance.

3. Operation and Maintenance

- (i) A more rigorous inspection of completed schemes is required. In particular the obligation of the contractor during maintenance period should be effectively enforced.
- (ii) A short comprehensive daily working instruction for each specific mechanical unit should be stuck on the pumphouse wall above the relevant unit. This would help to ensure that the staff are more aware of all the necessary preventive maintenance routines.
- (iii) Simplified daily schedules of activities should be prepared in chart form and permanently displayed in all regional offices and schemes, too.
- (iv) Minor and major overhaul must be done according to manufacturer's requirements.
- (v) A senior mechanic from the regional office should have to visit schemes for thorough investigation of the operational status of schemes at scheduled interval of time and also when emergency case arises.
- (vi) Improved and usually increased stocks of materials are required at all levels to minimize the frequency and duration of schemes breakdown.
- (vii) Spareparts for most major repair requirements should be kept in the regional offices workshop. At scheme

level only parts for regular maintenance and minor repairs will be needed. As the Authority experiences considerable difficulties in getting spares for well known and frequently used makes, serious investigations should be made to find possibilities for decreasing the shortage of spare parts when purchasing engines and pumps. Moreover, for major breakdown spare pumping units should be stored at the regional office level. In addition to material for rural supplies, vehicle spares should also be stored at the regional level.

All personnel assigned to the warehouse and supply storage areas must be properly trained in storage procedures and material handling techniques and provided with adequate material handling equipment and the necessary storage areas.

#### 4. Mobile Maintenance Team

It is suggested that an improved operation and maintenance capability should be organized on a regional based mobile maintenance team equipped to deal with schemes breakdown routine maintenance operations which cannot be carried by scheme operation staff.

The current regional office maintenance organizations and schemes operation staff need to be strengthened with adequate finance, transport, skilled staff, supplies and materials. Therefore, more efficient management is required to help alleviate the current operation and maintenance shortcomings.

#### 5. Rehabilitation

Rehabilitation of existing rural water supplies would be extremely cost effective investment. The author recommends that the Authority gives the first priority of consideration to larger schemes in high potential areas. Second priority

should be given to larger schemes of medium potential areas. The smaller schemes in the medium to low potential areas should be restored to design efficiency as a third priority. Nevertheless, the recommendation has to pay great attention in the maintenance and rehabilitation of existing schemes together with the expansion of new water supply systems construction in the rural areas so that the Authority meets its goals.

#### 6. Data Recording

If operation charts are to perform their planned function these charts must be regularly inspected by qualified personnel and the information fed to planners, designers and operation staff.

#### 7. Supervision

In most rural water supply systems, schemes staff are not capable of keeping the records that are required, thus they have to be shown and taught what is required and must be regularly supervised and guided by senior staff from the regional office. Improved supervision is required at all levels as a fundamental management input.

#### 8. Resources

The cost of operation and maintenance sample calculations should be made to clearly show the need for a cost and management accounting systems. This if developed on scheme basis will provide accurate information in which to base projected operation and maintenance financial requirements. Therefore, immediate action has to be taken to start the accounting systems of individual scheme.

#### 9. Revenue

A proposal has been made for the Authority to take over revenue Collection. It is also recommended that water rates

be set to Eth. Birr 1.00/m<sup>3</sup> (one Birr) till a thorough study is made that will enable the water rate to be sufficient enough to cover all operation and maintenance expenses without any subsidy being required from the government. The Authority should also organize its accounting system so that it can take all the responsibility of its revenue functions.

#### 10. Supervising Staff

Two senior engineers should be assigned at the head office level to take the full responsibility, one of them for the construction control and the other one for the operation and maintenance of all the rural schemes in the eight regions. However, more engineers have to be assigned as the need arises in the future.

They should take the responsibility for collecting data sheets from the field and schemes and make regular inspection tours. They should also be responsible for any technical help needed at the regional level.

At each regional office a senior engineer should be assigned and be responsible for giving technical help to the schemes while an administrative officer is required to carry out the office administrative routine. The senior engineer should be responsible for designing minor extension and alterations with the approval from the head office.

#### 11. Fund

In order for the management of rural water supply systems to run smoothly, keep pace with the advocated increase in capital investment and improve the operation and maintenance of the schemes a substantial growth in the allocation of sufficient amount of funds is very important.

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