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Tampere University of Technology
Department of Civil Engineering
Institute of Water and Environmental Engineering

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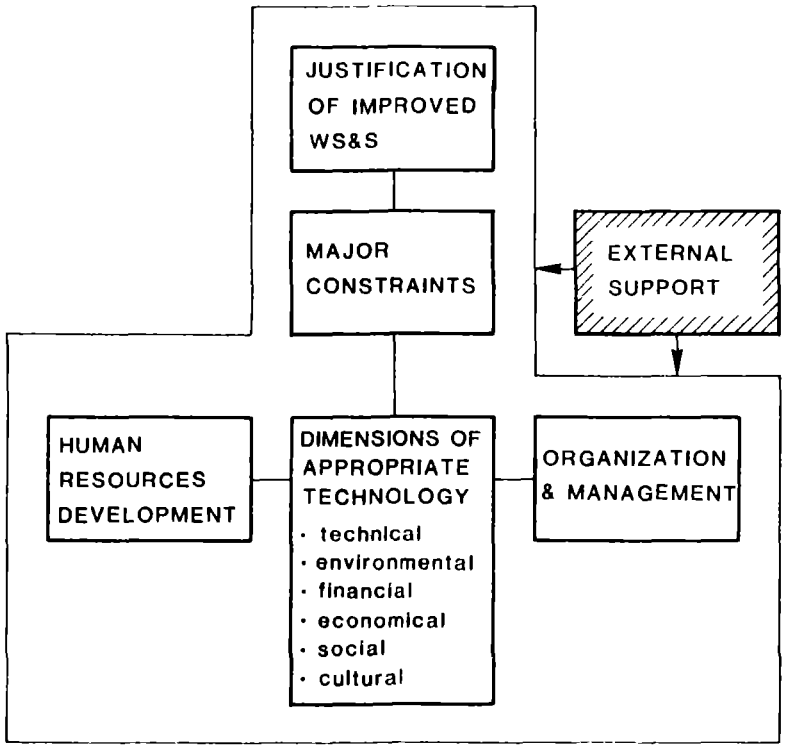
Katko Tapio

Technical and Non-Technical Aspects of Externally Supported Rural Water Supply Projects in Developing Countries



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PREFACE

This study was carried out at Tampere University of Technology (TUT), the Institute of Water and Environmental Engineering mainly in 1986 - 1987. The study and the preceding survey were both financed by the Academy of Finland. This support is gratefully acknowledged.

The research topic "Development Cooperation Projects in Rural Water Supply and Sanitation -Alternatives for Transferring Responsibility to the Recipients" has been inspired by TUT's involvement in various water sector activities, particularly the postgraduate training programme in and for East-Africa. The theses prepared by the African participants in this programme have made valuable contributions to my work. In the study I have also utilized my field experiences in Malawi and Tanzania.

The study is divided into two separate parts. The first one published in this report covers widely the scope of rural water supply and external support in developing countries. The second part of the study published in a separate volume deals with Nordic-supported rural water supply projects in Tanzania. Together these studies form my licenciate thesis.

I would like to express my sincere gratitude to Professor M. Viitasaari from TUT for continuous encouragement and supervision of my study. Especially the views and support of Messrs. R. Häkkinen and P. Rantala at TUT are highly appreciated. Special thanks go to Mr. J. Heinänen, Dr. R. Lucas and Dr. A. Mashauri for commenting on the manuscript.

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Tampere, December 1987 Tapio Katko

Katko, T. 1987.
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ABSTRACT

The study covers widely the technical and non-technical aspects of externally supported rural water supply projects in developing countries.

Improved water supply has some positive impact on health conditions. The benefits increase by proper sanitation and health education. Additionally, the economic effects, mainly savings in time and energy, should be considered. The allocations by international organizations to the water supply sector have typically been two to four per cent of their total assistance. The Water Decade has hardly managed to attract additional external resources to the sector. The governments of the developing countries will not be able to increase their allocations nor will they be able to supply water free of charge, which some of them are doing now.

A survey was done on the major constraints in rural water supply in four selected countries. Foreign experts as well as representatives of the national governments were interviewed. The difficulties in operation and maintenance combined with logistics were the most severe constraints in all countries as seen both by the national governments and by foreign experts. The developing countries laid more stress on the lack of trained personnel and funding, whereas the foreign experts and, particularly, external agencies were more concerned about inadequate cost-recovery.

Appropriate technology has technical, environmental, economical, financial, social and cultural dimensions. In the implementation of rural water supply in developing countries, low-cost technology is in most cases appropriate. However, also high technology, for instance in telecommunication, mapping or in the inventory of deep ground water resources, is needed. Applied technical research in practical water engineering should be increased. The solutions developed mainly in and for temperate or cold climates do not necessarily work in the hot climates of developing countries.

Community participation should not be seen merely as a social activity but it should also include involvement and contribution. Pricing of water must be introduced. Women, the main drawers of water, should be involved at different stages of projects. Human resources development is very important in all development projects. Instead of the projects the national training institutions should be mainly responsible for education and training.

Because of the huge number of external agencies in the sector coordination is imperative. Experts and expert teams can be more suitable for planning activities. In large projects distinct and autonomous project management units are often needed. There is a high potential for cooperation in "twinning" between water supply boards and training institutions. Different organizational forms of assistance are not contradictory but should rather support each other.

Key words: external support, rural water supply, developing countries, major constraints, appropriate technology, human resources development, organizational alternatives.

Katko, T. 1987.
Technical and Non-Technical Aspects of Externally Supported Rural Water Supply Projects in Developing Countries. Tampereen teknillinen korkeakoulu, vesi- ja ympäristötekniikan laitos. Julkaisu A 33. 112 s.

TIIVISTELMÄ

Tutkimuksessa käsitellään laajasti maaseudun vesihuollon kehitysyhteistyöprojektien teknisiä ja ei-teknisiä näkökohtia.

Hyvällä juomavedellä voidaan parantaa terveysoloja jonkin verran. Hyödyt lisääntyvät, jos mukaan liitetään käymälöiden rakentamista ja terveyskasvatusta. Lisäksi tulisi huomioida ajan ja energian säästöstä saatava hyöty. Eri järjestöjen kokonaisavusta on vesihuoltosektorille tullut noin kahdesta neljään prosenttiin. Kuluva vesihuollon vuosikymmen on tuskin lisännyt tätä osuutta. Kehitysmaiden hallitukset eivät pysty lisäämään sektorin rahoitusta, eivätkä ne pysty järjestämään vesihuoltoa ilmaiseksi kuluttajille, kuten jotkut niistä nykyään yrittävät tehdä.

Maaseudun vesihuollon pääongelmat kartoitettiin neljässä kehitysmaassa. Sekä kehitysmaiden edustajat että ulkomaiset asiantuntijat pitivät käyttöä ja kunnossapitoa vaikeimpana ongelmana. Kehitysmaat painottivat enemmän koulutetun henkilöstön ja rahoituksen puutetta, kun taas ulkomaiset asiantuntijat olivat huolissaan riittämättömästä kustannusvastaavuudesta.

Soveltuvalla vesihuoltotekniikalla on paitsi puhtaasti teknisiä myös ympäristöllisiä, taloudellisia, rahoituksellisia, sosiaalisia ja kulttuurillisia ulottuvuuksia. Maaseudun vesihuollon toteutuksessa ovat yksinkertaiset, varmatoimiset ratkaisut useimmiten parhaita. Korkeaa tekniikkaa tarvitaan esim. viestinnässä, kartoituksessa ja syvien pohjavesivarojen etsinnässä. Kehitysmaiden soveltuvaa teknistä tutkimusta tulisi lisätä sektorilla. Lauhkean tai kylmän ilmaston ratkaisut eivät välttämättä toimi kehitysmaiden lämpimässä ilmastossa.

Kuluttajien osallistuminen vesihuoltohankkeisiin on tärkeää. Sosiaalisten seikkojen lisäksi myös taloudelliset seikat tulee huomioida. Vedestä tulisi periä kuluttajamaksuja. Erityisesti naisten tulisi osallistua hankkeiden eri vaiheisiin. Tärkeänä osana hankkeita on kehittää kohdemaan henkisiä resursseja. Avunsaajamaan omien oppilaitosten tulisi kantaa päävastuu koulutuksesta.

Avunantajien suuren määrän vuoksi koordinaatio on hyvin tärkeää. Yksittäiset asiantuntijat voivat sopia parhaiten suunnittelutehtäviin. Laajoissa hankkeissa tarvitaan usein erillisiä tai autonomisia projektiorganisaatioita. Sisarorganisaatiotoiminta avunantajan ja kehitysmaan laitosten ja koulutusinstituutioiden välillä on lupaava mahdollisuus. Kehitysavun eri muotojen tulisi tukea toinen toisiaan.

Hakusanat: external support, rural water supply, developing countries, major constraints, appropriate technology, human resources development, organizational alternatives.

TECHNICAL AND NON-TECHNICAL ASPECTS OF EXTERNALLY SUPPORTED RURAL WATER SUPPLY PROJECTS IN DEVELOPING COUNTRIES

TABLE OF CONTENTS

1 INTRODUCTION

1.1 Background of the Study

Rural water supply and sanitation is often seen as one of the most important sectors of development programmes for third world countries. Many of the developing countries have set an ambitious goal of supplying water and arranging proper sanitation to their people during this international water supply and sanitation decade. The results have, however, been commonly disappointing.

Water supply is also among the main assistance sectors of many external support agencies, although its share of the total allocations is usually only a few per cent.

There are three alternative approaches for meeting the goals of the water decade. We can start by developing appropriate technology which is low-cost but also durable in the conditions of developing countries. Secondly, we can develop the organizations channelling the support and implementing the projects. Thirdly, we can increase funds for the sector. Since external support is rather declining than increasing indigenous funding on national, regional and consumer levels is becoming a necessity.

The original research topic "Development Cooperation Projects in Rural Water Supply and Sanitation - Alternatives for Transferring Responsibility to the Recipients" is based on the previous studies done at the Institute of Water and Environmental Engineering, Tampere University of Technology (TUT). In 1983 a presurvey was done to find out the most important development and research needs in the sector. In 1984 the study was continued with the emphasis on development cooperation projects. This bore the need for research on alternatives for transferring responsibility to recipients. Since 1979 East-African water engineers have been trained at TUT and they have contributed to this research through their M.Sc. theses and doctorate dissertations. The author's field work in Malawi and Tanzania as well as several shorter visits to the East-African region have given necessary background orientation to the research topic.

1.2 Objectives of the Study

The primary objectives of this study focus on the following two questions:

1) What types and levels of technology should be used in development cooperation projects in the field of water supply and sanitation, so that they could be implemented, if possible, under the responsibility of the national institutions?

2) What are the organizational requirements for implementing the above mentioned projects?

Additionally, the concrete planning and implementation constraints are to be studied. It is hypothesized in this study that the sooner the responsibility is transferred to the national

institutions the more the projects face typical implementation constraints. These constraints affect the possibilities for achieving the goals and they can be

- import restrictions,
- lack of foreign currency,
- bureaucracy,
- lack of cooperation and coordination, and
- unclear rules and by-laws and difficulties in their interpretation.

With careful planning some of those constraints can be avoided. However, because of continuously changing conditions, certain flexibility is always needed.

1.3 Methodology and Structure of the Study

The whole study is divided into two sub-studies: the overall framework of externally supported rural water supply and a comparative study on four Nordic-supported projects in Tanzania.

This report covers the first sub-study. It is mainly based on fairly intensive literature review. The theses prepared by the African participants of TUT's postgraduate courses have made valuable contributions to the work. Jointly for the courses and the study several one-day workshops on specific topics have been organized. A survey on major constraints in rural water supply was made including a questionnaire and interviews. In the study the author has also utilized his field experiences particularly from Malawi and Tanzania.

This sub-study deals widely with the water supply sector in developing countries and forms a framework of the different aspects of development cooperation projects (Figure 1.1). The study starts with the justification of water supply and sanitation (chapter 2). The trends of external support in the sector are discussed in the following chapter. The fourth chapter is based on a survey on major constraints in the sector in Kenya, Malawi, Sri Lanka and Tanzania. This is followed by a comprehensive review, discussion and classification of appropriate technology.

Human resources development and training are discussed in the sixth chapter. The seventh chapter presents institutional and organizational alternatives for external support in rural water supply. Finally conclusions and recommendations are presented.

Parts of this study have been published separately, namely

Katko, T., 1986a.
Major Constraints in Water Supply in Developing Countries. Aqua Fennica. Vol. 16, no. 2. p. 231 - 244. (main parts of chapter 4).

Katko, T., 1987.
Organizational Alternatives for Externally Supported Rural Water Supply. Aqua Fennica. Vol. 17, no. 1. pp. 3 - 15.(main parts of chapters 3 and 7).

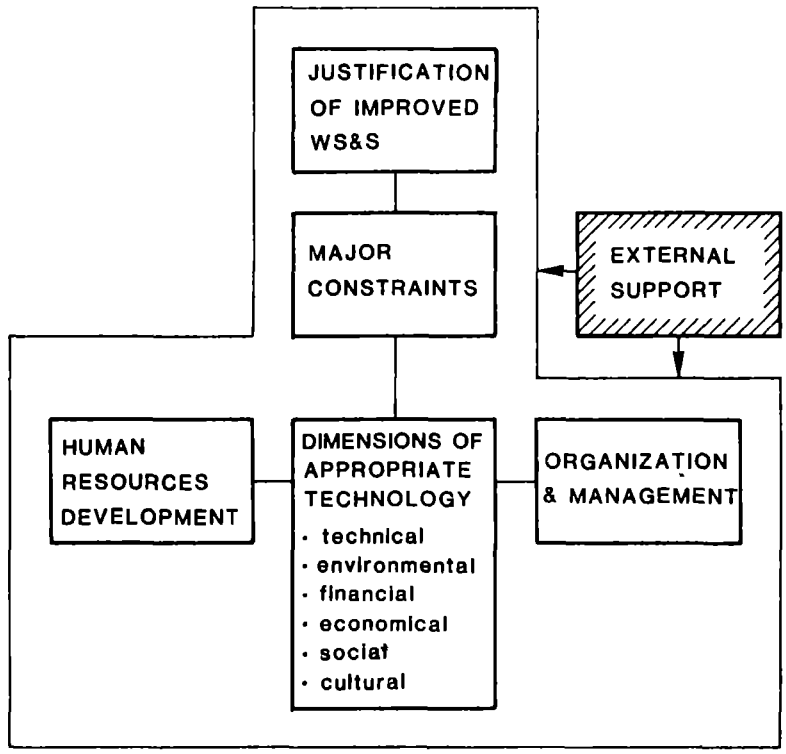

Figure 1.1 The structure of the study on externally supported rural water supply in developing countries.

The second sub-study on the Nordic support in Tanzania is published as report no. 34 of this same publication series. In December 1987 these two sub-studies combined have been accepted as the author's licentiate thesis by the Department of Civil Engineering, Tampere University of Technology.

2 JUSTIFICATION OF IMPROVED WATER SUPPLY AND SANITATION

2.1 Conceptual Framework of Possible Benefits

The potential benefits of improved water supply and sanitation as seen by Overseas Development Administration (ODA, 1985) are presented in Figure 2.1.

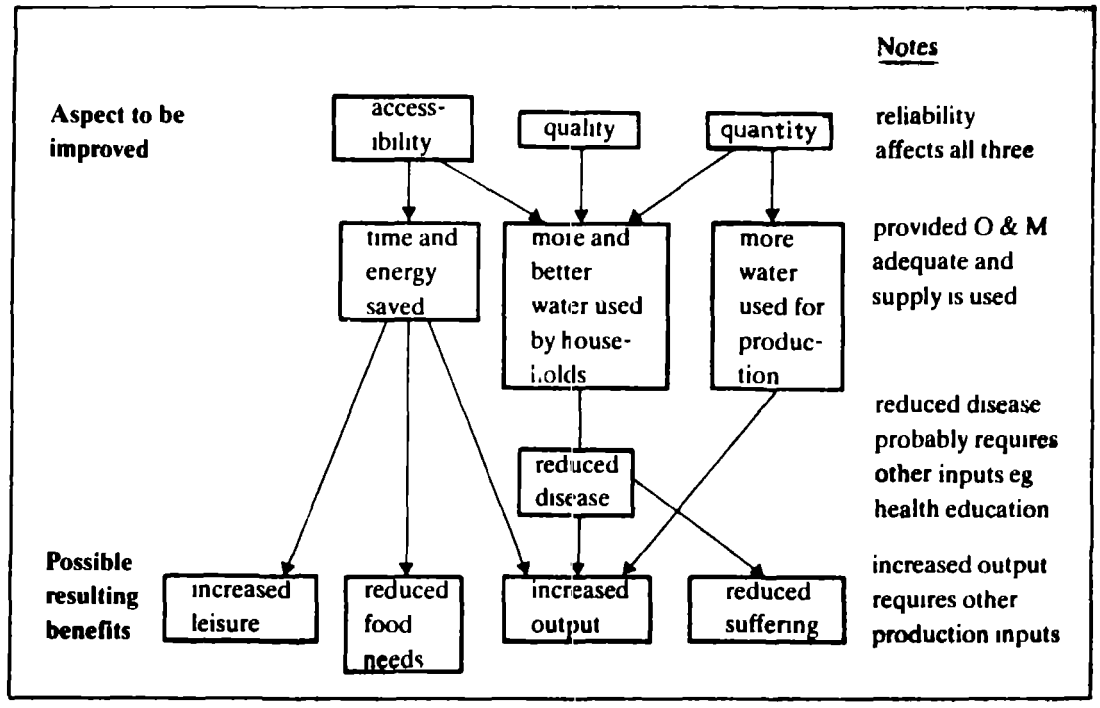

Figure 2.1. The Potential benefits of rural water supply and implications for appraisal (ODA 1985).

Improved accessibility, quality and quantity have positive effects if operation and maintenance is provided. The effects can be increased leisure and output or less hunger and suffering.

Figure 2.2 presents a conceptual framework of indirect and direct effects of improved water supply and sanitation. According to Cvjetanović (1986) it is, however, practically impossible to quantify this dynamic flow.

"Direct" health benefits are gained by preventing waterborne diseases and improving the nutritional situation. These benefits give time for productive work which generates "indirect" health benefits.

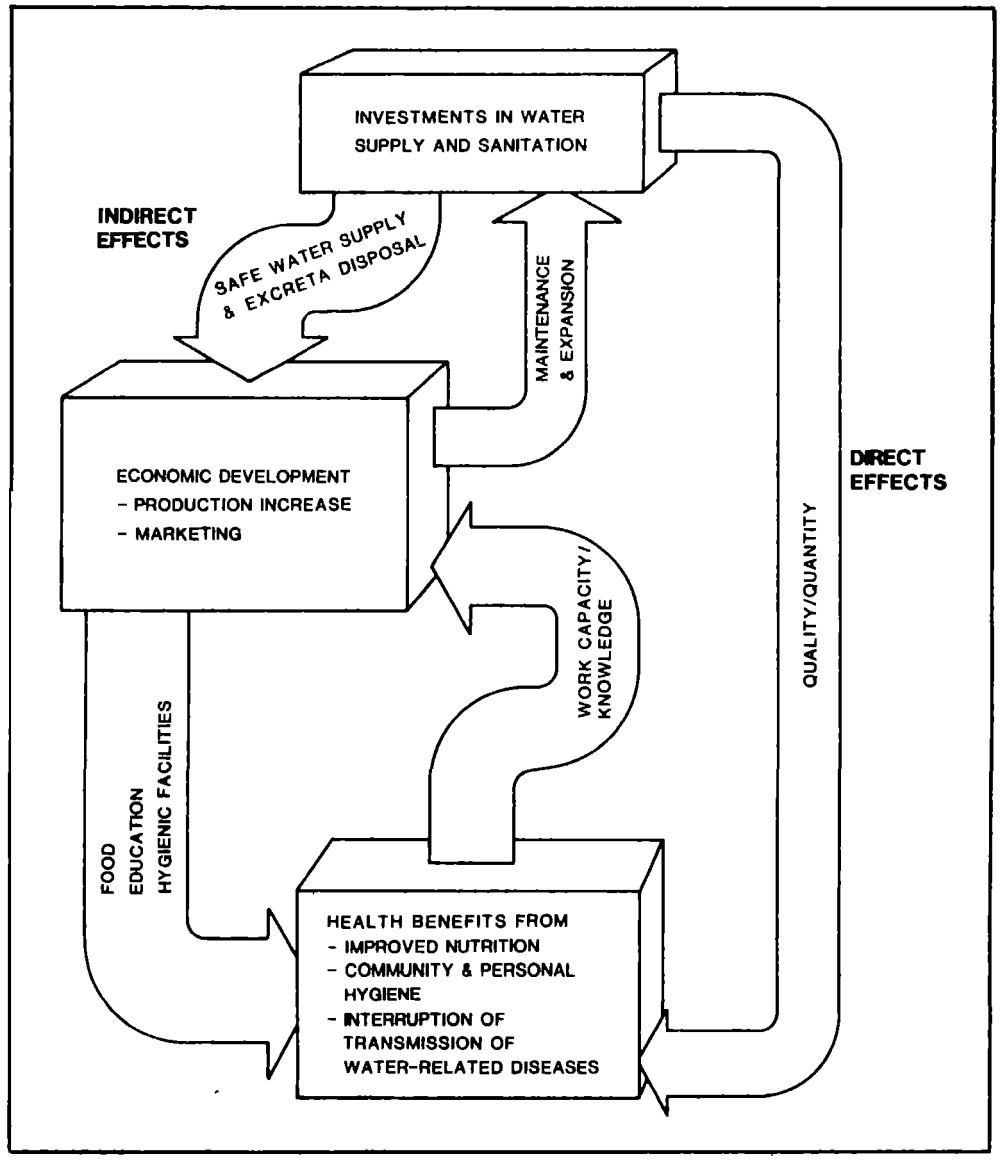

Figure 2.2. Conceptual framework on direct and indirect effects of water supply and sanitation investments (Cvjetanović 1986).

2.2 Health and Other Social Effects

There has been quite a debate on possible health effects caused by improved water supply and sanitation. For instance, Cvjetanović (1986) noted that the majority of studies on the health effects of water supply and sanitation deal only with their impacts on illness but not with their positive effects on health.

The World Health Organization, WHO has estimated that 80 per cent of all diseases in the world are water-related. The single most important disease is diarrhoea which according to recent thinking affects particularly children under five years of age.

In 1975 the World Bank invited an expert panel to give advice on how to estimate health impacts. The panel concluded

> "Long-term longitudinal studies of large size and expense are probably the only means through which there is any chance of isolating a specific quantitative relationship between water supply and health."

Because these studies, according to the panel, were very costly they should not be undertaken (World Bank 1976 cited by Briscoe et al 1986 and Cvjetanović 1986). According to Feacham (1987) this resolution has had negative effects on trials to quantify health effects.

Saunders and Warford (1976) classified the health effects as
- reduction in mortality rates,
- reduction in morbidity rates, and
- reduction in the spreading of disease.

When a person dies the community loses his/her lifetime output. There has been debate whether this should be calculated on a net or gross basis. Anyhow Saunders and Warford (1976) and McJunkin (1982) stressed that all the significant health improvements caused by improved water supply and sanitation have affected the children.

McJunkin (1982) concluded in his comprehensive review that there is a significant amount of evidence on a positive linkage between sanitary water supply and excreta disposal and long-term health effects. When diarrhoea morbidity and mortality are high, improvements of 20 to 40 per cent are not unusual.

Esrey et al (1985) cited by Briscoe (1986) have recently made a review on the impact of improved water quality and quantity. They have noticed considerable reductions in diarrhoea morbidity (Table 2.1). Water quality or quantity or excreta disposal alone reduced diarrhoea morbidity by about 20 per cent. Water quality and quantity together reduced illnesses by about 40 per cent.

Table 2.1. Impact of safe water and sanitation on diarrhoea morbidity (Esrey et al 1985, cited by Briscoe 1986).

Improvement in	Median reduction %
water quantity	25
water quality	18
water quantity and quality	37
excreta disposal	22

Briscoe (1986) pointed out that the death of a child in a developing country is seldom caused by one disease only. Water is one route for transmitting faecal oral pathogens, others include person to person contact and contaminated food. He concluded that for child survival, improved biomedical technologies such as oral rehydration therapy (ORT) and immunization are not enough. Improved water supply and sanitation is needed and all of the mentioned aspects should be seen mutually reinforcing.

In a workshop in Bangladesh 1983 Briscoe et al (1986) reported on measuring the health impacts of water supply and sanitation programmes. The earlier standard longitudinal studies were regarded too time-consuming and expensive. However, recent advances in rapid epidemiological assessment techniques have made case-control studies more reliable.

Miller (1982) reminded about one of the ironies of history; the level of public health was perhaps better in some preliterate villages and cities in the Near East than today. Excavations of ancient sites show that careful housekeeping was one typical aspect in early village behaviour.

SIDA (1980) reported on changes of the social structure in rural areas facilitating the modernization process. Additionally, benefits of greater social and economic equity are reached. Time and energy savings offer possibilities for improving social position of women.

2.3 Economic Effects

Time and energy saved

The World Bank (1986b) stated in its recent policy paper that rural water projects particularly lead to saved time and efforts in transporting water. It is usually possible to prioritize strategies without having to estimate the health effects. Even though health effects are vital for decision-making, it is still better to start by estimating the time-savings.

According to the World Bank (1986b) a key question in time-savings is how to value the time saved. This can be calculated by estimating how much the consumers could earn if they used the saved time for productive work. This concerns mostly women, the typical drawers of water. The World Bank stresses that the cost of transporting water is high compared to other cost factors even in low-wage economies. The strongest evidence of the value of time saving is perhaps the fact that in rural areas of developing countries households often choose to pay others to get water.

The saved time can be utilized if opportunities for productive activities exist (Saunders and Warford 1976). The author's view is that if these opportunities exist, they are not necessarily fully utilized.

Energy saved in transporting water also leads to reduced national demand as stated by ODA (1985).

Productive use of water

When rural water supply is provided there are, at least to some extent, possibilities to use water for productive purposes such as irrigation of vegetable gardens during periods when water sources like wells and taps are not in use. Mujwahuzi (1984) suggested that fish farming on communal basis could provide use for the water supplied. However, the quantity of water needed for fish farming is so high that it could only be considered when gravity supplies have excess capacity.

Bonnier (1984) proposed that development of rural water supplies should always be linked with productive use of water resources. If possible the responsibility of operating and maintaining the system, e.g. a hand-pump well should be given to a person who gains direct economic benefits when the system is working. In this case drinking water supply could be a by-product of the economic use of water resources. On the whole, this approach probably has quite a limited potential but it could be used in introducing new types of technologies.

2.4 Discussion on Justification

Mujwahuzi (1984) concluded in his paper that water supply projects have been chosen solely on the basis of social rather than economic factors. The economic factors should be considered together with the social benefits. He also criticized external supporting agencies for favouring social aspects. The 1980 resolution of the UN General Assembly connected with the Decade indicated this bias. Mujwahuzi continued that it is quite difficult for developing countries to have a different approach to that of the external supporting agencies. If the developing countries want to have the support they have no other choice than to comply with the interests of those with funds.

In addition to benefits the costs of improved services must be seriously considered. This is particularly important in operation and maintenance. The overall record of operative water supplies in many developing countries is quite disappointing (Katko 1986a). Case studies report operative levels as low as 10 to 20 per cent for pumped rural schemes. For hand-pump wells and boreholes the record is better although not satisfactory.

As reported by ODA (1985) it is obvious that too many benefits are expected from improved water supplies. It is difficult, if not impossible, to estimate the effect of one seperate sector like improved water supply on general development. Few innovations have by themselves brought economic development but many innovations together can have a cumulative effect.

The author suggests that the social effects, mainly health impacts, should not be ignored. However, the economic aspects should be considered more carefully than before. Additionally it is important to note that improved health conditions are a basic requirement for introducing e.g. family planning programmes in the developing world.

3 SUPPORTING AGENCIES IN DRINKING WATER SUPPLY AND SANITATION

3.1 Official Development Assistance of OECD Development Assistance Committee (DAC) Members

The group of DAC donors comprises bilateral agencies and the European Economic Community (EEC). WHO (1985a) has listed altogether 18 DAC donors active in the water supply and sanitation sector, namely

- Australia,
- Austria,
- Belgium,
- Canada (CIDA),
- Denmark (DANIDA),
- Finland (FINNIDA),
- France,
- The Federal Republic of Germany (BMZ),
- Italy,
- Japan,
- The Netherlands,
- New Zealand,
- Norway (NORAD),
- Sweden (SIDA),
- Switzerland,
- The United Kingdom (ODA),
- The United States of America (USAID), and
- The EEC.

Volume of assistance

Figure 3.1 compiled by the author shows the volume of official development assistance of selected bilateral agencies from 1979 to 1985 in current values and as a percentage of Gross National Product (GNP).

The United States of America has the highest absolute volume of assistance (note the tenfold scale) but the GNP based value has been, on an average, just over 0,20 per cent. This is the lowest value among the selected bilaterals in 1985. The United Kingdom has decreased its assistance and has settled around 0,35 percent. Norway, Sweden and the Netherlands have the highest volumes close to one per cent of GNP during the period. Denmark's support has been between 0,7 and 0,85 per cent.

Australia, Canada and the Federal Republic of Germany not included in Figure 3.1, have given about 0,5 per cent of their GNP. Finland has increased its assistance continuously and is planning to reach 0,7 per cent of GNP by 1990.

Figure 3.2 compiled by the author presents the annual official development assistance to drinking water supply and sanitation and its relative portion of the total official development assistance by the above mentioned agencies.

On the whole, during the first half of the Decade there has been a slight total decrease in the sector. The United States have the highest absolute volumes. Denmark has the highest assistance as a percentage of its total official development assistance. The Netherlands seems to have a declining trend. The figures of the United Kingdom are exceptionally low. This could be due to the fact that most of its assistance is given via integrated programs probably not shown in the figures. Clark (1987) noted that two thirds of the UK assistance to African agriculture and rural development goes to roads as well as to productive schemes like rubber, sugar, coffee, cocoa and tea. The share of rural water supply is only one per cent. The integrated programmes could

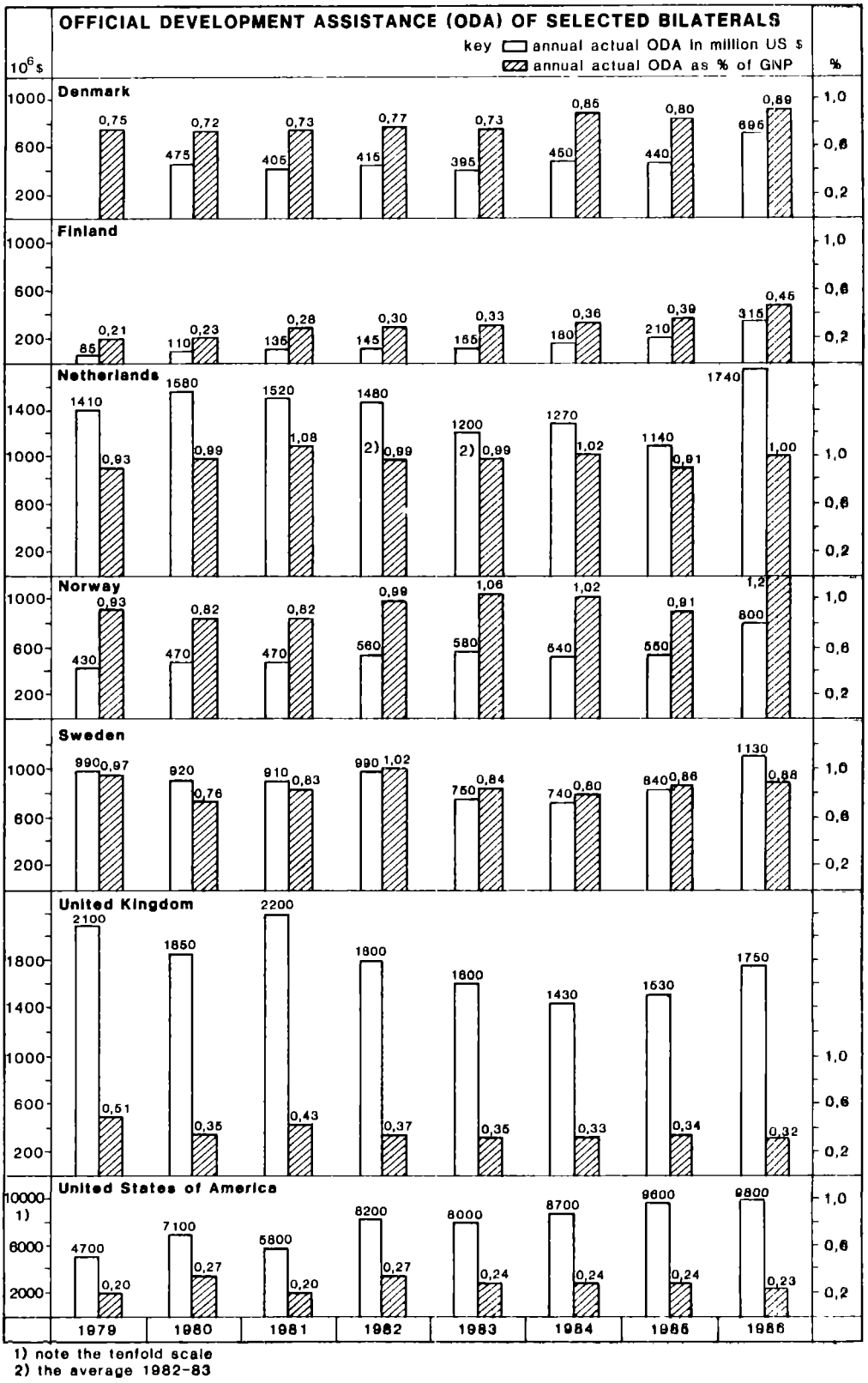

Figure 3.1. Official Development Assistance (ODA) of selected bilateral agencies 1979 - 1985 as absolute volumes (current prices) and percentage of Gross National Product (GNP) (FINNIDA 1987b, OECD 1986, SIDA 1982, 1983, 1985; WHO 1983, 1985a; compiled by the author).

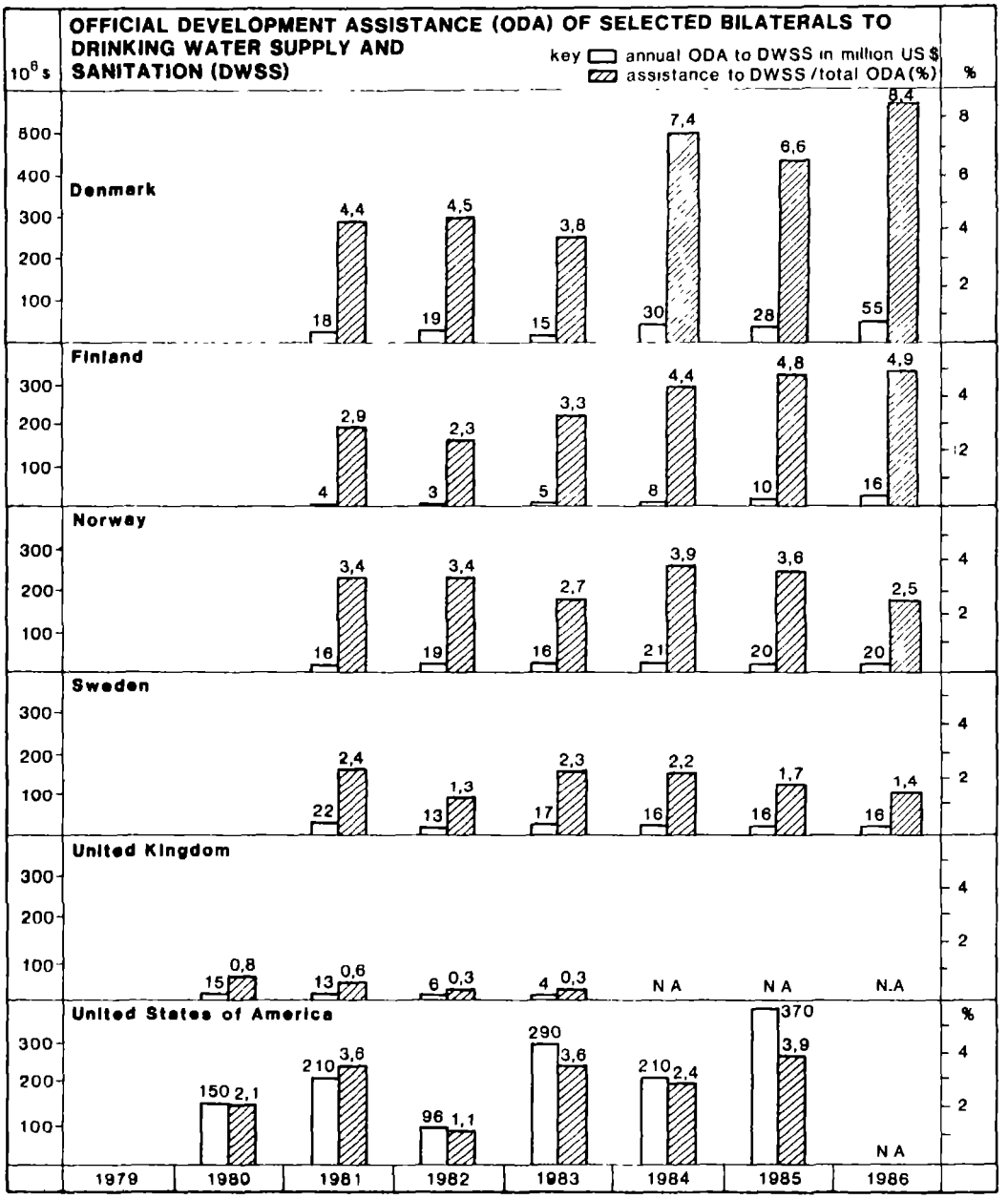

Figure 3.2. Official Development Assistance (ODA) of selected bilateral agencies to drinking water supply and sanitation (DANIDA 1987, FINNIDA 1987a, NORAD 1987, SIDA 1987, WHO 1983, 1985a; compiled by the author).

also result in some inaccuracy in the volumes of other agencies and, therefore, the figures are only indicative. Additionally many bilateral agencies give support to the sector through multilateral organizations but specified figures on this support are seldom available.

Recipient countries

The donors with higher absolute volumes of assistance are active in a great number of countries all over the world. Naturally, countries like France, the Netherlands and the United Kingdom are mainly active in their earlier colonies. The Nordic countries have concentrated on a number of countries particularly in East-Africa. Table 3.1 presents the main recipients of the Nordic bilateral support to the drinking water supply and sanitation sector.

Table 3.1. Main recipients of Nordic bilateral support to drinking water supply and sanitation in 1983-87 (SIDA 1987, WHO 1985a; compiled by the author).

Recipient country	Bilateral donor			
	Denmark	Finland	Norway	Sweden
Bangladesh	x			
Botswana				x
Ethiopia				x
India	x			x
Kenya	x	x	x	x
Sri Lanka	x	x	x	x
Tanzania	x	x	x	x
Vietnam		x		x
Zambia			x	
Zimbabwe			x	x

Denmark has supported and still supports a great number of other countries in addition to those shown in the table. In the 1970s Sweden gave support to a large number of countries but has more recently concentrated on a few. Kenya and Tanzania are the most common recipients of Nordic support.

Types of assistance

Most of the bilateral donors channel a part of their support via non-governmental organizations (NGOs) and multibi-programmes (multibi means bilateral funds allocated to certain country/countries via an executing multilateral agency). The relative amount of NGOs and multibi-support of most bilateral agencies is often less than 10 percent in drinking water supply and sanitation. However, of the Swiss water sector aid about 20 per cent is channeled via NGOs and 50 per cent via multibi-programmes.

Most of the bilateral agencies give their support in the form of grants. Countries like Denmark, the Netherlands, the United Kingdom and the United States also give support on a loan basis, although in decreasing amounts. Most of the Japanese support to the sector is in the form of loans (WHO 1985a).

3.2 Banks and Funds

This category includes multilateral, regional and national development financing institutions. WHO (1985a) presented in its External Support Catalogue the following banks and funds:

- Abu Dhabi Fund for Arab Economic Development,
- African Development Bank,
- Arab Bank for Economic Development in Africa,
- Arab Fund for Economic and Social Development,
- Arab Fund for Technical Assistance to African and Arab Countries,
- Asian Development Bank,
- Caribbean Development Bank,
- Central African States Development Bank,
- Central Fund for Economic Cooperation (Caisse centrale, France),
- European Economic Community,
- East African Development Bank,
- Inter-American Development Bank,
- Iraqi Fund for External Development,
- Islamic Development Bank,
- Kreditanstalt für Wiederaufbau (Federal Republic of Germany),
- Kuwait Fund for Arab Economic Development,
- OPEC Fund for International Development,
- Saudi Fund for Development,
- West African Development Bank, and
- World Bank.

Of greatest interest in this context are the World Bank and the regional development banks.

3.2.1 The World Bank

Volume of assistance

The lending by the World Bank to water supply and sewerage in 1977-1986 has varied quite a lot (Figure 3.3, compiled by the author). However, the general trend seems to be towards increasing funds in urban and particularly, in rural water supplies. The cumulative percentage of the Bank's lending to water and sewerage in 1974-85 was 5,2 per cent of which 4,7 per cent went to the urban and 0,5 per cent to the rural sector. In 1986 the total sector percentage was 3,9 (World Bank 1986a).

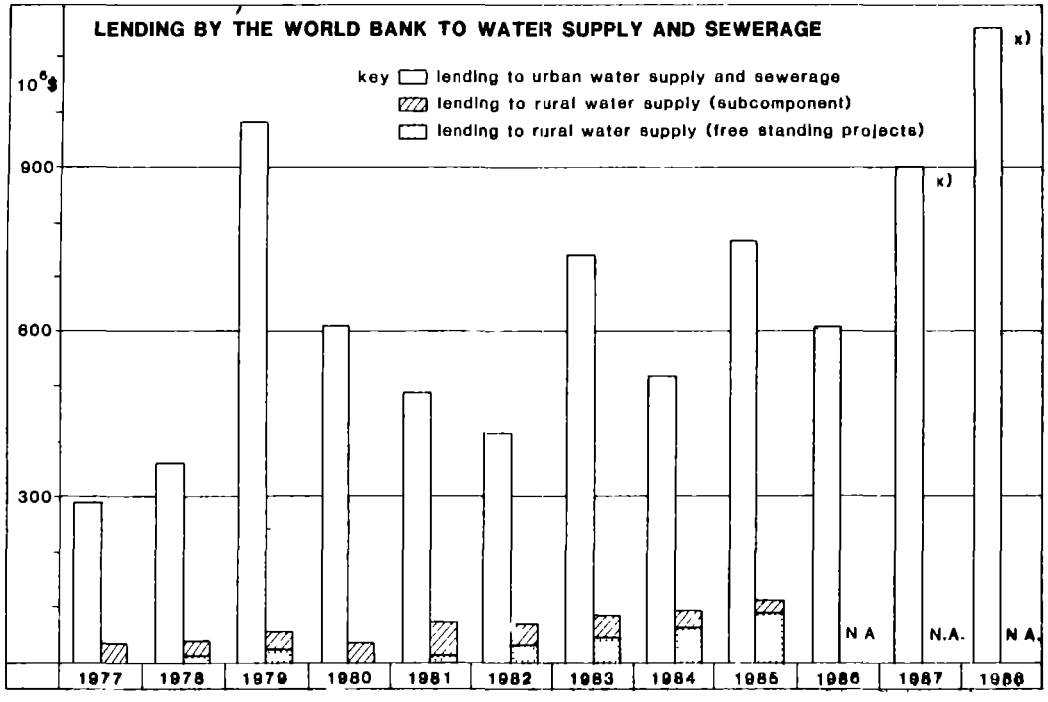

Figure 3.3. Lending by the World Bank to water supply and sewerage in 1977-1986 and estimates for 1987-1988 in current prices (World Bank 1986b, 1987; compiled by the author).

Recipient regions

Figure 3.4 presents the World Bank lending to water supply and sewerage in 1983-86 by region. The Latin American and Caribbean region has lately received the highest volume of support. East Asia and the Pacific region show a growing trend whereas lending for Africa has been falling reflecting the general trend in the world economic market.

Type of assistance

The World Bank is a group of three institutions, the International Bank for Reconstruction and Development (IBRD), the International Development Association (IDA) and the International Finance Corporation (IFC).

The IBRD, established in 1945, is owned by the governments of 146 countries. It finances the lending operations mainly from its own borrowings in the world capital markets. The IDA was established in 1960 to assist primarily the poorer developing countries by easier terms support called credits to distinquish them from IBRD loans (WHO 1985a).

The portion of IDA credits of the total funds has varied from 10 to 50 per cent in 1979-84.

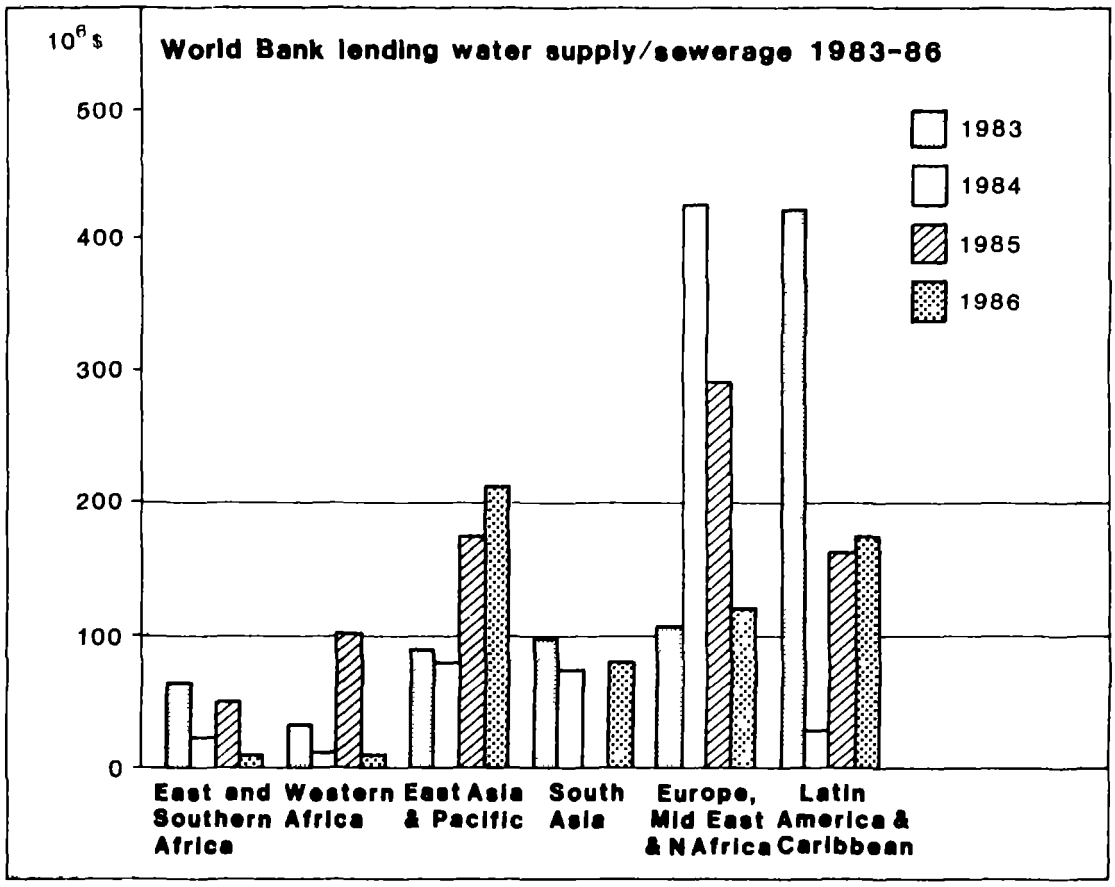

Figure 3.4. The World Bank lending to water supply and sewerage in different regions in 1983-86 in current prices (Anon 1986b).

Special features

The World Bank has a special technical assistance programme supporting the present Water Decade. The aim of the programme is to develop and support the use of low-cost water supply and sanitation particularly by

- Testing and developing village-level operation and maintenance (VLOM) hand-pumps,
- Developing low cost on-site sanitation,
- Resource recovery (waste recycling),
- Establishing and coordinating the Information and Training Network for Water and Waste Management for developing countries, and
- Project preparation units nowadays called sector development teams in Africa and Asia.

This assistance programme is supported by UNDP and various bilateral organizations (World Bank 1986b).

3.2.2 Regional Development Banks

The African Development Bank group, with its headquarters in the Ivory Coast is composed of the African Development Bank (AfDB) itself as well as two special funds - The African Development Fund (AfDF) and the Nigerian Trust Fund (NTF). The Asian Development Bank (AsDB) with its headquarters in Manila, in the Philippines, has 31 regional members from Asia and 14 non-regional members, mainly the bilateral DAC countries (WHO 1983). Table 3.2, compiled by the author shows some annual lending figures of the two development banks.

Table 3.2. Annual assistance to water supply and sewerage by the African Development Bank Group and the Asian Development Bank (WHO 1983, 1985a; compiled by the author).

Bank	Assistance to water supply and sewerage in million US $					
	1979	1980	1981	1982	1983	1984
African Development Bank Group	62	44	n.a.	n.a.	n.a.	60
Asian Development Bank	108	107	124	59	188	n.a.

The Inter-American Development Bank (IDB) was established in 1959 to support its member countries in Latin America. In the 1960s the Bank accounted for 25 per cent of the total investments in water and sanitation. In the period 1961-80 the Bank contributed about 1500 million US $ which is more than a half of all external investments in the region (WHO 1983).

The overall role of Arab development banks and funds not discussed in this context, is described e.g. by Halttunen and Korvenpää (1985).

3.3 United Nations Organizations

3.3.1 Principal Organizations and Specialized Agencies of the United Nations Involved in the Water Sector

The United Nations system includes departments and programmes under principal organizations and specialized agencies (Figure 3.5).

Principal organizations

The principal organizations involved in water resources development are as follows (United Nations 1982):

- Department of International Economic and Social Affairs (DIESA),
- Department of Technical Co-operation for Development (DTCD),
- Economic Commission for Europe (ECE),
- Economic Commission for Asia and the Pacific (ECAP),
- Economic Commission for Latin America (ECLA),
- Economic Commission for Africa (ECA),
- Economic Commission for Western Asia (ECWA),
- Office of the United Nations Disaster Relief Co-ordinates,
- United Nations Industrial Development Organization (UNIDO),
- United Nations Environment Programme (UNEP),
- United Nations Centre for Human Settlements, (HABITAT, UNCHS),
- United Nations Children's Fund (UNICEF),
- United Nations Development Programme (UNDP), and
- World Food Programme (WFP).

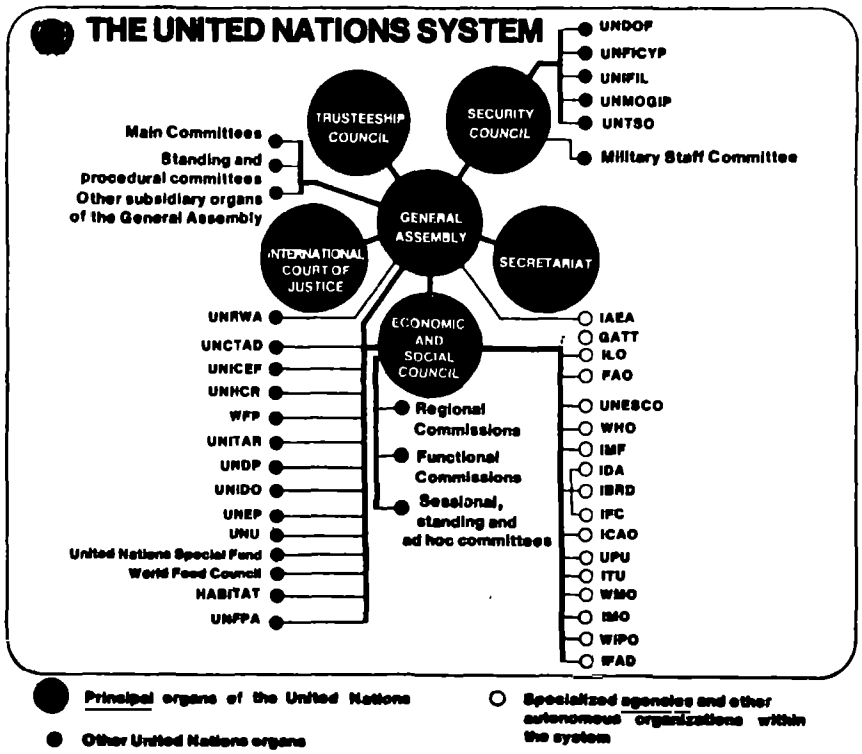

Figure 3.5. The United Nations system (WHO 1985a).

Specialized agencies

The specialized agencies in the water field include (United Nations 1982):

The International Labour Organization (ILO),
The Food and Agriculture Organization of the United Nations (FAO),
The United Nations Educational, Scientific and Cultural Organization (UNESCO),
The World Health Organization (WHO),
The World Meteorological Organization (WMO),
The World Bank and (WB), and
The International Fund for Agricultural Development (IFAD).

Table 3.3 shows the organizations of the United Nations system in water resources development indicating the main and applied areas of interest.

3.3.2 The United Nations System and the Water Decade

The organization of the United Nations involved in water supply and sanitation established a Steering Committee for the present Water Decade. In 1985 the Committee was composed of 11 United Nations organizations. WHO, through its unit for Community Water Supply and Sanitation (CWS) acts as a secretariat of the Steering Committee (Figure 3.6.)

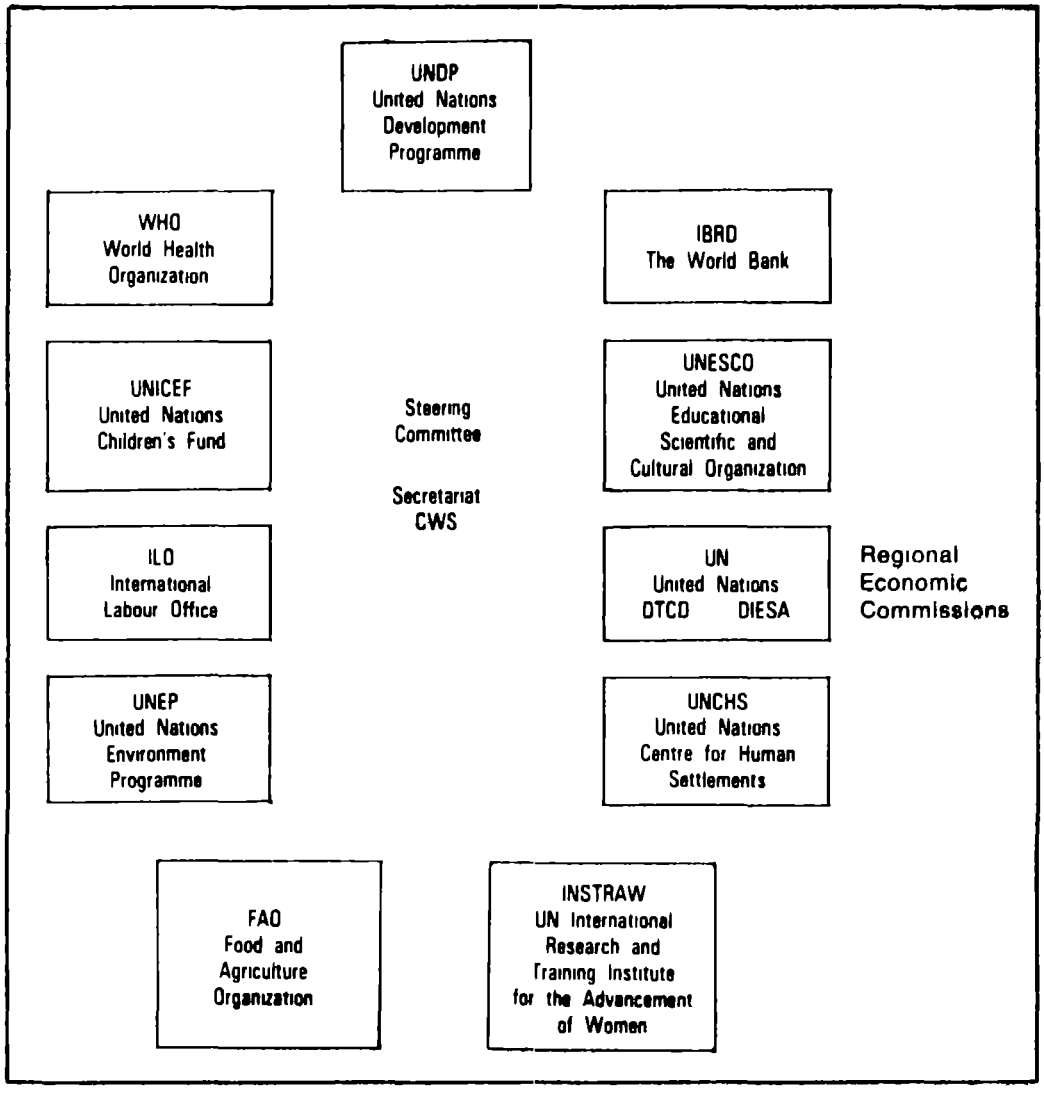

Figure 3.6. Members of the Cooperative Action (CA) to support the Water Decade (WHO 1985a).

Table 3.3. Involvement of the United Nations Organizations in water resources development; indication of main and applied areas of interest (United Nations 1982).

Use and management areas	Organization(s) with Main Concern in Indicated Area	Organization(s) with Interest in Applied Aspects of Indicated Area
A. COMMON MANAGEMENT FUNCTIONS		
1. Water planning, policy legislation and administration (including river basin development planning)	UN/DTCD, FAO, UNDP WB, ECA, ECE, ECLA ECWA, ESCAP	UNESCO, WMO, WHO, UNEP, UNICEF, UNIDO, ILO, IAEA
2. Water resources assessment (Collection, processing, storage and dissemination of surface and ground water data), including the Application of Remote Sensing and Isotope Techniques	WMO, UNESCO, IAEA, FAO	UN/DTCD, WHO, UNDP WB, ECA, ECE, ECLA ECWA, ESCAP, UNEP
3. Education and training	UNESCO, ILO	All others
4. Water and human environment Water quality management and pollution control	UNEP	All others
5. Flood control (flood loss management)	UNDRO, WMO, ESCAP	UNDP, WB, FAO, UNESCO UN/DTCD, ECA, ECE, ECLA ECWA
6. Drought management (desertification control)	UNEP, FAO, UNESCO, ECWA	UN/DTCD, ECA, ECE, ECLA ECWA, ESCAP, WMO, UNDP WB, WFP, IFAD, UNDRO
7. Technical Co-operation among developing countries (TCDC)	UNDP	All others
B. DEVELOPMENT AND USE FOR SECTORAL PURPOSES		
1. Agriculture and fisheries (Irrigation and drainage; rainfed agriculture; fresh water fisheries; aqua-culture)	FAO, WB, WFP, IFAD	UNDP, UNESCO, WMO, ILO, UNDP, UNEP, UN/DTCD, ECA, ECE, ECLA ECWA, ESCAP, IAEA
2. Community water supply and sanitation	WHO, WB, UNICEF, UNDP	FAO, UN/DTCD, ECA, ECE ECLA, ECWA, ESCAP, UNEP UNESCO, WMO, ILO, UNCHS
3. Ground water resources development (including exploration and well-drilling)	UN/DTCD, UNICEF, FAO, WHO, WB	ECA, ECE, ECLA, ECWA, ESCAP, UNESCO, WMO, IAEA, UNCHS
4. Industrial water use	UNIDO	WB, UN/DTCD, FAO, UNDP ILO, ECWA, ECE
5. Inland navigation	ECE, ESCAP, ECLA, ECA, ECWA, UN/DTCD	WB, UNDP, ILO
6. Hydropower	WB, UNDP, UN/DTCD	FAO, WMO, UN/DTCD, ESCAP ECWA, ECLA, ECA, UNIDO

3.3.3 Activities of the Most Important Principal Organizations

Department of Technical Cooperation for Development (DTCD)

The Department has a broad approach; it assists in water policy, planning and management, both for ground and surface water resources. It is also involved in studies, publications, guidelines and other supporting measures such as conferences, seminars and symposia.

The ground water projects of the Department can be illustrated by the following activities:

- Ground water exploration and development in Mali,
- Water policy management and legislation in Liberia,
- Artificial recharge studies in India, and
- Strengthening of ground water services in Haiti.

Among the surface water projects there are e.g. (United Nations 1982):

- Integrated development of the Garabia River Basin, and
- National water resources master plan in Malawi.

Regional Economic Commissions

The four regional commissions for the developing world

- Economic Commission for Africa (ECA),
- Economic Commission for Latin America (ECLA),
- Economic and Social Commission for Asia and the Pacific (ESCAP), and
- Economic Commission for Western Asia (ECWA).

are mostly active in water planning, policy, legislation and administration (United Nations 1982).

United Nations Industrial Development Organization (UNIDO)

UNIDO's activities cover manufacturing of equipment related with water development and use as well as industrial water and wastewater practices.

Projects carried out by UNIDO have covered a.o. (United Nations 1982):

- Industrial pollution control/effluent treatment control (Africa, regional; Upper Volta),
- Water pumping/windmill technology (Ethiopia, Kenya, Somalia), and
- Marine pollution (together with UNEP).

United Nations Children's Fund (UNICEF)

UNICEF is one of the major partners in the Water Decade concentrating on community water supply and sanitation in rural and certain semi-urban areas in close to 100 countries (UNICEF 1980). UNICEF's total assistance and the assistance to water supply and sanitation sector in 1965-1986 is shown in Figure 3.7 (compiled by the author).

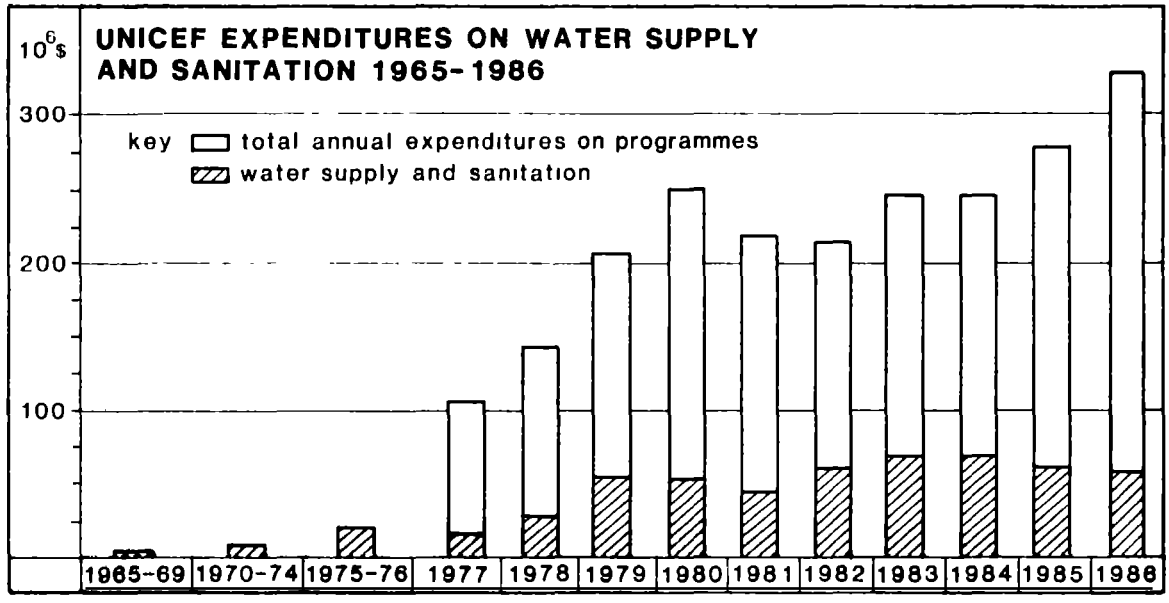

Figure 3.7. UNICEF assistance to the water supply and sanitation sector in 1965-1986 in current prices (UNICEF 1980, 1978-86, 1987; WHO 1983, 1985a; compiled by the author).

The total expenditure of UNICEF has a slightly growing trend in the 1980s. The portion of water supply and sanitation has been 20-28 per cent during the same period. From 1975 to 1985 UNICEF's expenditure was 75 per cent of the whole United Nations system grant support for water supply and sanitation (DTCD 1987).

In recent years sanitation and health education components have been attached to UNICEF supported programmes. In the field it has over 100 technical project staff posts. UNICEF can also give support by supplying materials to projects executed by other agencies.

Typical projects executed by UNICEF have included a.o. (United Nations 1982):

- Water and sanitation components in integrated basic service programmes in Pakistan,
- Programme starting with the sanitation component followed by well drilling and hand-pump installation in Nigeria. The project is a community education based effort,
- A feasibility study in Malawi of integrating protection of existing shallow wells, rehabilitation of existing boreholes, construction of dug wells, construction of shallow boreholes and organizing maintenance for all water points, and

- A sanitation project in Wanging'ombe, Tanzania creating close to 9000 family-owned VIP-latrines by 1985 (Hilsum 1983, Msimbira 1986).

United Nations Development Programme (UNDP)

UNDP was established in 1965 as the development aim of the United Nations system. It serves as the world's largest channel for multilateral technical cooperation. Approximately 120 current projects related to the Water Decade receive support from UNDP and two UNDP associated programmes: the United Nations Capital Development Fund (UNCDF) and the United Nations Sudano Sahelian Office (UNSO). Of the total financing about 60 per cent came from UNDP and about 40 per cent from UNCDF. Nearly all UNDP-financed projects (72 out of 87) were executed on its behalf by the United Nations, the World Health Organization or the World Bank (WHO 1985a).

Table 3.4. Areas of activity covered by UNDP-financed Water Decade related projects (WHO 1985a).

Areas of Activity	No. of Projects
Drinking water supply	75
Training/human resources development	68
Surveys/studies/planning	63
Rural coverage	55
Institution-building	53
Water resources development	33
Introduction of technologies	25
Sanitation	23
Health education	17
Urban coverage	15
Preparation of investment projects	11
Water quality (pollution control)	8

3.3.4 Activities of the Most Important Specialized Agencies

United Nations Educational, Scientific and Cultural Organization (UNESCO)

The International Hydrological Programme (IHP) has a central place in UNESCO's water-related activities. This programme focusses on scientific and educational aspects of hydrology and water resources management.

Among typical projects executed by UNESCO the following can be mentioned (WHO 1985a):

- Water resources assessment projects (Algeria, Brazil, Canary Islands, Mozambique, Spain, Tanzania, Zambia),

- Applied research institution building (Argentina, Brazil, India, and Sudan), and
- Water resources education institution building (Brazil, India Nigeria and Tanzania).

World Health Organization (WHO)

WHO's interest in water-related activities arises mostly from the fact that clean water and adequate sanitation have an impact on human health. WHO provides the Secretariat for the Steering Committee of the Water Decade as mentioned in Chapter 3.3.2. The volume of WHO's financial resources for community water supply and sanitation in 1980-87 has been about four per cent (Table 3.5, compiled by the author).

Table 3.5
WHO's financial resources for community water supply and sanitation in 1980-87 (WHO 1983, 1985a; compiled by the author).

Biennia	Financing of CWSS[1] 10^6 US $	CWSS/Total financing %
1980-81	34	4,0
1982-83	40	4,2
1984-85	45	4,6
1986-87	43	n.a.

1) CWSS Community Water Supply and Sanitation

WHO's participation in the Water Decade follows its global strategy for Health for All by the Year 2000, based on primary health care.

The major activities of WHO for the Water Decade are:

- promotion of the Decade,
- institutional development ,
- development of human resources,
- information exchange, and
- mobilization of financial resources.

In October 1984 the European Bilateral Donor Consultation was organized by the Federal Republic of Germany (BMZ) in cooperation with WHO (WHO and BMZ 1985). A follow-up meeting was arranged through OECD/DAC in 1985 (OECD 1985). This type of coordination, strongly supported by the developing countries, is planned to continue on a regular basis.

3.4 Volunteer Organizations

Volunteer organizations provide mostly young but qualified people to work in developing countries. The organizations can be administratively under official development assistance organizations like bilateral agencies or they can be independent. In most cases they are financially supported by the national governments.

The WHO (1985a) cataloque included the following volunteer organizations:

- Danish Association for International Cooperation,
- French Association of Volunteers for Progress (AFVP),
- U.S. Peace Corps, and
- United Nations Volunteers (UNV).

Additionally, there is the Swedish Volunteer Organization which was earlier a department of SIDA but since 1983 has been an independent body. Another organization active in the water sector is the Organization of Netherlands Volunteers (ONV).

FINNIDA supported volunteers for a few years in the late 1960s and the early 1970s. In 1985 the independent body, Finnish Volunteer Service (FVS), was established to organize volunteer activities and coordinate the aid of non-governmental organizations (NGOs). Table 3.6 (compiled by the author) shows examples of the scope of volunteer organizations' activities.

Table 3.6. Selected volunteer organizations and the scope of their activities (Swedish Volunteer Service 1987, WHO 1985a; compiled by the author).

Organization	Established in	Number of volunteers			Major recipient area
		Period	Total	Water sector	
Danish Association for Int. Cooperation	1944	1968-83	n.a.	10-12	East-Africa
AFVP (France)		1982	500	n.a.	Sahel
Swedish Volunteer Service (Fredskåp)	1965	1967-83	n.a.	230[1)]	East-Africa
Swedish Volunteer Service	1983	1983-86 1986	n.a. 80	5 n.a.	Africa
U.S. Peace Corps	1961	1961-84 1970-84 1981	97 000 n.a. 500	n.a. 1500 350	Africa
UNV	1970	1983	100	n.a.	90 countries

1) Figure for Tanzania only, activities also in other countries.

The U.S. Peace Corps has the highest volunteer contribution but, in the water sector, the Swedish Peace Corps has contributed a lot in relation to Swedish total external support. The volunteer service in developing countries often offers a good recruitment basis for later expert posts and project personnel.

Lehmus (1984) reported on the use of experienced and retired managers as advisors in developing countries on voluntary terms. The British Executive Service Overseas (BESO) and the Canadian Executive Service Overseas (CESO) are examples of such voluntary organizations.

3.5 Non-Governmental Organizations (NGOs)

The non-governmental organizations (NGOs), also called Private Voluntary Organizations (PVOs), can be classified according to their background and nature as:

- missionary organizations,
- general NGOs with a wide spectrum of development sectors, and
- NGOs concentrating on the water sector.

The NGOs can also be classified as those based in the donor country, the "transnational" NGOs and those of the recipient country. There are various relations between the public and private sphere. In spite of their common private nature, governments often support their work.

Of the missionary and church organizations active in the water sector one can mention a.o. (WHO 1985a)

- The Catholic Relief Services (CRS, USA),
- The Christian Aid (UK),
- The Church World Service (CWS, USA),
- The Interchurch Coordination Committee for Development, Projects (ICCO, the Netherlands), and
- The Lutheran World Federation (LWF, Switzerland).

Water development is typically a component of integrated development programmes which usually have a grass-root approach. The programmes typically concentrate on a fairly limited area and use simple technology.

As examples of other NGOs one can mention e.g.:

- The Environmental Sanitation Information Center (ENSIC, Thailand), and
- The Volunteers in Technical Assistance (VITA, USA).

These organizations concentrate on development and dissemination of appropriate technologies in developing countries.

Some organizations have been created particularly for the ongoing Water Decade such as:

- Global Water (USA), and
- Water Aid (UK).

United Nations Non-Governmental Liaison Service (1985) specialized in the NGOs activities have prepared a directory of the organization comprising aid issues. UNDP (1986) has gathered a register of the NGOs active in the Water Decade including over 800 organizations both in the developed and developing countries.

Professional organizations have shown their interest in water development in the developing countries by establishing a special committee. Among these organizations are:

- The Institute of Water Pollution Control (IWPC, UK),
- The International Water Resources Association (IWRA), and
- The International Water Supply Association (IWSA).

3.6 Discussion on the Roles of the Supporting Agencies

Table 3.7 gives a summary of international support to the water sector. There is a slightly increasing trend although the figures are not adjusted by the index. The role of the World Bank and development banks is slightly decreasing whereas bilateral support in increasing. The NGOs' portion, is increasing, too.

Table 3.7. Trends of external support to drinking water supply and sanitation (Skyttä 1984).

Supporting agency	Support								
	1970s mill.US$ a^{-1}	%		1980 mill.US$ a^{-1}	%		1981 mill.US$ a^{-1}	%	
Bilaterals agencies	242	30		715	35		805	36	
Development banks	220	27	62	450	22	53	500	22	51
The World Bank	285	35		630	31		690	29	
UN organizations	37	5		145	7		150	7	
NGOs	30	3		110	5		130	6	
Total	814	100		2050	100		2225	100	

On the whole, there are numerous different types of organizations giving assistance to developing countries. In a developing country there are often over ten bilateral agencies working in the water sector. In addition to these a few multilateral organizations and a huge amount of national and foreign NGOs usually work in the country. This situation brings up the difficult issue of coordination. Moreover, it is obvious that to some extent donor support has a competitive nature.

The water resources sector is quite well covered by the different organizations. Particularly the sector of drinking water supply and sanitation, often mentioned among the most necessary ones, receives commonly 2 to 4 per cent of total assistance of bilateral agencies. The WHO, which acts as a coordinator of the Water Decade, gives only about 4 per cent of its total funds to the sector (Table 3.5). When considering improved water supply and sanitation as one of the most important elements in health care this figure is very low. It is obvious that the conventional medical sector dominates WHO's activities.

In the field of human resources development UNESCO has so far concentrated on hydrology, particularly surface water resources. Compared with the goals of the Decade (UNDP 1980) this approach is, to the author's view, quite biased. This bias is evident among all training activities in the sector and partly explains the difficulties of implementing the Decade programmes and projects.

There is a slightly increasing trend in overall inputs into the sector. However, the present Water Decade has not managed too well in attracting additional resources to the sector. This fact supports the development and use of simpler and lower cost technology where the World Bank has perhaps taken the leading role. Naturally the development of institutional capacity and management procedures are equally important, if not even more so.

The possibilities of national governments in East-Africa to increase investments to the sector are quite poor because of the difficult economic situation. Thus more efficient use of available resources via institutional and management improvements is important.

The dissemination and development of appropriate technology is probably well suited to the World Bank organization. According to Skyttä (1984) bilateral organizations are more suitable to support implementation of rural water supplies than large and quite inflexible international organizations and development banks. He suggests that bilateral support should be increased in rural water supply and sanitation.

The international assistance to water supply and sanitation has concentrated on investments, mainly on constructing new schemes. The needs for rehabilitation and, above all, operation and maintenance have become acute questions (Katko 1986a).

Raising funds for operation and maintenance costs of water supplies means cost-recovery either in the form of monetary or non-monetary contributions. Donors should probably take partial responsibility at least of those schemes whose construction they have supported. This means mainly material and personnel assistance.

In monetary terms the role of the NGOs is quite insignificant. However, they seem to be getting more active, particularly in rural water supply and sanitation. OECD (1986) reports that in 1985 there was a strong increase in resources for emergency and development purposes by private voluntary organizations. Bilateral aid as a whole has an increasing trend whereas multilateral support is declining.

The different supporting agencies seem to have their own preference areas in water supply and sanitation development. The commonly raised argument on the best supporting agency in the sector is, however, irrelevant. The key issue is the coordination between the different organizations to make the support as efficient as possible.

4. MAJOR CONSTRAINTS IN WATER SUPPLY IN DEVELOPING COUNTRIES

4.1 Major Constraints before the Decade

In 1970 the World Health Organization (WHO) forwarded a questionnaire to the governments of developing countries (Pineo and Subrahmanyam 1975). The constraints, ranked according to their severeness, were as follows:

(i) insufficient internal financing,
(ii) lack of trained personnel,
(iii) inappropriate administrative structure,
(iv) lack of external finance,
(v) inappropriate financial framework,
(vi) insufficient production of local material, and
(vii) inadequate or outmoded legal framework.

Before the beginning of the Decade WHO organized a large review of national baseline data (WHO 1984) as the basis for a systematic follow-up of the Decade.

The constraints were classified as very severe, severe, moderate and no constraints and they were weighted by three, two and one respectively to give the ranking index. Figure 4.1, compiled by the author shows the results from the African region. The results were converted to a percentage scale by the author in the manner shown in the figure.

The most important constraints as seen by the governments in Africa were funding limitations, the lack of trained personnel, particularly professionals, as well operation and maintenance and logistics.

Overriding constraints at the global level included
- the lack of trained personnel,
- limitation of funds,
- shortcomings in operation and maintenance, and
- inadequate cost-recovery from customers.

The Americas region ranked inadequate cost-recovery as the most important constraint. Funding limitations were listed at the top by the least developed countries and the most seriously affected countries.

In October 1984 the European Bilateral Donor Consultation identified nine major constraints to be overcome (WHO and BMZ 1985):
- low government priority for the sector,
- imbalance between coverage in urban and rural areas,
- lack of integration between sector institutions,
- operation and maintenance inadequacies and need for rehabilitation,
- shortage of properly trained staff,
- inadequate health impact,
- poor community participation and choice of technology,
- failure to attract more external support, and
- water resources management.

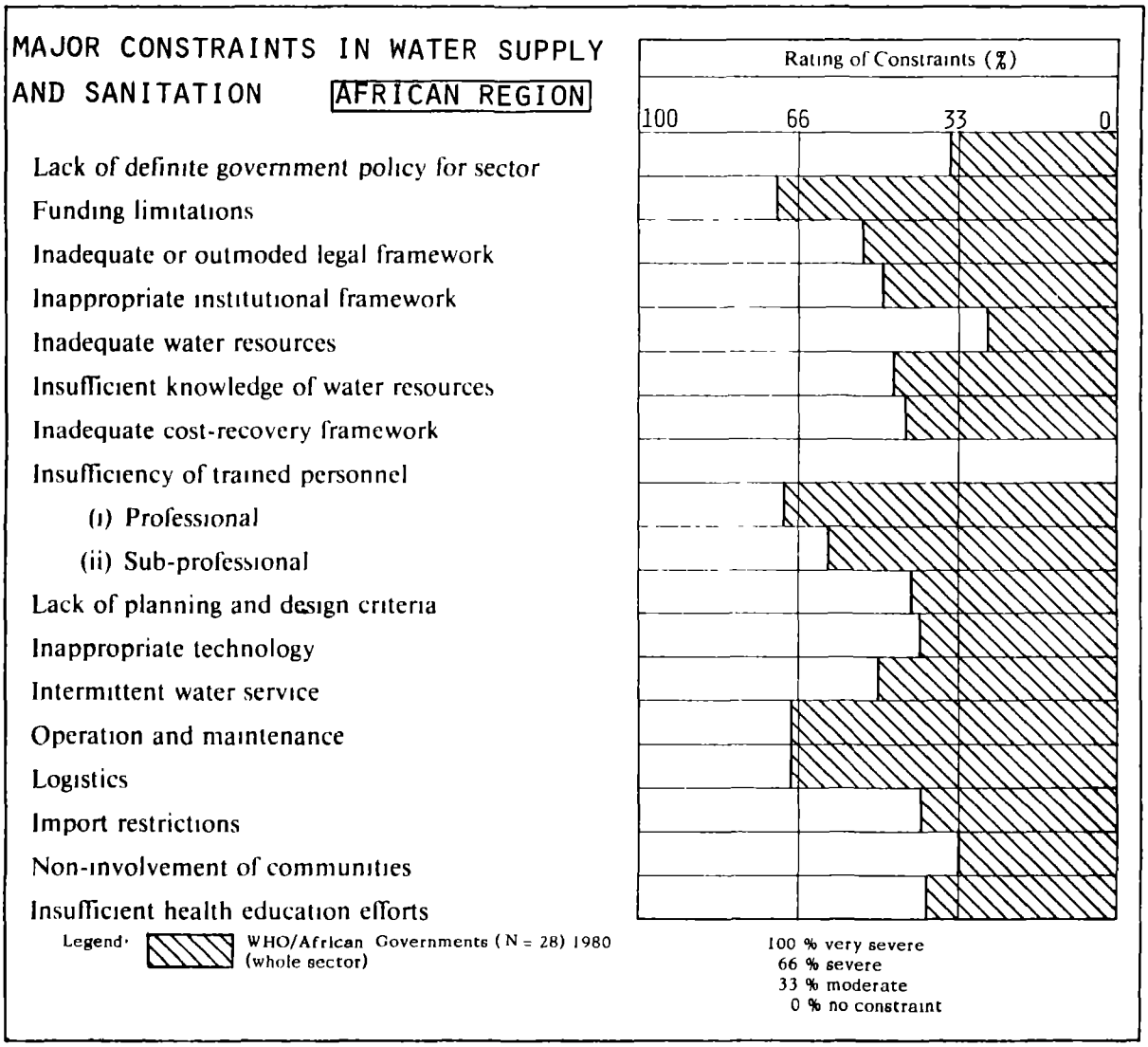

Figure 4.1 Major constraints in water supply and sanitation in the African region (WHO 1984; compiled by the author).

Bilateral agencies reported their evaluation and the lessons learned in a catalogue compiled by WHO (1983). No systematic constraint analysis has been done. The author listed the issues according to their frequency as follows

- operation and maintenance (9)
- manpower/human resources development/training (7)
- community participation (7)
- low-cost/appropriate technology (7)
- socio-economic expertise (6)
- organizations, institutions and management (6)

4.2 Major Constraints in Water Supply in Selected Countries

4.2.1 Research Methodology

The author sent a modified version of the WHO questionnaire on major constraints to persons having served as foreign experts

or project personnel in developing countries. A column for non-constraint was added as well as logistics (materials, spare parts, transport, fuel) was explained. The questionnaire of this study was limited to rural water supply only. The forms were for the most part completed in 1984 and the comments covered the time period from 1977 to 1985. In addition, some of the above respondents as well as some professionals from developing countries were interviewed with open questions based on the form.

The results for the different countries are not necessarily directly comparable. Instead the relative differences of severeness in each country are most important. A number of the respondents have been working in several of the countries selected. This makes the results at least weakly comparable.

4.2.2 Kenya

The development of water supply in Kenya is negatively affected by the population growth of about 4 per cent per annum, which is one of the highest in the world.

The most severe constraints in the whole sector as seen by the Government in 1980 (WHO 1984) were operation and maintenance as well as lack of trained personnel (Figure 4.2).

The views of foreign experts (Figure 4.2) differ considerably from those of the Government. Operation and maintenance linked with logistics is the most important constraint. The Governmentpolicy for the sector is not seen appropriate and the cost-recovery framework is seen as very inadequate. Both of these are probably connected with the very common piped water supply schemes with chemical treatment units in rural areas which cannot always be considered as appropriate.

The philosophy of low-cost or simple technology in rural water supply is officially accepted in Kenya, but in practice such technology is commonly neglected. So far rural water supplies have mainly relied on surface waters. In this respect the rural water supply project in western Kenya is quite pioneering on using shallow wells equipped with hand-pumps. The project is supported by the Finnish International Development Agency (FINNIDA 1985).

The legal and institutional framework were not seen as the most problematic constraints by foreign experts. Instead the performance and function of the organizations, as well as lack of cooperation between different institutions, were seen as very severe. The private sector and water associations recently introduced to the sector could probably be utilized more.

The water resources are very unevenly distributed in Kenya. The northern part of the country is desert or semi-desert, but e.g. in western Kenya the annual precipitation is commonly 2000 mm. The knowledge of water resources, especially of ground water, is limited. This partly explains the bias towards surface waters. Like Kenya, many parts of Africa are directly underlain by crystalline basement rocks. Aquifers are developed in the weathered mantle and in the fractured basement rocks. Although not very productive, these aquifers are of increasing importance to rural water supply (Foster 1984).

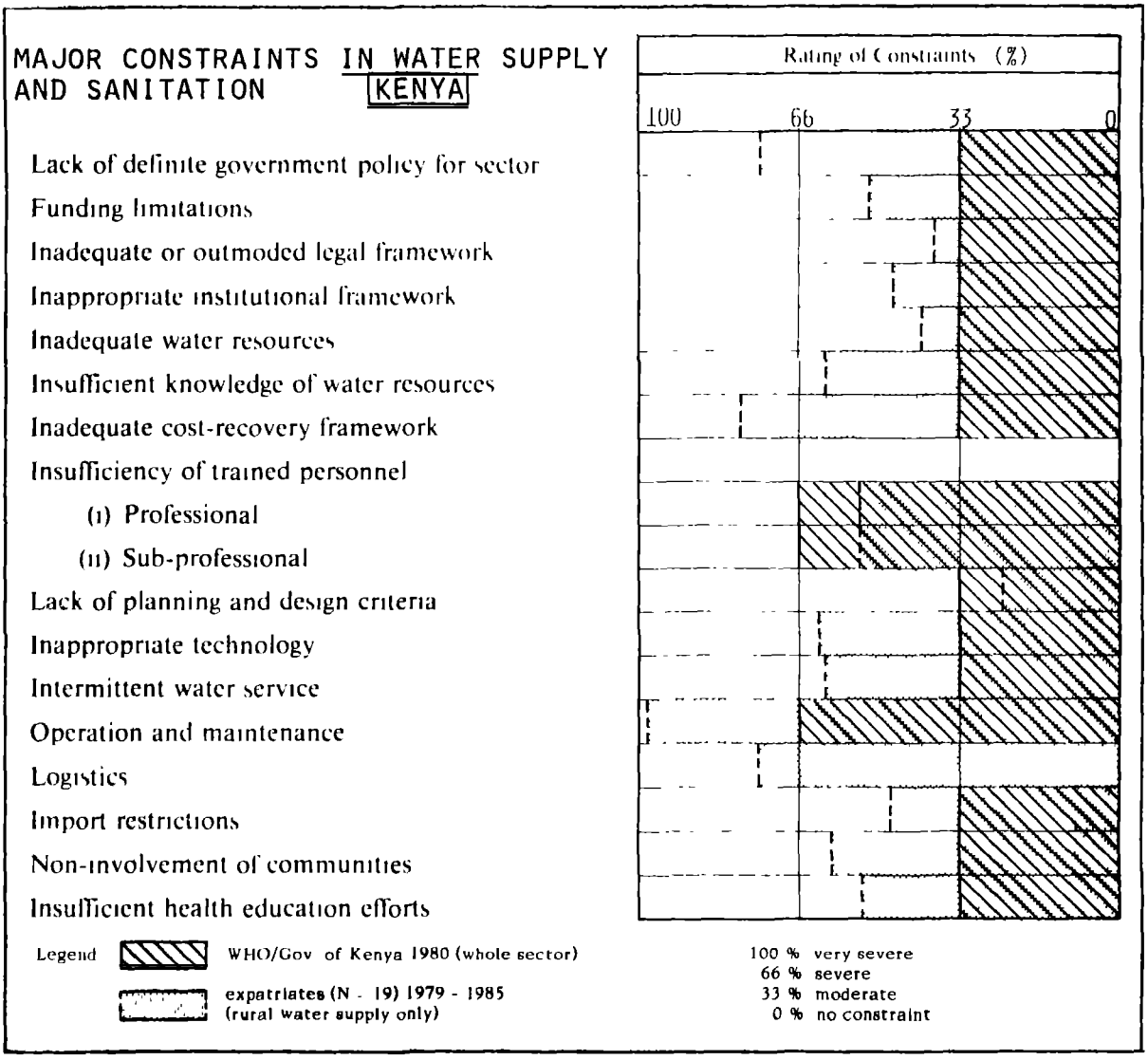

Figure 4.2. Major constraints in water supply and sanitation in Kenya based on the questionnaires by WHO (1984) and the author.

Non-involvement of communities is considered quite severe. This is partly due to the sophisticated technology used, which can make it more difficult to participate in different stages of projects.

In 1980 Kenya was assisted by 41 government donors and a huge number of NGOs, quite many of those active in the water sector (Morss 1984). Therefore, the coordination of activities in the sector is quite difficult.

4.2.3 Malawi

The number of replies (eleven) concerning Malawi was the lowest in this study and, therefore, the results are the least reliable. However, even this small number of answers, added to the author's personal working experience in the country, accord with the constraints shown in Figure 4.3.

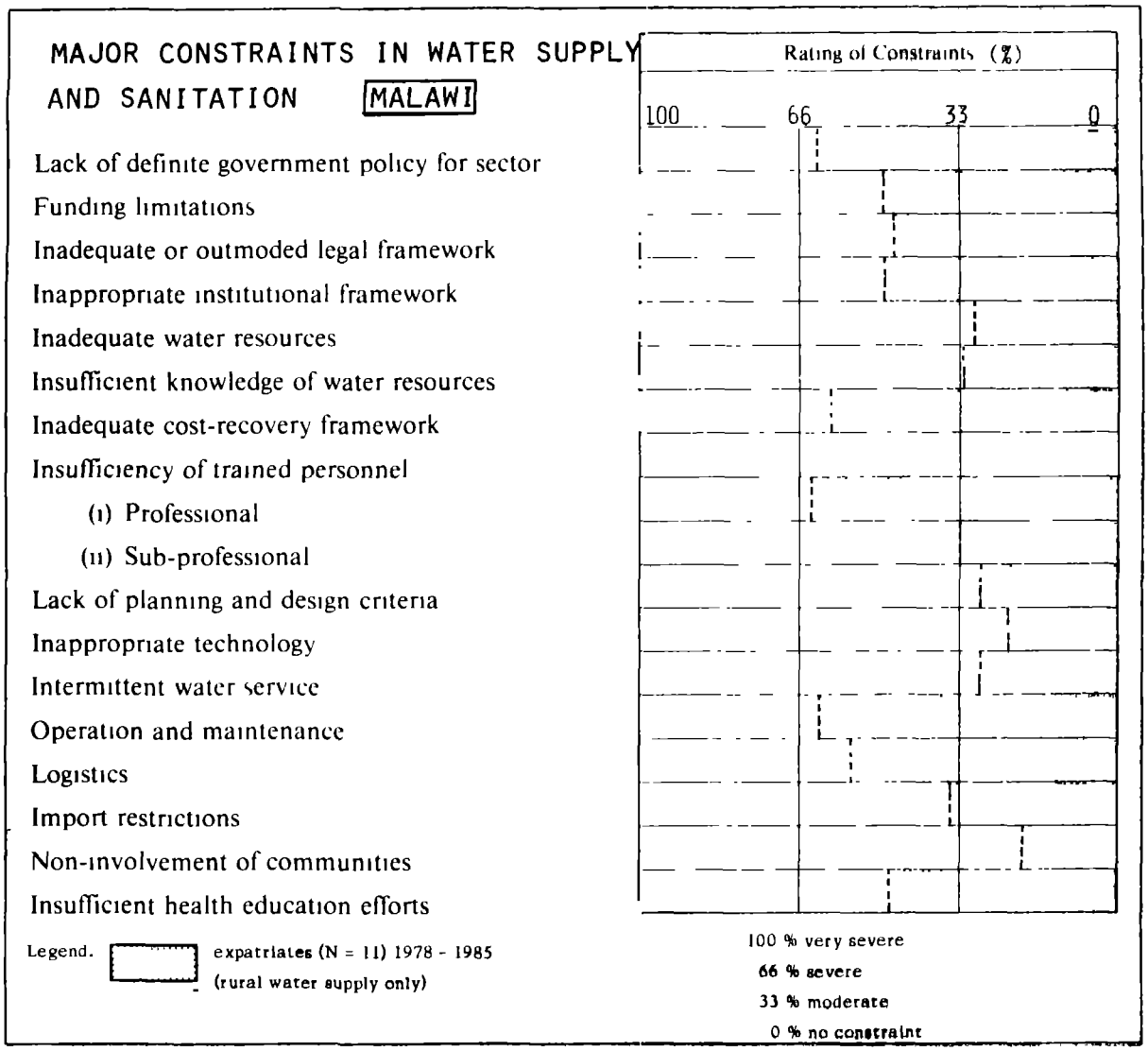

Figure 4.3. Major constraints in rural water supply in Malawi based on the questionnaire by the author.

The most severe constraint is the lack of professional staff. This is partly due to the fact that Malawi allows expatriates to take line positions in Government at all levels (Morss 1984). On the other hand, this perhaps could partly explain the generally quite satisfactory development of the sector since independence.

The foreign experts find the lack of a definite policy for the sector and problems of operation and maintenance the next most severe constraints. As a landlocked country Malawi has special logistic problems.

As for water resources, Malawi is quite lucky to have a precipitation of 700 - 2000 mm per annum. So far the most well-known progress has been achieved by constructing gravity schemes utilizing mountain streams in different parts of the country. This activity started on a minor scale in the 1960s and increased following a step by step approach. However, the potential for further schemes is now practically exhausted.

For ground water utilization special designs of hand pumps and well structures have been developed. The technology selected seems to be reasonably appropriate for the existing conditions. The involvement of communities has been quite successful and has gained international reputation.

Although the constraints as viewed by foreign experts seem to be relatively moderate one could ask, like Morss (1984), whether Malawi's capacity to run its own affairs and establish its own policies has been given sufficient attention.

4.2.4 Sri Lanka

The most important constraints in the whole sector as seen by the Government in 1983 (WHO 1984) were related to funding, cost-recovery, trained personnel, operation and maintenance, non-involvement of communities as well as insufficient health education efforts.

The foreign experts regarded operation and maintenance linked with cost-recovery and logistics as the most severe constraints. Figure 4.4 shows the views of the two interest groups.

The legal framework is relatively satisfactory, but land ownership can often cause problems for community water supplies. The institutional framework generally exists. Still, recently large donor support from USAID has been given for overall development of the institutions, including administrative, organizational, management and material support.

The annual precipitation is about 650 - 1000 mm in the so-called dry area covering about 65 per cent of the country. In the south-western part of the country the figures are 1800 - 5500 mm. The knowledge of ground water resources is again quite inadequate. The Harispattuwa water supply and sanitation project supported by FINNIDA mainly utilizes ground water (FINNIDA 1983).

The availability of trained personnel is affected by the drain to oil-producing countries.

The technology used was earlier biased towards surface water supply schemes. Development cooperation projects laying stress on simple techniques are changing this situation.

Other comments dealt with internal and external pressures affecting particularly externally supported projects in the sector. Lack of coordination between the external agencies as well as the institutions in the sector seem to be severe.

4.2.5 Tanzania

As far back as 1971 the Tanzanian government launched a twenty-year rural water supply development programme with the objective of the present water decade. This programme is one of the most ambitious in the developing world. Since the 1970s Tanzania has received external support from more than ten countries. Now most of the regions have got their water master-plans, most of which are being implemented by projects supported externally, especially by the Scandinavian countries, including Finland.

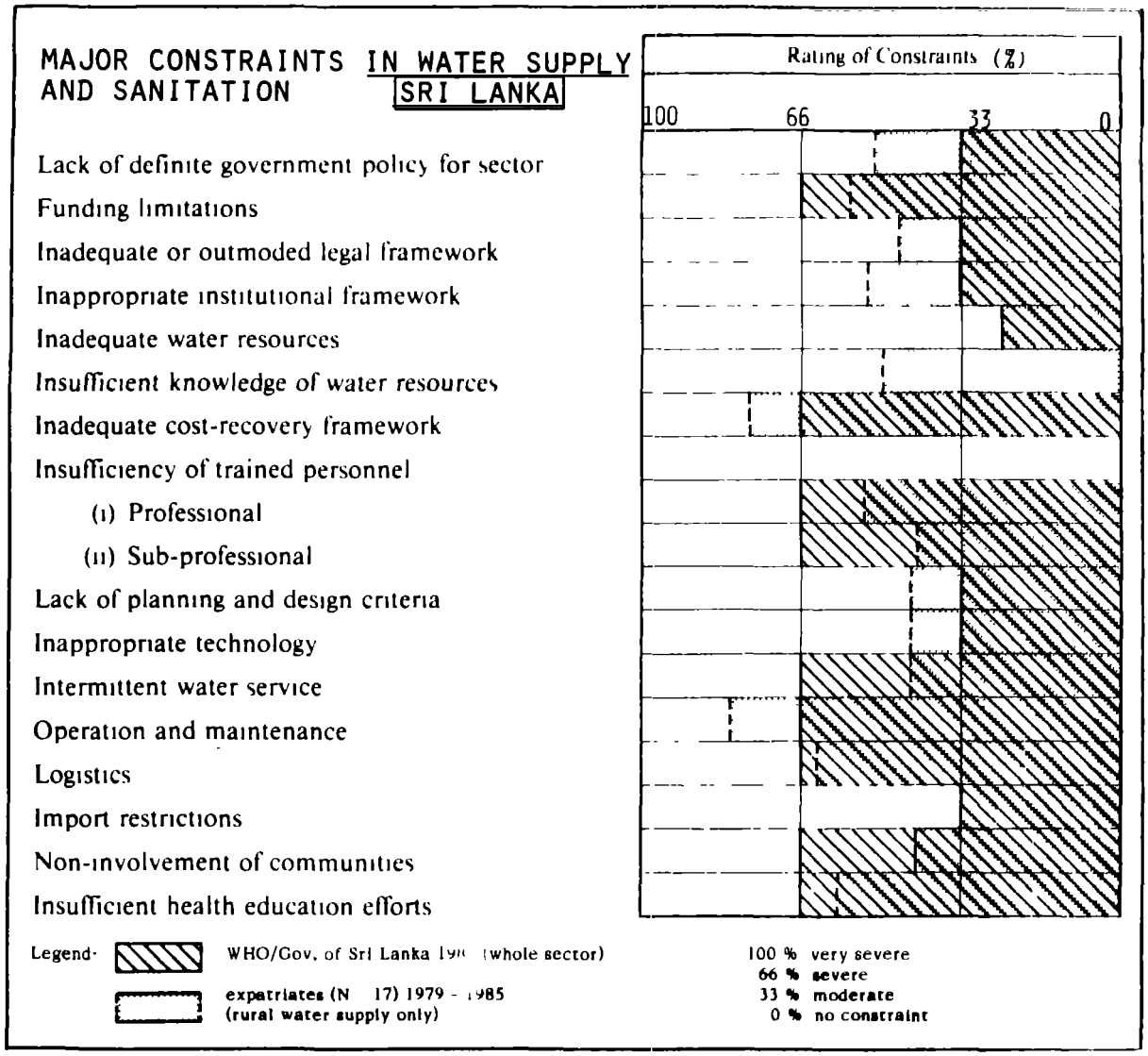

Figure 4.4. Major constraints in water supply and sanitation in Sri Lanka based on the questionnaires by WHO (1984) and the author.

The total number of answers concerning Tanzania (forty-nine) is considered to give quite reliable views on the constraints. Operation and maintenance linked with logistics and cost-recovery were regarded as the very severe constraints by foreign experts, as shown in Figure 4.5.

The number of operative rural schemes, particularly the piped ones equipped with diesel pumps commonly constructed till the latter part of the 1970s, is extremely low. A number of schemes implemented with external support are not functioning because of the lack of fuel. This problem is connected with the technology used, which in the present economic situation is in many cases beyond the country's economic capacity. Low-cost technology, such as hand-pump wells, is accepted in practice. However, the hand-pumps need maintenance and it is conceivable that even hand-pump wells represent too high a level of technology. Large scale use of hand-pump wells was introduced by the Dutch-supported project in Shinyanga, soon followed by the FINNIDA-supported project in Mtwara and Lindi regions (FINNIDA 1984a).

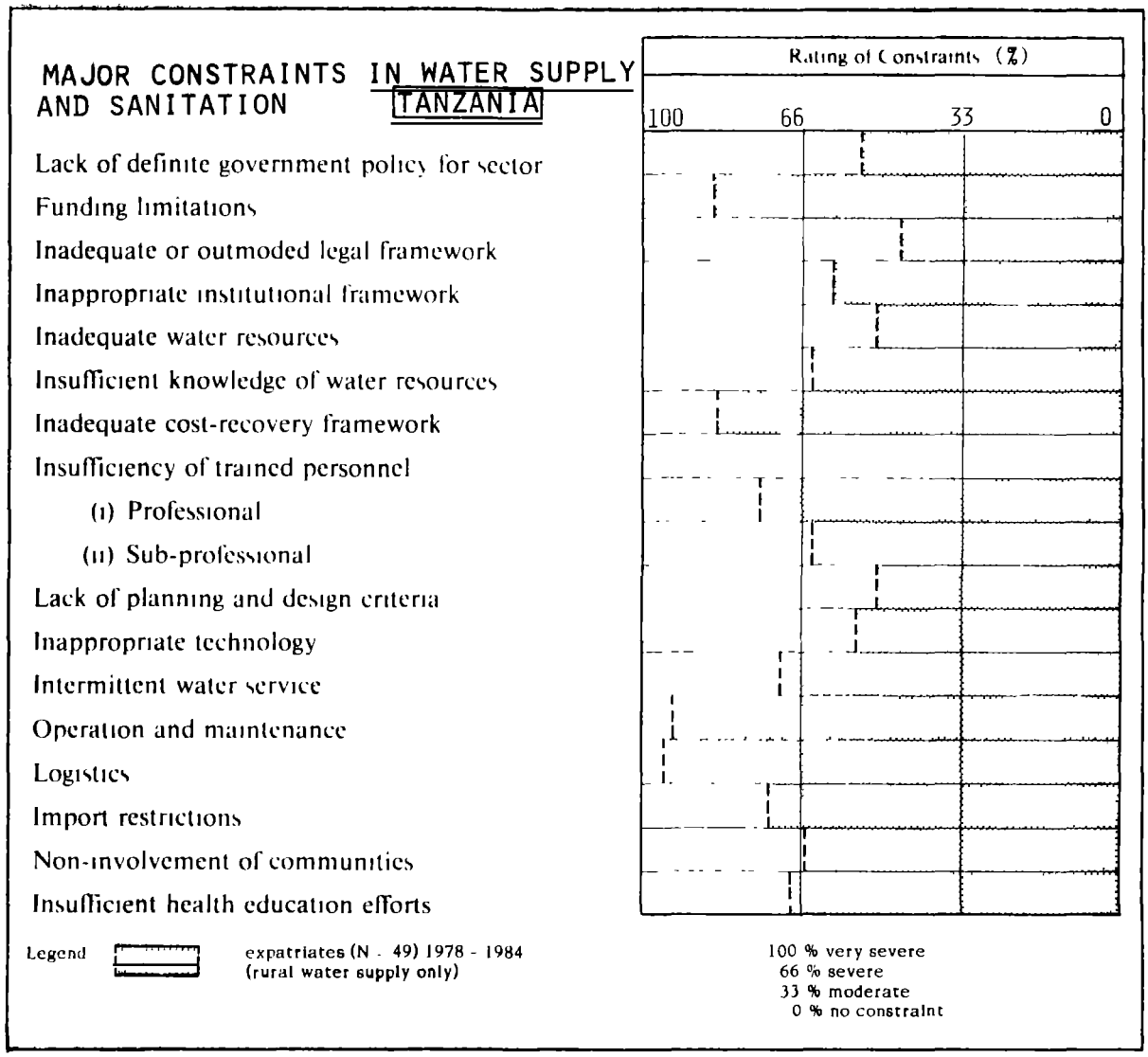

Figure 4.5. Major constraints in water supply and sanitation in Tanzania based on the questionnaire by the author.

Another question related to the non-operative schemes is the role at the Ministry. It has been suggested that the Ministry should concentrate on control and advice instead of actual implementation.

The supply of spare parts through the Ministry's central store does not seem to function. The externally supported projects are usually allowed to arrange the purchase via direct channels. The purchase of different materials and spare parts will be one of the major difficulties after the present development cooperation projects have been phased out and responsibility transferred and accepted.

The Tanzanian Government's early decision to supply all the population with water free of charge makes it very difficult to arrange cost-recovery. It seems to be the growing opinion in all developing countries that at least part of the operation and maintenance costs should be contributed by consumers.

Funding limitations were also regarded as a very severe constraint in spite of the fact that Tanzania receives relatively the highest amount of external support among the selected countries. Because of the economic crisis during the last few years the government has had serious difficulties in paying the local component of the development cooperation projects. This component is commonly under 10 per cent of the total project costs. Because the questionnaire was not clearly defined, operation and maintenance costs have probably been partly included in this category.

Institutional framework is in principle quite well established. However, the coordination of activities in the sector and between other sectors is not functioning. The efficiency of the Ministry in charge of water development is weakened by quite frequent changes in ministries and departments, lack of incentives and motivation as well as frequent changes in the duties of national personnel. The Regional Water Engineer's (RWE) offices are administratively under the Regional Development Director (RDD) and therefore the Ministry cannot have sufficient control over the sector.

Water resources in Tanzania are quite unevenly distributed. In some areas the limited quantity of water is the major constraint, sometimes worsened by the low quality of water. The inadequate knowledge of water resources is still commonly a more severe constraint. The number of trained personnel at different levels is relatively higher than in many other least developed countries. Therefore, a potential for development already exists if only the human resources could be fully utilized.

4.2.6 Discussion

The form proved to have its limitations missing, e.g. management-oriented constraints. In addition, those not personally interviewed probably interpreted the questions in different ways. The original WHO form was designed for the whole sector, whereas this study concentrated on rural water supply. Therefore, there might be a slight urban bias. Additionally, it is evident that intermittent water service is rather the result of inadequate maintenance than a constraint. However, the questionnaire gives a reasonably reliable figure on the major constraints in the countries selected as seen by national governments and foreign experts. The number of answers given by national experts from the developing countries was quite limited. These answers were not included when ranking the constraints shown in Figures 4.2 and 4.5. The number of donor representatives was very low and their views were included in the category of foreign experts.

Most of the foreign experts were civil engineers. The number of persons with other professional background was so small that it was not possible to make comparisons. All the experts were not necessarily sufficiently familiar with all the sectors of the project. In the analysis of the responses between different professional groups the arithmetic mean was used. It would have been more correct either to use the harmonic mean or present the results with a frequency distribution for each category (rate of severeness).

In spite of differences between the countries selected and between the different areas in each country, there is a remarkable number of similarities. Operation and maintenance combined with logistics as well as cost-recovery are seen as the most severe constraints both by national governments in developing countries and by foreign experts. The developing countries place more stress on the need for trained personnel and funding, whereas foreign experts are more concerned about cost-recovery.

The results obtained are by no means surprising. In 1938 Bunher (cited by Donaldson 1984) summarized the problems of water and sanitation in Latin America as follows

(i) The drinking water sector efforts were concentrated in a few urban areas
(ii) The operation and maintenance of the systems were often poor
(iii) There was usually a lack of trained technical and managerial personnel
(iv) The systems were usually inadequate to cover the area served
(v) Financing was often a problem
(vi) Organizational problems where more common than technical ones.

At least the second, third, fifth and sixth aspects are the major constraints as seen by the two interest groups of this study. Chambers (1974) noted in his study on rural development in East Africa that

> "Too often a lack of high-level manpower was used as an excuse for poor performance and for failing to probe into its causes and as a polite expression to cover up culpable inefficiency and corruption".

Probably more attention should be paid to the quality of training and its applicability to the tropical developing conditions as well as to motivation and incentives.

4.3. Constraints Caused by International Aid

The foreign aid of the 1970s which supported general programmes (personnel and materials support) has changed in favour of specific project aid with more donors. This is true of water supply as well. According to Morss (1984) this project and donor build-up is having a negative impact on government institutions of developing countries. He points out the large number of projects with their own specific objectives and the competitive nature of donor interactions.

In the water sector there is a high number of supporting agencies, e.g. in Tanzania there are more than ten bilateral agencies in the sector in addition to multilateral and non-governmental organizations. In fact the bilateral agencies have introduced coordinating activities during the last few years in Tanzania. Some attempts to coordinate activities were made as far back as the early 1970s.

In this study especially the few professionals from developing countries mentioned the need for more coordination.

Moris (1977) wrote that observers from the industrialized countries tend to ignore the cumulative impact of constraints upon the systems. He concludes that the major reason for the weakness of the transfer of western management innovations has been the general preoccupation of the outside agencies with semiautonomous projects as their main focus. On the other hand, the experiences of institutional support in the form of materials and experts who are without their own facilities or purchase channels have proved to be quite disappointing. Therefore, agencies like SIDA changed their support mainly to project-type aid during the late 1970s.

4.4 Minimizing the Constraints

There are many types of constraints, some of them permanent and hardly ever to be eliminated, such as the lack of water resources. Others can be binding in the short run, but many may be changed as time goes by. There are also man-made constraints set by political situations in developing and donor countries (Miser and Quade 1985).

In this study a number of noticeable differences between the interest groups of national governments and foreign experts were noted. The results seem to agree with the ideas of WHO report (1981) which states

> "Too often the constraints are regarded as the cause and not the symptom of inadequacy and a solution may be sought by simply increasing the amount of funds or hiring more central agency staff when in many cases those measures are merely palliative".

Instead of palliative measures we should find long-term solutions focusing on underutilized resources rather than on increasing pressure on overworked and frequently underpaid national professionals.

In this study it has been possible to present the views of two interest groups. Figure 4.6 shows a hypothetical scenario of different interest groups and their views on how to close the gap between needs and resources (Subrahmanyam 1982). One alternative is to lower the needs by lowering the service level or unit cost, or by serving only the unserved or less served groups. This alternative is favoured by the donor countries. The other alternative is to increase resources either by national sector allocations or external aid. Naturally the interest groups in developing countries favour the increase of external aid, whereas the donor countries support national sector allocations. The two extreme groups are the political level in the developing country and the tax-payer in the donor country. Although the figure is hypothetical, it probably gives a quite good overall picture of the views of different interest groups. A compromise in large-scale national and international cooperation is therefore necessary.

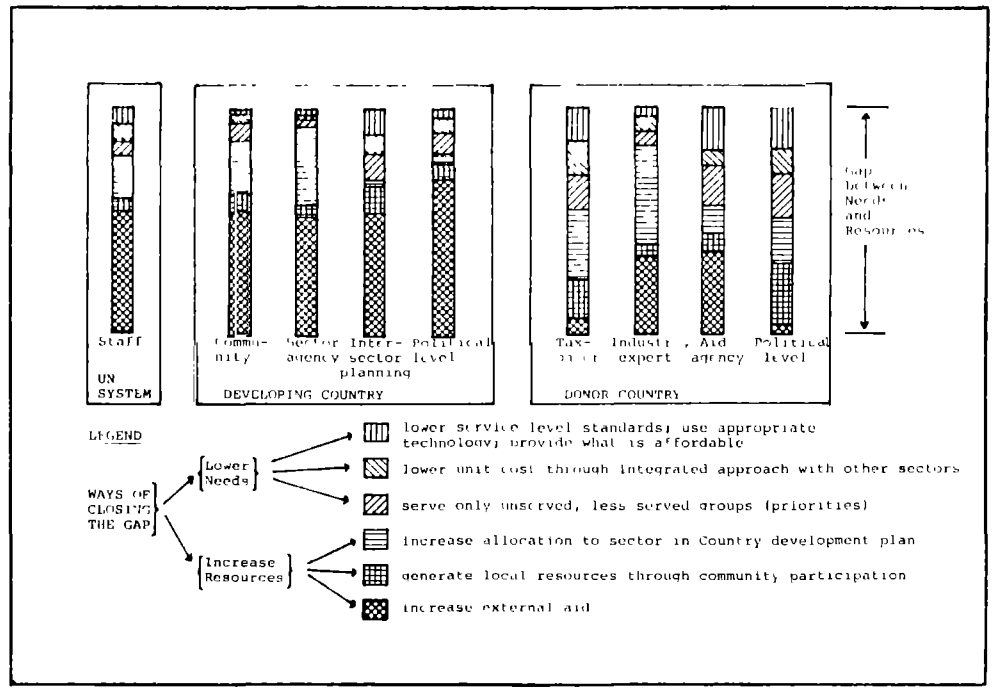

Figure 4.6 How to close the need-resources gap: a hypothetical scenario of viewpoints of main groups of actors (Subrahmanyam 1982).

Ahman (1980) divides the constraints into two types: "performance oriented variables" and "programme oriented variables". The "performance oriented variables" have principally to do with the technological type and the service level. The change can be made by reducing costs. The "programme variables" include programme policy, technological mix and time distribution. In the latter category the main type of limiting or critical factor is the public pressure on politicians and administrators.

The WHO/BMZ consultation in 1984 clearly indicated that donors have moved towards consensus positions on important issues like

- coordination,
- cost-recovery,
- institutional and human resources development,
- community participation and the role of women,
- appropriate technology, and
- sanitation and hygiene education (WHO and BMZ 1985).

The need for coordination was also pointed out recently by the OECD (1985) Development Assistance Committee. Thus there are many signs and examples that coordination is taking place between the supporting agencies. However, the exchange of ideas and information flow between different development projects, whether supported by the same donor or different donors, are equally important. The overworked personnel of national institutions and donors will certainly prefer effective consultations rather than just meetings for their own sake.

Coordination should in fact be optimized, not maximized. Chambers (1974) pointed out that the words coordination and cooperation are often much favoured by visiting missions, when

instead they should be trying to see how to get things done. One can actually hear the call for coordination quite often in developed countries also.

At the beginning of the Decade the following major issues were reported by UNDP (1980):

- rural emphasis and community participation,
- education and community support,
- training required personnel,
- choosing the right technologies, and
- maintenance.

These issues are in principle easy to agree on. However, community participation has often been presented as the most important means for solving the constraints of the sector. The author's view is that instead of a strategy, community participation should rather be seen as an objective in itself. The World Bank (1986b) speaks of community input, which means contributions in the form of cash payments, labour, maintenance, etc. Its key issue is that rural communities can afford to contribute more to water supply than commonly believed so far.

In its recent policy paper the World Bank (1986b) pointed out that the original quantitative goals of the Decade are unlikely to be met. It is not simply a question of inadequate amounts being invested. Because of the lack of community input and proper maintenance, systems are going out of operation faster than new ones are being constructed. Therefore, a fundamental reorientation of policies and investment strategies is needed. Also, it is evident that the right or appropriate technology often does not exist, and therefore in the selection one should lay stress on applied technical research and development. The worldwide hand-pump development project is one good example.

4.5 Implications of Constraints for Alternative Strategies

As a whole, one can present the following ways for coping with the constraints.

4.5.1 Constraints Seen as Limiting or Totally Inhibiting Factors

Constraints as limiting factors

When constraints are seen as limiting factors one can change objectives and needs, e.g. by lowering service level. If it is not possible to organize operation and maintenance for hand-pump wells, one could improve water supply by temporary solutions or a step by step approach. Berhane (1984) has suggested this kind of strategy for rural water supply in Ethiopia by constructing improved open wells instead of covered wells with hand-pumps. SIDA has in principle accepted the approach of improving traditional water sources as one alternative in Tanzania (Hannan-Andersson and Andersson 1985b). The economic capacity of the area to be served must be seriously taken into account. We have to ask whether even hand-pump wells represent too high technology for low capacity areas.

Constraints as totally inhibiting factors

When constraints restrict alternatives, certain objectives cannot be achieved (Miser and Quade 1985). The alternatives are screened

and those affected by constraints are seen as not feasible. A total withdrawal of a donor from a country is an example of this.

4.5.2 Constraints to Be Overcome

More time for development

This alternative suggests that more time should be allowed for promotion and for a felt need to arise among consumers. The approach has been commonly used by missionaries. For bilateral or multilateral donors this is quite critical since the decision-makers, and particularly the taxpayers in the donor countries, usually want to see results as soon as possible.

Reorganizing the use of resources

It is possible to concentrate resources into the fields which need them most. Organizational and managerial procedures can be developed without necessarily increasing resources. One possibility is to concentrate the activities in a limited geographical area and proceed to the next one after the first area has had its water supply needs satisfied. This could economize on transport needs. One drawback of this approach is that some people may prefer other services like a dispensary. In fact, it is now generally accepted that a felt need for improved water supply should exist before starting a water project.

In the case of personnel management, different types of incentives could be used to motivate towards better performance. One possibility, which is quite popular in developing countries, is to decentralize the activities down to local levels-regions, districts, etc. However, this seems to be quite a difficult issue because central control over the sector is always needed to some extent. The level and amount of professionals are also serious limiting factors.

Attract more internal resources

The relative appropriation to the sector in national budgets could be raised. The first years of the Decade generally show that it has not been possible to get sufficiently high government priority for the sector. Secondly, it would be very important to allocate a larger share of the sector funds to operation and maintenance.

The third alternative is to transfer resources from urban schemes to rural schemes so that the whole sector remains self-sustained.

The fourth alternative is to get more resources from the beneficiaries. This community input can be based on monetary or non-monetary contributions. It is clear that even a partial contribution will increase the sense of ownership and responsibility thus motivating to maintain the systems in function.

Linking water supply with agricultural, forestial, industrial or any productive field could be a way to raise funds for operation, maintenance and even investment. This productive use could produce an improved drinking water supply as a by-product of the main activities.

Attract more external resources

The alternative of getting more support from external agencies is often seen as a means of overcoming constraints. For instance, Tanzania has succeeded well in getting this support from quite a number of agencies. It is common for donors to cover about 95 per cent of the investment costs of rural water supply projects. However, it is not clear to what extent donors will support operation and maintenance costs. In any case there is a limit to external support if we wish to promote local initiative and action. Too high a dependence on external sources can be quite dangerous for national capacity building.

Development of technology

In the developing world so far too little attention has been paid to applied technical research in the sector. Hand-pump and low-cost sanitation development projects are good examples, but obviously many others are needed as well.

Institutional capacity building and development

Technical assistance within development cooperation normally means support to national institutions in the form of human or material resources. These institutions often already exist.

The second alternative is to support the development of small private enterprises and contractors which could help in manufacturing, implementing and even operating water supplies. This alternative seems to be becoming more accepted now than in previous years in developing countries.

The use of local, private voluntary organizations (PVOs), such as women's organizations, could be one possibility for transferring responsibility to the local level.

Use of experience from other developing areas

The technological, economical and organizational experiences from other areas of the country concerned and other developing countries are not always fully utilized. Often information is better available in a donor country than in the developing country itself.

Human resources development

Although human resources development is necessary, it alone is not sufficient to cope with constraints in all the main alternatives. It is obvious that none of the alternative approaches mentioned will provide the only solution. Instead, an appropriate combination of these issues could form applicable strategies.

5 APPROPRIATE TECHNOLOGY

5.1 Classification of Appropriateness

In the 1950s and 1960s when most of the developing countries became independent, conventional, mostly western technology was used in the water sector. In the mid-1960s Schumacher (1965) cited by Pacey (1977) introduced the concept of "Intermediate Technology". This concept stresses possibilities to use local resources as much as possible and thus only intermediate or low-capital investments are required. One of the key arguments was the need to choose among a great number of technologies at different levels.

Based on the ideas of intermediate technology the term appropriate technology was taken to use, particularly after the UN Water Conference in Argentina in 1977.

Pacey's (1977) criteria of appropriateness (Table 5.1) are based on immediate objectives and further goals. The latter ones are divided into three classes which follow each other in case the previous goals have been met and necessary additional inputs are applied.

Table 5.1. Goals and objectives for water supply improvements in rural areas of developing countries (Pacey 1977).

Immediate Objectives	*Further goals—stage I* (these follow as consequences when the immediate objectives have been met)	*Further goals—stage II* (these follow from previous stages if complementary inputs are provided)	*Further goals—stage III* (these are consequences of reaching the previous goals which follow if there are also inputs on many other fronts)
FUNCTIONAL to improve the quality, quantity, availability and reliability of the supply OTHER to carry out this improvement in a manner which (a) secures the support of users, (b) conserves scarce resources (e g capital), (c) avoids adverse environmental consequences (e g lowering water tables, encouraging mosquitoes)	HEALTH to reduce incidence of water-borne and water-based disease ENERGY/TIME (ECONOMIC) to save time and energy expended in carrying water SOCIAL to arouse interest in the further health and economic benefits which may arise from the water supply ECONOMIC to provide more water for livestock and garden irrigation, (water may be used for this even if it is intended solely for domestic supply)	HEALTH to reduce incidence of water-washed infections (*inputs required* improved hygiene, health education, improved sanitation) SOCIAL/TECHNICAL to ensure good long-term maintenance of water supply and sanitation facilities (*inputs required* training, clear allocation of responsibility, build-up of local maintenance organization) ECONOMIC to use energy/time savings and increased water availability to achieve better agricultural output (*inputs required* extension work, fertilizer supply etc)	to achieve the greater well-being of the people through (a) social change—greater self-reliance in the community, better organization, better deal for the poor, women, etc (b) improved standard of living - health, nutrition, income, leisure

In 1976 the World Bank started a two-year research project on appropriate technology for water supply and particularly for sanitation. The project took two years and compiled experiences of primarily sanitation in developing countries. The results were gathered into 12 volumes which were widely distributed. This

research project was a basis for the World Bank's activities for further development of hand-pumps and improved latrines for developing countries (Kalbermatten et al 1980).

In this study the term appropriate technology is used in its widest sense including:
- technical appropriateness,
- economical appropriateness, and
- social and cultural appropriateness.

It is quite difficult to make clear distinctions between these three categories. They are also more or less linked to each other.

In engineering analysis feasibility is a common term which normally includes
- technical,
- economical,
- environmental,
- financial,
- institutional, and
- social aspects.

In the field of forest technology according to Mustanoja (1984) conventional appropriateness assessments like feasibility studies and appraisals have been biased towards technical and economic appropriateness. It is questionable whether this is true with the water sector, too.

Stern (1985) saw appropriate technology as a term describing both a method and a movement. The concept includes the appropriate application of scientific knowledge to development and the movement that started in the mid-1960s.

5.2 Technical Appropriateness of Rural Water Supply

5.2.1 Water Consumption

The commonly used design criteria for drinking water supplies in rural areas is 30 litres or 6 gallons (27 litres) per capita per day. This criteria has been used both for public standposts outside housecourts as well as for hand-pump wells. However, the real consumption figures have often been far less, commonly in the range of 10-15 litres. In Malawi the average per capita consumption was about 15 litres per day in a gravity scheme equipped with public taps (Katko 1986b). Stanislawski (1974) made a survey on two pumped and piped rural water supply schemes in Tanzania. The average consumption was 35 litres per capita per day. Stanislawski also pointed out the need to take into account the cattle water demand. In Sri Lanka people traditionally use a lot of water for washing and therefore the consumption figures are clearly higher than generally in East-Africa (Katko and Lehmusluoto 1984).

The absolute minimum of water needed, for food preparation and drinking is around 3 litres per day depending on the weather conditions. From the health viewpoint McJunkin (1982) suggested that 50 litres per day should be a minimum goal. With the present economic situation this figure seems too high in rural areas of many developing countries.

5.2.2 Water Sources and Abstraction

Water for drinking is available either in surface sources or ground formations. In many developing countries the use of surface water has been favoured even in rural water supplies although quite often safer ground water would be available. Table 5.2 shows a simplified comparison of the advantages and disadvantages of the two main sources (Wihuri 1985a). On the whole, surface water requires nearly always treatment which calls for qualified manpower in operation and maintenance.

Table 5.2. Comparison of ground water and surface water (Wihuri 1985a).

Ground water		Surface water	
Advantage	Disadvantage	Advantage	Disadvantage
	not visible	easy to find	
steady amount	limited amount		fluctuating amount limited amount
stabile quality			rapidly changing quality
very little organic matter	dissolved solids (inorganic)	less dissolved solids	organic matter
clear			turbidity, suspended substances
"no life" in water			"life" in water

Ground water

Surface water has often been preferred because it is visible. The knowledge of ground water has been quite limited even among the professionals, although the construction of permanent wells is known to date back to the 6th millennium BC in Mesopotamia (Miller 1982).

Well siting has been and probably still is the most difficult part in ground water utilization. Water witching has appeared through the history of mankind and it has been one of the toughest superstitions to fight against (Wihuri 1985b). This applies to the developed countries as well. Lehr (1985) wrote about the situation in the United States:

> "There is no doubt that the underdevelopment of ground water is at least a partial result of the significant lack of confidence our citizens have in the continued availability of underground water. This lack of confidence is a direct result of the common belief that ground water flows in secret rivers and

channels whose presence is known only to our friendly water witches. City administrators, often believing ground-water occurrence to be mysteriously unpredictable, do not encourage the use of this important resource."

Research on water witching has been carried out in different parts of the world. The result has been always the same: there has been no correlation between the results of different witchers used in the studies. The occurrence of ground water is based on the geological structure of earth and rock.

In a large scale water resources inventory we can use remote sensing e.g. satellite and air photos. For field surveys modern geophysical investigation methods, together with geological expertise, offer the most reliable knowledge. In most cases the costs of these investigations are quite reasonable compared to the classical "trial and error" principle. The electrical and resistivity sounding are the most common investigation methods. In borehole construction geophysical logging methods based on resistivity and radioactive sources can be used (Luonsi and Lappalainen 1981).

In Finland the seismic sounding method was used for investigating the glacial formations. However, after the Finnish consultants gained experiences of resistivity sounding in East-Africa in the 1970s the method was taken to use in the home-country, too. This is an example of indirect technology transfer from developing to developed countries. The use of microcomputers helps in interpreting sounding data which is quite labourous by manual methods.

Large areas in Africa are underlain by crystalline basement rocks. Main rock aquifers are found either in the weathered mantle or in the fractured basement rocks (Foster 1984, Jones 1985). Although these aquifers are not very productive they are normally sufficient for rural water supplies based on hand-pump boreholes.

Based on experiences in southern Tanzania the potential of the weathered mantle was pointed out by Finnwater... (1977) and Mälkki (1979). For higher yields fractured zones in basement areas must be found. However, it is evident that further research to improve well siting and field techniques is needed to avoid concentrations of fluoride, sulphate, magnesium, iron and manganese as suggested by Foster (1984).

Manufacturers of drilling rigs have introduced new models which are lighter and more movable than before. Drilling fluids have also been developed but these new polymer muds are less appropriate for the developing world because of their high price.

Development of springs, wells and boreholes

The use of ground water seems to play a major role in the present Water Decade, and a number of programmes with wells and boreholes are under way in different parts of the world.

Already in colonial times some rural water supplies were developed although not to the same extent as later on. Carruthers (1973) reported that from 1942 to 1962 in Kenya the following water supply schemes were developed:

- 1590 permanent and temporary dams
- 310 subsurface dams in "sand rivers"
- 105 boreholes
- 75 piped water schemes
- large number of wells and protected springs.

As an example the East African Literature Bureau (1950) published a handbook in Swahili on spring tapping and use of cattle water. This booklet was also used in secondary schools. Quite similar material is now produced by donor supported projects and programmes. However, in Africa large scale water supply projects based on shallow wells and boreholes have mainly started in the 1960s after the independence.

Tapping of spring water is the easiest way to utilize ground water. Despite this and technology development it is often difficult to keep the water flow from escaping if the aquifer is disturbed. Tapping of springs has perhaps been seen as too easy and therefore there are only a few available publications on the matter such as those by Swiss Association for Technical Assistance and Yaounde (1980) and Raus (1985).

Since independence the technical development of water supply in East-Africa has followed different patterns. In Uganda emphasis was on boreholes with hand-pumps, whereas Kenya and Tanzania emphasized piped supplies for rural areas (Warner 1973). In Uganda development came to a hault because of the instability of the country since the early 1970s.

In Tanzania the Dutch Government supported the first regional project using shallow wells equipped with hand-pumps from 1974 to 1978 (DHV... 1979). The project was handed over to the Regional Water Engineer's office over a few month's period. It did not take long before the system collapsed partly or totally because of inadequate maintenance.

Shallow well technology was tested by the FINNIDA-supported project in Mtwara and Lindi regions in Tanzania during the water master plan phase 1974 - 1977. The implementation started in 1978 and was based on mixed technology using ground water wherever possible including hand-pump wells and boreholes with piped and pumped schemes. The use of shallow ring or tube wells equipped with hand-pumps was particularly emphasized.

When the economic crisis hit Tanzania in the early 1980s it was often impossible to operate and maintain diesel pumped rural schemes. Other donor-supported programmes have thereafter shifted towards shallow wells and gravity schemes. In spite of the very severe constraints and lack of fuel for the pumped schemes they are still planned and constructed by the present Ministry of Lands, Housing, Water and Urban Development in Tanzania.

In Kenya piped schemes using surface water, often equipped with conventional chemical treatment, have dominated rural water supplies until recent years (Anon 1982a). The first large-scale rural water supply project based on hand-pump wells or protected springs wherever possible was started in western Kenya with the support of FINNIDA.

In February 1987 Rotich (1987) stated in the African Water Technology Conference in Nairobi:

> "It is crucial that the Ministry will always favour least-cost solutions both in capital investments and operation and maintenance costs. Here I should like to make it clear that least-cost solutions do not mean shallow wells and handpumps".

Although hand-pump and spring technology is appropriate, it seems very difficult for Kenyan authorities to fully support this approach. Anyway, in the countryside the number of unused and non-operative piped schemes is huge. Thus the fact that some shallow wells dry up during especially dry years seems to be overemphasized.

In the 1970s in well construction donor supported projects often used machines such as excavators. Later they have introduced labour-intensive methods such as hand digging and hand drilling of wells. When consumers are involved in construction, responsibility and sense of ownership wil' be born. Heinänen (1987) pointed out the fact that water quality is better in hand-dug wells. When the well is dug by an excavator the back-filling and compaction will be more difficult than with manual construction methods.

Hand-pumps and other lifting devices

The use of hand-pump wells is perhaps the most important way of utilizing ground water. The World Bank has executed a development project on Village Level Operation and Maintenance (VLOM) hand-pumps since the early 1980s and has gained remarkable results. Many bilateral and other organizations have supported this programme by doing field tests in different parts of the world. More than a hundred manufacturers have become interested in hand-pump development. This is an example of the private sector's contribution to the sector development.

The project has developed a so-called direct-action pump, a version without the fulcrum area or lever arm and thus with less moving parts needing maintenance. Figure 5.1 shows an example of the direct action pump.

Suuriniemi (1987) pointed out that in hand-pumps for developing countries light, strong and durable materials of maximum quality must be used. From the manufacturer's viewpoint this demands fairly high technology. From the consumers viewpoint the product is simple with few moving parts and very easy operation.

The first hand-pumps used in developing countries were the same types commonly used in developed countries mainly for private, single family house wells. These pumps did not work at all in communal wells of Africa.

The second generation of hand-pumps were built stronger but they were still based on the same working principles and materials such as cast iron and wood. The third generation pumps such as the direct action pump are made of steel (parts above the ground) and plastic (parts under the water table).

Figure 5.1. NIRA AF-85 direct action pump (Photo J. Viiala).

In India UNICEF has led the development of India Mark II, perhaps the most widely known and used hand-pump for deep wells. Of particular interest is the strict quality control in pump manufacturing. In 1984 there were altogether 35 UNICEF-licensed manufacturers of pumps. This quality control costs 250 000 US $ per annum but seems to be worth the effort (Charnock 1984).

The development of hand-pump technology supported by a number of donors has stimulated the important issues on standardization and local manufacturing. The author's view is that more than one type of hand-pump per country is needed. We should probably limit the number to 2 - 4 models per country to ensure possibilities for maintenance and spare part services. If only one or just a few models are available, the cost per unit tends to rise as it did in Zimbabwe.

According to the World Bank (1986b) donor agencies have reported that 70 per cent of hand-pumps, although one of the most simple means of supplying water, were sometimes out of order. Sometimes even hand-pumps seem too advanced for the least developed countries.

In India the Lutheran World Federation has supported the construction of open wells (Nathan 1983). Berhane (1984) suggested that in rural Ethiopia the so-called improved open wells with the rope and bucket should be constructed in areas where it is not possible to arrange reliable maintenance. In Zambia the hand-pump resistance prompted an Irish-supported project where

partly covered wells are equipped with winches (Anon 1983). In principle, in Tanzania SIDA has also accepted the strategy of small-scale improvement by raising the standard of traditional water sources (Hannan -Andersson and Andersson 1985a).

Windmills have been used to lift water from boreholes among others in Singida Region, Tanzania. However, they proved to be too complicated in those conditions as noted in the completion report (Snowy Mountains... 1985).

As for solar pumping the Intermediate Technology Power Ltd (1983) estimated that mass production of the photovoltaic cells which convert sunlight into electrical energy will reduce the cost by the year 2000 by two thirds. Ward and Dunford (1984) have studied the use of solar powered ground water pumping in remote locations. They expect that the option will become popular in the future.

Hydraulic rams have been used for nearly a century in the developed countries. They have also been used to some extent in the developing world. Because of cheap oil in the 1950s and 1960s they were nearly forgotten. Recently they have become topical again and e.g. in East-Africa some donor supported projects are using them as an additional alternative for specific sites. Rams have proved to be reliable and they do not need much maintenance.

There are other lifting alternatives such as the counterpoised lift (shadouf), different types of water wheels and chain lifters. So far in developing lifting devices hand-pumps have been the main target. However, other alternatives could also be worth developing.

Surface water dams and charcos

Relatively safe surface water can be found in mountain streams above permanent housing and in large lakes without human or industrial pollution.

In developing countries decision-makers have often favoured surface water sources. Surface sources like dams and charcos are visible and are thus good examples for potential voters. However, this water is not safe for drinking . For agricultural purposes dams are basically acceptable but they are often very costly.

Other water sources

Rainwater harvesting is one way to collect water for dry seasons. The study by Omwenga (1984) in western Kenya showed that this alternative has potential. In most cases the quality of rainwater is high and much better than that of the traditional sources. Rainwater catchment was discussed in a conference in Thailand in 1983 (IDRC 1986). Recent development has been reported by Pacey and Cullis (1986).

Ground water or infiltrated surface water in river bed deposits can be utilized by different types of collector wells and infiltration galleries (Buss 1981). The idea is to purify water by natural or artificial sand and gravel layer on the river bed.

River bed deposits can also be used for storing water by building sub-surface flow dams. A sub-surface dam is constructed on the ground level for arresting the flowing water in a natural aquifer. The so-called sand-storage dam is constructed above the ground and it catches coarse particles like sand and gravel brought by the river flow (Hansson and Nilsson 1986).

Sub-surface flow dams have been used in different parts of the world. In Europe and Northwest Africa the dams have served fairly large schemes whereas in Ethiopia, Kenya and Namibia they are used mainly for small-scale rural schemes (Hansson and Nilsson 1986, Wipplinger 1958).

5.2.3 Water Treatment

In tropical conditions surface water can contain high turbidity values especially during high peaks of rainfall. They can also contain, at least occasionally, high values of manganese (MAJI 1982). Surface water is often of low quality due to direct access of bacteria and pathogens.

Deep ground water quality can be lowered by high values of salinity, often combined with low pH causing agressivity. High values of fluoride can cause fluorosis which is particularly harmful to children.

Protection of water sources

The simple protection of water sources can improve water quality a lot. In western Kenya Nyangeri (1986) studied the water quality in privately owned hand-dug wells and communal springs. Only three per cent of the sources met the bacteorological requirements of the WHO guidelines. By covering hand-dug wells properly, water quality could be improved remarkably.

Boiling

Boiling is perhaps the most traditional way to treat water in case of suspected contamination. However, this method consumes a lot of firewood which is getting scarce in many developing countries. Therefore, in most cases boiling is not appropriate for water treatment.

The author is concerned about the fact that the idea of boiling water is so deep-rooted in the developing countries and that it is still encouraged by some international organizations. In a recent seminar in Arusha, Tanzania the audience learned of boiling in the SIDA-supported project. Janse (1985) reported that in Tanzania women want to boil water before they use it. A film by UNICEF (1985) showing water supply and sanitation in Nigeria also included the issue of boiling. In health education campaigns the boiling of water is highly recommended.

In an emergency boiling is probably necessary. Boiling of water can be also feasible for infants. However, supplying safe water preferably without any treatment from a protected source would be the ideal case. If this is not possible the water should be treated as simply as possible using local resources and materials.

Storing of water

By storing water one to two days E.coli bacteria can often be reduced by one half (Pacey 1977). In a large water supply system this is not practical. Storing could be done at home but then there is the risk of contaminating the water by other means. Lehmusluoto (1987) made a survey on water contamination in western Kenya. He found out that water drawn from a protected source and carried home was in most cases contaminated on its way, or in the house.

Slow sand filtration

Slow sand filtration (SSF) has been studied and promoted for instance by the International Reference Centre for Community Water Supply and Sanitation (IRC) (van Dijk and Oomen 1978). In principle this physical-biological method should be used rather than a chemical process.

The greatest difficulty of slow sand filtration is clogging caused by turbid waters during hi$_b$h peaks of rainfall. There has been some research to develop appropriate methods to remove turbidity instead of using conventional chemical treatment. Horizontal roughing filter (HRF) is a channel of about 10 metres studied by Riti (1981) and Wegelin (1986). The channel is divided into three successive units. The first unit has the coarsest grain size and the last unit the finest. Models with backwashing have been developed but there still seems to be some doubt of the economy of the method.

A similar method is to install coarse gravel or even boulders around water intakes in surface waters thus forming an artificial infiltration unit. Meskus (1986) mentioned this type of unit been constructed already in colonial times and ever since used successfully in southern Tanzania. In Finland a resembling intake structure called "piisaminpesä" has been recently taken into use in some rural water supply schemes. In Kenya Heinänen (1987) studied the use of diatomic earth in filtration with encouraging results. In the case of Kenya this media is industrial waste and, therefore relatively cheap.

Swirl concentrators could perhaps be used in pretreatment of turbid waters. Mashauri (1986a) did research on a vortex type single basin for primary clarification of water. Ryynänen developed models of a multi-stage swirl separator for water treatment. So far, there are no full scale experiences of these separators in tropical conditions (Häkkinen et al 1987).

Iron removal

In Finland Ashenafi (1986) investigated a dry filter application where the influent trickles through a coarse gravel media. This microbiological method removed iron very efficiently and reduced the amount on manganese, ammonia and carbon dioxide. There is also on-going research of the use of wet gravel filters in practical field conditions (Mälkki 1986). In India Dahi et al (1985) have developed iron removal plants made of locally available materials and connected with hand-pump wells. In western Kenya Heinänen (1987) has developed simple iron removal units. On the whole the biological iron removal phenomenon is still partly unknown.

Odira (1985) investigated the use of upflow filters in direct filtration of turbid waters. The laboratory scale results were promising.

Water quality control

Sechu (1986) studied possibilities for water quality control in southern Tanzania in one of the least developed regions of the country. As one alternative he suggested sanitary inspections assisted by occasional sampling for laboratory analysis. The use of conventional quality control methods is often far beyond the capacity of developing countries. However, continuous appropriate quality control would be necessary to discover possible changes in quality.

WHO (1985b) has in its recent guidelines for drinking-water quality made a special volume for small rural communities. The given values are not to be used as standards but they should be applied according to local conditions. In a way the guidelines accept the step by step approach for improving water quality in rural areas.

5.2.4 Water Distribution

Conventional pipeline materials like cast iron have proved to be quite durable in tropical conditions whereas galvanized iron pipes are subject to corrosion. The use of locally manufactured materials is generally preferred.

In developing countries plastic pipes have increased their share on the market. Because plastic pipes are light they are easily transported e.g. by putting pipes of different diameters inside each other.

Polyvinylcloride (PVC) pipes are easily destroyed by ultraviolet rays and therefore they should not be exposed to direct sun-light. Covering of pipes demands disciplinary management which is often missing.

In the developing countries PVC pipes are often manufactured by local factories. They tend to become expensive because of relatively high volumes of imported raw materials. The PVC pipes produced locally are much thicker than those of similar diameter manufactured in modern factories of developed countries. Additionally the durability of locally manufactured pipes can be low as shown by Kayombo (1981).

The use of bamboo pipes has been studied in Tanzania (van den Heuvel 1983). The major problem is the durability against fungi and subterranean termites. Suggestions for protecting and lining have been made but it is not clear whether the methods are safe.

Conventional taps used in communal water points have often ceased to work in a short time. Special taps of a durable structure and material have been introduced to the market by a number of manufactures.

In reservoirs locally available materials like concrete and stone masonry should be used if possible. At least in the Caribbean region earth based reservoirs lined all around with plastic textiles have been used successfully (Hukka 1987).

Zaroff and Okun (1984) have studied the vending of water: carrying and selling of water. In many parts of the developing countries households pay frequently over 30 per cent of their monthly income for vended water when the figures are 1 to 5 per cent for most piped schemes. The costs of vended water could be significantly reduced by an improved institutionalized vending system. This would consist of proper design of vending stations. Water would be delivered by corrosion resistant containers for a fixed price. Stations would be equipped with storage reservoirs and proper delivery vehicles would be supplied to vendors. Improved vending would serve as an interim solution. Zaroff and Okun regard vending as a very appropriate technology for:

- communities to be provided with piped supplies at some date at least several years ahead,
- slum and squatter settlements for which the government is unwilling to provide costly permanent infrastructure,
- communities with dwellings irregularly spread over a large area,
- outlying areas of communities served with piped water, and
- communities in which the proximity of drinking water outlets permit easy collection of water by significant percentage of households.

Suleiman (1977) made a survey on water vending in Surabaya, Indonesia. He noticed that the work of water vendors is hard and does not necessarily benefit the vendors themselves. Instead of vendors he suggested communal water points (not public) which is privately owned but publicly supported. The owner agrees to sell water at a reduced price compared to vended water.

5.3 Economic Appropriateness

Affordability

A commonly used criteria for covering costs of a rural water supply is that a family should not have to pay more than 5 per cent of its income. Saunders and Warford (1976) estimated the income spent for water in 12 cities of the developing countries. In Addis Ababa, Manila and Nairobi the 5 per cent limit was exceeded among the lowest income group. The proportion of the sector allocations of international donors is on average 2-3 per cent of their total assistance. This would imply that the figure of 5 per cent is really a maximum value.

Saunders and Warford continued:

> "The general lack of any hard evidence on ability (and willingness) to pay has resulted in the politically expedient assumption, which has been made in most developing countries, that the rural population cannot pay the full cost of water."

The World Bank (1986b) dealt with the same matter in its recent policy paper. It states that rural households can afford to pay for water more than generally recognized, provided appropriate technology and delivery mechanisms are available and used. The Bank continues that with an average rural income of over US $ 250 per capita piped water supply tends to become affordable. In Africa few economies could not reach this level. The author thinks that this limiting factor could apply to quite a number of countries because of differences between regions and income groups.

One way of estimating the affordability could be to analyse the number of consumer items such as radios, bicycles or cattle and use them as basis for calculating the economic capacity of the rural area concerned.

In rural sanitation the World Bank has eagerly promoted the ventilated improved pit (VIP) latrine. The latrines equipped with concrete slabs could be an example of item not affordable in rural areas.

Willingness to pay

The willingness of consumers to pay for water in cash or in other form is mostly a social aspect and is connected with the key question: is there a felt need for the service?

In Finland e.g. in the Oulu region there is a number of large rural piped water supply schemes served by treated ground water. The natural ground water contains high amounts of iron and therefore single wells are not appropriate. In this situation people are willing and motivated to pay for improved water quality and supply.

The reliability of the water supply system as well as the simplicity of operation and maintenance have an effect on consumers' willingness to contribute to better services.

Experiences of consumers' willingness to contribute to rural sanitation vary a lot. The governing factors are strongly related to cultural and social aspects.

Water pricing and cost-recovery

Cost-recovery means the collection of revenues from the consumers. The advantages of increased cost-recovery are based on a.o. the following reasons (Hewitt and Becker 1986):

> "Replicability - Limited government resources combined with rapid growth and increasing demand require that users pay; without cost recovery utilities may not be able to replicate projects.
>
> Financial Viability - Prudent financial management requires financial independence; the existence of large scale subsidies undermines financial discipline and, from there, institutional and managerial autonomy.
>
> Efficiency - Users should pay prices that reflect real costs in order to attain efficiency in the use of scarce resources."

An expert panel on water pricing organized by ESCAP (1980) concluded that generally the price of drinking water can be increased. Raising of water prices is comparable to the cost of developing an alternative water supply. This alternative gives the maximum possible water prices for public utilities.

In rural areas with water supply systems such as hand-pump schemes cost-recovery criteria include (Hewitt and Becker 1986)

- village participation starting from the initial request for assistance, through construction and ongoing operation and maintenance,
- a history of community organization, and
- the integration of water projects into broader rural development projects.

In their rural development programmes missionary organizations have for long held the policy that a certain initial financial or other contribution has to be gathered before services such as improved water supplies will be supported. This approach has recently been adopted by a number of bilaterally supported projects like those of FINNIDA in Kenya, Sri Lanka and Tanzania (FINNIDA 1983, FINNIDA 1984a, FINNIDA 1985).

Cost-recovery in its broadest sense does not necessarily mean total recovery of costs but can also include partial recovery.

Hewitt and Becker (1986) studied 19 rural schemes most of which had flat rates like the schemes in China, Kenya, Liberia and Sierra Leone. The rates were generally low. Flat rates are subject to water wastage. Therefore, for a higher consumption a progressive tariff in one form or another would be appropriate. In developed countries there are many good examples of the effect of increased water tariffs in reducing consumption.

World Bank (1986b) suggested that the value of time spent for water carrying is high and should be taken into account. The rural population in developing countries are paying for water much more than the urban dwellers. The latter was reported also by White et al (1972).

Collection of fees

Metering is often seen as inappropriate in rural areas of the least developed countries. However, in richer rural areas of East Africa some people seem willing to pay for metered house connections. In Sri Lanka consumers in rural areas can request for a metered connection. One alternative is to collect water charges simultaneously with general tax revenues and fees. Whatever method is chosen it is important that the collected money will be used for its original purpose. This means financial arrangements in the community rather than at any higher administrative level.

Subsidies

In some countries subsidies are used in favour of the rural schemes so that the overall sector is more or less self-sustained. One possibility is to redistribute income between different development sectors.

Haddow (1980) pointed out the different water pricing policy of the donors. In Kenya in the 1970s rural water supply was viewed as a social benefit and was highly subsidized. This led to the low level of revenues, poor operation and maintenance and need for rehabilitation. In this situation a new tariff as a condition to a large loan was proposed by a donor agency. This tariff was higher than those used in most countries at that time. The Government accepted this policy but it also accepted support from an another donor suggesting relatively high subsidies. These contradictory decisions caused a lot of difficulties.

National economic aspects and external support

Developing countries generally have an excessive surplus of labour with low income. Therefore labour-intensive methods instead of capital-intensive ones should be used when implementing water supplies.

In rural water supply labour can be used for digging trenches, carrying pipelines and other raw materials, hammering chipping, screening aggregates and digging or drilling wells. The intensive use of labour contributes to the felt ownership of schemes which is one of the key functions in operation and maintenance.

Use of local materials and local manufacturing of e.g. hand-pumps should be encouraged.

SIDA was one of the earliest large scale development supporters in East Africa, starting in Tanzania in the mid-sixties. About 75 per cent of the sector funds were covered by SIDA, the total assistance from 1965 to 1976 being USD $ 45 million (SIDA 1980). This institutional support did not, however, prove to be successful. In the late 1970s and the early 1980s about 50-70 per cent of the piped water supply schemes with diesel pumping funded mainly by SIDA were out of order (Mujwahuzi 1978, Mansson 1979).

The author's ongoing research shows that even over 95 per cent of the investments of some rural water supply projects in Tanzania are financed by the Nordic countries. Reliable figures on the national components of these projects are not available but the percentage is of correct magnitude. The situation reflects the deteriorating economic situation in the country. However, one could seriously ask whether such a high amount of support on a grant basis gives enough incentive for national contributions.

Mujwahuzi (1984) noted that the water master plans done for most regions mainly by external support generally did not notice development potential or productive use of water. He continues that a country cannot ignore the fact that large rural projects cost a lot of money not only for investments but also for running.

In her study van Wijk-Sijbesma (1985) pointed out women's participation in water supply and sanitation. Women seem to be especially active in raising funds, collecting fees and supervising the local board. Traditionally women are also the main users of water for productive purposes.

In 64 of 70 countries unpaid work of women is not included in the Cross National Product (GNP) calculations and that is why the value of their work is vastly underestimated (Blades 1975 cited by van Wijk-Sijbesma 1985).

In the selection of a water source van Wijk-Sijbesma (1985) saw three main criteria: economic, perceived water quality and social relationships. Many studies in developing countries show that economic criteria are the most important ones.

In their literature survey Elmendorf and Isely (1982) identified the roles of women in water supply and sanitation as acceptors, users, managers and change agents. These criteria are related not only to social but particularly to economic matters.

Price policy on agricultural products in developing countries favour urban dwellers and does not give enough incentives for farmers for more effective production (Cleave 1974). This fact partly undermines the possibilities for the productive use of water. Lele (1986) reported that rural households have been responding to changing economic incentives with remarkable speed.

Operation and maintenance

Operation and maintenance problems are generally the most severe constraints in the sector as shown by Katko (1986a).

Until recently developing countries have concentrated on constructing new schemes partly because of international support. If most of the constructed schemes were maintained and kept operative, it would in many developing countries be impossible to have any funds for new investments. It is likely that the governments in developing countries have escaped bankruptcy in the sector development only because most of the water schemes are not operative. Thus there is an urgent need to develop methods for recovery by increasing local funds. Although donors have financed many investments, it is uncertain whether they would be willing to pay for operation and maintenence. There is probably little sense in that kind of support in the long-run considering the ultimate goal of any developing country, namely independence.

Viitasaari (1972) pointed out that in Tanzania it would not be possible to construct and maintain the continuously growing number of water supply schemes just as a social service. He concluded that sooner or later cost-recovery will be necessary. Ahtisaari (1984) found it beneficial to support programmes in social development such as health care or education. However, he pointed out that at the same time productive activities (either in agriculture or industry based on sound economics) must be developed.

USAID (1982) stated in its policy paper that it will not support programmes whose operation and maintenance costs cannot be financed over the long term by combining the contributions of the consumers, the local community and the regional and central government.

In its policy paper SIDA (1984b) emphasized the importance of cooperation to increase the recipients' capacity at national and regional level based on local priorities with popular participation. The responsibility for the installations and their maintenance should preferably be with the consumers. Pricing must be adapted to the economic capacity of the different consumer groups.

On the whole, the author suggests that drinking water supply should be seen as a part of basic infrastructure rather than a social service. In developed countries the provision of drinking water supplies is seen as an industry, which should also be the case in the developing world, at least in the industrialized urban areas.

It is evident that the decision by quite a few developing countries to supply water to all the people free of charge must be reconsidered and recovery encouraged.

5.4 Social and Cultural Appropriateness

The role of community participation in water supply and sanitation has been discussed a lot during the last decade. In the recent seminar in Arusha, Tanzania community participation was seen more as an objective than a strategy (Andersson et al 1986).

Miller (1978) abandoned the term of public participation in light of its multifarious aspect and employed the term "community involvement". Mashauri (1985) noted that community participation should be encouraged during all phases of a project, from initiation to operation and maintenance. However, it must be remembered that community participation does not always cut the costs and thus should not be the primary aim.

The author's view is that instead of participation we should rather speak of community involvement or contribution. As one African water engineer put it:

> "Participation is a term describing willingness to join gatherings and meetings if food and drinks are available free of charge."

Swantz (1985) reminded of the user's views in locating water sources. She stressed that we have to know something of the social structure of the community to find official and unofficial channels for community communication. Social customs related to water are another important field. Land ownership may limit the utilization of water resources. She pointed out the need for reliable information, the role of women and people's true needs. If we make a careful analysis of the communities we could charge for water from some public amenities and wealthy users. Thus there is a link between cost-recovery issues and social factors.

In rural areas women are the main users and drawers of water. Therefore their role in water supply and sanitation should be encouraged. However, in practice this seems to be quite a difficult issue. Men are traditionally represented better in political and social community decision-making. The World Bank (1986b) suggested that ways to reach women must be developed. Many development cooperation projects have failed in involving women.

The participation of women is naturally a complicated matter and depends on the overall cultural development. In this context generally accepted Nordic ideas of women's equality do not necessarily apply in the developing countries. Studies for instance by Kivelä (1985) have criticized project implementors of not involving women in the projects. This is often caused by national institutional structures and decision-making.

Mashauri's (1985) view was that there is a lack of harmony between national objectives and the needs of local communities. Provision of water forms a part of the whole spectrum of desirable inputs like health and sanitary education, cultural dimensions and social aspects. Changes in behaviour are gradual and therefore socio-cultural aspects should be handled with patience.

Falkenmark (1982) reminded that the provision of clean and accessible water revolutionizes the role of women. Improved water supply can reduce women's work load and increase their participation in the development process.

The author interviewed a number of professionals, mostly with engineering background. Their general view was that so-called socio-economic studies are often biased towards social aspects only or rather that they lack economic consideration.

Cultural aspects are particularly important in sanitation and they are closely related to health education. There can be a great variety of taboos, beliefs and customs which can hinder proper sanitation. In southern Tanzania there is a clear correlation between the religion of inhabitants and their sanitary behaviour. In Moslem coastal areas it is very difficult to introduce sanitation without water. In most of the Christian inland areas it is easier to introduce latrines. In Ethiopia some ethnic groups do not lay human excreta on a place where someone has done it earlier. Introduction of improved latrines in these kind of circumstances will not be possible without long-term educational efforts.

5.5 Level of Technology

Appropriate technology is commonly seen as a synonym for low-cost, simple technology or low technology. Van Wijk-Sijbesma (1985) saw locally made rainwater tanks, water transport facilities and household water filters as appropriate technology. These technologies represent self-improvement which is certainly very valuable. According to Bhagavan (1979) "low-cost" technology concentrates on economic aspects, intermediate on the engineering aspects and appropriate on the socio-cultural aspects. In these examples technology is seen only from the rural consumer's viewpoint.

Suuriniemi (1987) noted that an appropriate hand-pump represents low technology for the consumers but very high technology for the manufacturer when the best materials are used. Other examples of this low/high technology combination are plastic pipes and solar pumps.

Norconsult... (1982) classified technological options as low, intermediate and high (Table 5.3). This type of classification is naturally relative. Again boiling of water is taken as one treatment method.

Table 5.3. Different levels of water supply technologies (Norconsult... 1982).

Water supply component or activity	Development at different technology levels		
	Low technology	Intermediate technology	High technology
SPRING PROTECTION	Cleaning, fencing	Protection with concrete rings and slab Piped outflow Catchment protection	More sophisticated spring and catchment protection Flow control and piped outlet
WELLS	Unlined bucket dipping Fencing, cleaning	Concrete ring or brick lined cover slab, handpump	Concrete ring or brick lined, with infiltration galleries Cover slab, motorised pump
RIVER OR LAKE	Bucket dipping Shadoof. Fencing of collection point	Simple intakes for int tech pumps or gravity supplies. Gabions and rock and soil dams	Designed dam, screen and controlled flow intake chamber Concrete dams
BOREHOLES	Non-existent	Handpump or other int tech pump.	Motorised pump, deeper boreholes
WATER TRANSPORT DOWNHILL	Pots and buckets carried by humans and animals. Open channels, hand-carts	Buried bamboo pipes, carefully constructed open channels Small quantities	Buried iron, plastic and concrete pipes Lined canals Large quantities
WATER TRANSPORT UPHILL	Pots and buckets carried by humans and animals Hand-carts Small quantities, usually low lift.	Ram pumps, simple wind-driven and animal-driven pumps Chain and washer pumps and many other int' tech' pumps. Small to medium quantities and lift	Motorised pumps, diesel, electric, solar, wind-powered Virtually limitless quantity and lift possibilities
STORAGE	Clay pots, old oil drums Small quantities, less than 1 m^3	Dug ponds, simple dams, ferrocement pots Woodstave tanks Small-medium quantities	Large designed dams and reservoirs Concrete, steel and plastic purpose-made tanks Medium to large quantities
TREATMENT	Boiling	Pot chlorination, simple rapid sand filters, short-term storage Simple ceramic filters	Full treatment and continuously dosing chlorination Slow sand filtration Ultraviolet, silver filters
DISTRIBUTION	Individual collection at source. Delivery in containers by 'professional' water carriers.	Delivery through simple pipes and channels to improved collecting points.	Delivery to individual consumers premises through sophisticated pipe networks

Mashauri (1985) stated in his paper on cultural dimensions of water:

> "Most cultures are rich in indigenous technologies, e.g. in siting of wells and their maintenance, and in traditional water treatment and disinfection, that are waiting for further investigation and exploitation. It must be remembered, however, that the appropriate technology is not necessarily the "primitive" or "low" one just because the community is at a low stage of development. The appropriate technology is the one that works for the benefit of the target community."

The author agrees with Mashauri and sees that appropriate technology contains all possible levels of technology and their combinations. Low technology is needed especially in implementation of rural water supplies whereas high technology is needed especially in ground water resources inventory. It is also important to remember that quite many infrastructure-related basic services like telephones, telex etc. are high technology.

5.6 Framework for Appropriate Technology

As a summary we can present a list of criteria to describe the nature of appropriate technology classified as technical, economical and socio-cultural aspects (Table 5.4). Additionally, the importance of each criteria in the categories is presented. Respectively, environmental aspects are included in the technical and financial aspects in the economic category.

Table 5.4 . Primary, secondary and tertiary criteria for technical, economical and social appropriateness of rural water supply in developing countries suggested by the author.

Criteria	Category of appropriateness		
	Technical[1]	Economical[2]	Socio-Cultural
Felt need		xx	xxx
Quantity	xxx		
Quality	xxx		
Availability	xxx		
Accessibility	xxx		
Reliability	xxx		
Workability	xxx	xx	x
Easiness to operate and maintain	xxx		xx
Affordability		xxx	
Willingness to pay			xxx
Fund collection and management	x	xxx	x
Motivation-building		xxx	x
Involvement		xx	xx
Sexual equality			xx
Behavioural change			xxx

1) including environmental aspects
2) including financial aspects

xxx primary
xx secondary
x tertiary

Felt need for improved water supply is mainly a socio-cultural aspect. A number of technical aspects form the necessary although alone inadequate basis for improved services. Economic category serves as a link between technical and socio-cultural categories. For appropriate water supply, development of all these aspects is needed.

6 HUMAN RESOURCES DEVELOPMENT

6.1 Concept and Scope of Human Resources Development

The Task Force set up by the Decade Steering Committee divided human resources development into three areas, namely

- planning,
- training, and
- management.

Thus human resources development includes employment, supervision, continuing education and training, and occupational welfare (WHO 1982).

Spencer (1985) discussed manpower development and noted

> "Engineers, too, are aware that lack of attention to the manpower aspect creates a risk that newly-constructed water supplies will fail to reach expected levels of performance - failure which occasionally is wrongly attributed to poor design or construction and is laid at the engineer's door."

Spencer pointed out that manpower development must be seen at institutional, organizational and individual levels (Figure 6.1). The institutional level deals, for instance, with status, tariffs, staff salaries and promotion. The organizational development includes matters such as organizational structures, training, promotion policy and budget. The employee development level contains e.g. employee's real duties, opportunities and facilities for training.

6.2 Obstacles and Constraints in Training

Goma (1975) discussed the obstacles of effective utilization of trained scientific and technical personnel in Africa. He mentioned the general obstacles such as brain-drain, the isolation of a technical person, the shortage of competent technicians and inadequate finance. Four matters given insufficient attention or neglected were

- the general shortage of high-level manpower itself,
- the unripe, uncongerial and sometimes risky environment,
- academic freedom and university autonomy, and
- the divided world and the informational bandwagon.

According to Goma very few decision-makers are sufficiently familiar with science and technology to be able to make sound, prompt and realistic decisions. The scarce trained technical personnel are overworked with many routine duties.

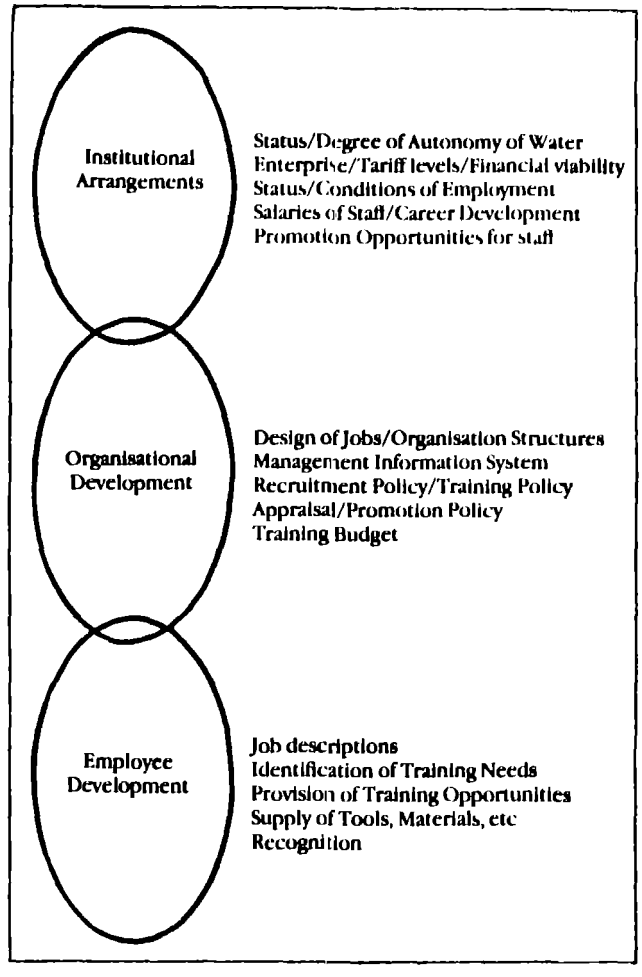

Figure 6.1. The institutional, organizational and individual decision-making levels affecting manpower development (Spencer 1985).

The second obstacle culminates in the lack of self-confidence. The work of the national staff is not sufficiently appreciated and therefore, specialists are invited. Connected with the third obstacle the author has noticed that in the water sector very few links exist between universities, national institutions and development cooperation projects. Additionally, the syllabi seem to be more oriented towards theory than practical engineering. In the sector the training programmes concentrate on hydrology, not on water supply and wastewater engineering.

The fourth factor implies that international cooperation in technology and science has been politically important but scientifically negligible. The author's view is that science is universal and political boundaries should be crossed.

Austin et al (1981) pointed out the need for a systematic approach to human resources development. According to them the current fragmentation of the sector programmes is a major obstacle in meeting the goals of human resources. Each of the numerous agencies specializes in one aspect of the water supply and sanitation sector. They also criticized the lack of cooperation between projects supported by different donors leading almost to competition.

Gibson and Carefoot (1984) pointed out that training is not a "cure all" for the developing world. The problem is not necessarily the lack of manpower itself but rather the lack of performance standards and productivity.

The need for a change in attitudes was stressed by Gondwe (1986). Technicians and engineers should be more willing to work in rural areas. He also stressed the urgent need of theoretical and applied research for proper water supply development. Probably some kind of incentives would help in this matter.

In addition to the above-mentioned aspects the author has found recurring constraints in information flow, "handbook" solutions and continuing education. It is paradoxical that developed countries often have better information and data of a developing country than the developing country or region itself. African engineering seems to rely more on handbook solutions and perhaps on earlier design experiences. In water supply and sanitary engineering most of the handbooks are, however, meant for the developed countries and urban areas. Producing manuals especially for hot climates and less developed environments has improved the situation. One could still ask whether these manuals keep up the overrating of printed instructions instead of engineering common sense.

Continuing education in the water sector is practically missing in the developing countries. This means that the knowledge and know-how will become out of date relatively soon. The lack of access to information sources as well as the lack of informal contacts between professional colleagues makes the situation worse. The latter is caused by the lack of proper infrastructure but there are also cultural hindrances.

6.3 Levels and Types of Training

Well and pump caretakers or attendants represent the lowest professional level in rural water supply. The experience is gained on-the-job. Formal introductory and refresher courses at different levels will be needed. Status alone is probably not sufficient reward for the attendant and therefore he or preferably she should receive a compensation in one form or another. Women should be preferred and the selection of young, unmarried men avoided. The caretakers supported by water committee could also collect the water fees if they are introduced.

Foremen are typically trained on-the-job or in-service in development cooperation projects. The vocational training institutes can also be supported externally.

Training of technicians is commonly taken care of by national institutions. The syllabus of the Water Resources Institute in Tanzania is now under renewal and it will become more performance oriented. It used to be quite theoretical with few ties to practical water engineering (SIDA 1984a). Lower technician grades can be achieved by working experience and by passing national grade tests.

The German Agency for Technical Cooperation (GTZ) stated that medium level training of technicians, administrators, laboratory assistants etc. is frequently neglected (Kresse 1984). GTZ has

supported the training of Tanzanian university technicians and laboratory workers in Germany in the German language (Mashauri 1986b).

The lower university degree, Bachelor of Science (B.Sc. (Eng.)) takes usually 3 to 4 years. During the last year the student specializes in water engineering via a few special subjects and course studies. On the whole, the B.Sc. level civil engineer has quite a wide and general background.

There are a few examples of training B.Sc. engineers of a developing country in another, slightly more developed one. In the early 1980s SIDA financed a "crash-programme" for about 120 Tanzanian technicians for a B.Sc. degree at the University of Roorkee, India.

After working for a few years those B.Sc. engineers with honours can often join Master of Science (M.Sc.) -courses. In Africa the Universities of Dar es Salaam, Tanzania and the University of Ahmadu Bello, Nigeria offer M.Sc. courses in water resources engineering for the Anglophone Africa. They are supported by UNESCO via the African Network of Scientific and Technological Institutions, ANSTI (Gondwe 1986).

Most of the M.Sc. courses in water engineering are held in the developed countries. The scope of the courses is typically quite narrow with specialization in one field of water supply and sanitary engineering. The M.Sc. course organized by the Water, Engineering and Development Centre (WEDC) at the University of Loughborough, England lasts for 11 months. It is specially designed for the needs of developing countries and includes a considerable input of management and sociology (Pickford 1985).

The International Institute for Hydraulic and Environmental Engineering in Delft, the Netherlands offers one-year diploma courses in Environmental Science, Hydraulic Engineering, Hydrology and Sanitary Engineering. These courses are practically-oriented but their contents are not specially designed for the developing countries.

Tampere University of Technology (TUT), Finland has since 1979 organized an 18-month Postgraduate Course in Water Supply and Sanitation specially designed for the developing countries. The first part of 12 months is run in Finland and the following thesis period takes place mostly in the participants' home countries. The course has so far been offered to Ethiopia, Kenya, the Sudan, Tanzania and Zambia. The course covers the area of water engineering quite widely. In 1985 the training programme was evaluated by an international team. The team found the course structure innovative but stressed the need of transferring the course to the recipient region in the long-run (FINNIDA 1986).

Häkkinen et al (1986) pointed out that there should be more cooperation between the donor-supported projects and national training institutions.

It is obvious that presently Master's and higher degrees must mainly be given by institutes in the developed countries. By increasing the capacity of the universities in the developing

countries it will be possible to shift the postgraduate courses within a reasonable time. Twinning between the universities in the developed and the developing countries is one possible form of cooperation.

Carefoot (1976) discussed the scope of environmental health and leadership in this sector. He noted that a person with the conventional engineering training with B.Sc. and M.Sc. courses has little or no knowledge of human and social sciences. In 1967 the University of Pittsburgh offered a mid-career option by starting a Master of Public Works course. This degree has an inter-disciplinary curriculum given by the School of Engineering, the Graduate School of Public Health and the Graduate School of Public and International Affairs.

6.4 Training Connected with Externally Supported Projects

The choice of an agency to implement an externally supported project is very important. In a country or region with little rural development, manpower development should be the initial target (Haijkens and Turrell 1978). The common problem in development assistance is that trained personnel easily leave the project. Despite that the trained departed personnel will be able to contribute to the national development needs.

It has been said that development cooperation projects pay too little attention to human resources development. Anyway, training should be mainly the responsibility of the national training institutions. Therefore, the extent of training given by a project must be considered in each case.

Viitasaari (1982) noted that sometimes international organizations pay too much attention to the high training and academic level of their experts and do not value sufficiently practical engineering experience.

Hämäläinen (1986) suggested a pilot training approach for transferring knowledge and practices to the local counterparts in the FINNIDA-supported project in western Kenya. This type of pilot project would cover about 10 per cent of the area. It would operate as an independent body but be partially supported by the main project. The pilot area could be expanded and the responsibility gradually transferred when the capacity of the pilot-project has increased.

It is obvious that particularly expatriates who do not have experiences of the developing countries should be given a briefing course. These kinds of courses normally cover general social and cultural aspects. The author's view is that experts with no prior experience of the third world should also be given a short course in their professional field. This would be especially important if a simultaneous working period for transferring the duties is not possible as often is the case.

Von Troil (1986) suggested that all foreign experts should have thorough knowledge of the local culture and society. The author's view is that particularly those who work mostly in the field would benefit a lot from this kind of knowledge. However, the target of thorough knowledge to all the experts seems exaggerated

considering time and costs. Yet all foreign experts should be encouraged to learn basic vocabulary of the local language. Naturally the selected experts should have pedagogical skills in order to train their counterparts or co-workers.

The potential of expatriate resources can be increased by voluntary and associate expert programmes. One interesting alternative is to offer junior posts within a development cooperation project for young expatriate graduates at the end of their studies. This kind of programme organized by TUT has proved to be quite successful.

Figure 6.2 shows a hypothetical view on the relative volumes of construction, operation and maintenance as well as training needed in a development cooperation project. The operation and maintenance phase demands quite a lot from training.

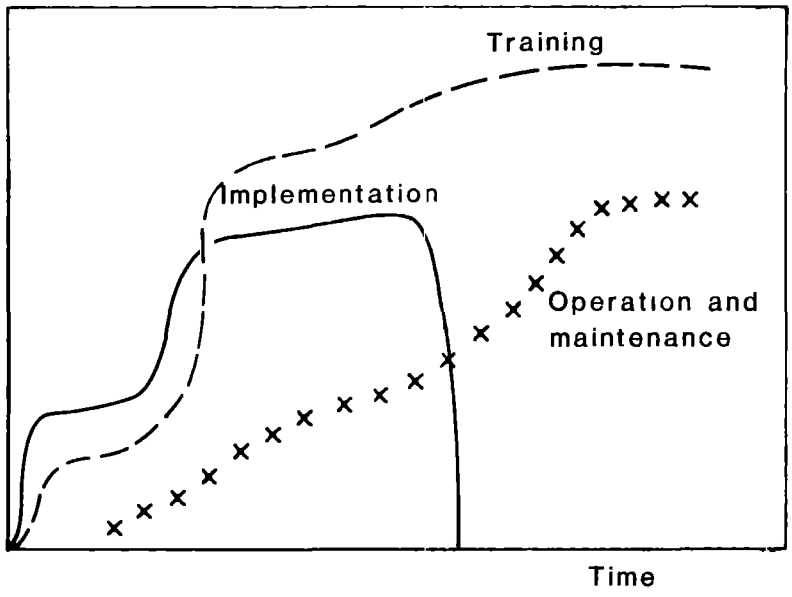

Figure 6.2. The relative volumes of construction, operation and maintenance as well as training needed in a development cooperation project (Rantala 1984).

The importance of training and human resources development is now also understood in project export activities. Käyhkö (1985) wrote about a consulting engineers company which includes training and technology transfer in all its projects.

7 INSTITUTIONAL AND ORGANIZATIONAL ALTERNATIVES FOR EXTERNAL SUPPORT

7.1 Institutional Capacity Building

In addition to technology, material and human resources, appropriate institutions are needed for water resources development and management. In most cases institutional capacity building would mean the reinforcement of existing organizations but sometimes the establishment of a new institution or organization is necessary.

Honadle (1981) defines "capacity" by the ability to

- anticipate and influence change,
- make informed, intelligent decisions about policy,
- develop programmes to implement policy,
- attract and absorb resources, and
- evaluate current activities to guide future action.

These activities have been presented in a framework by Honadle in Figure 7.1.

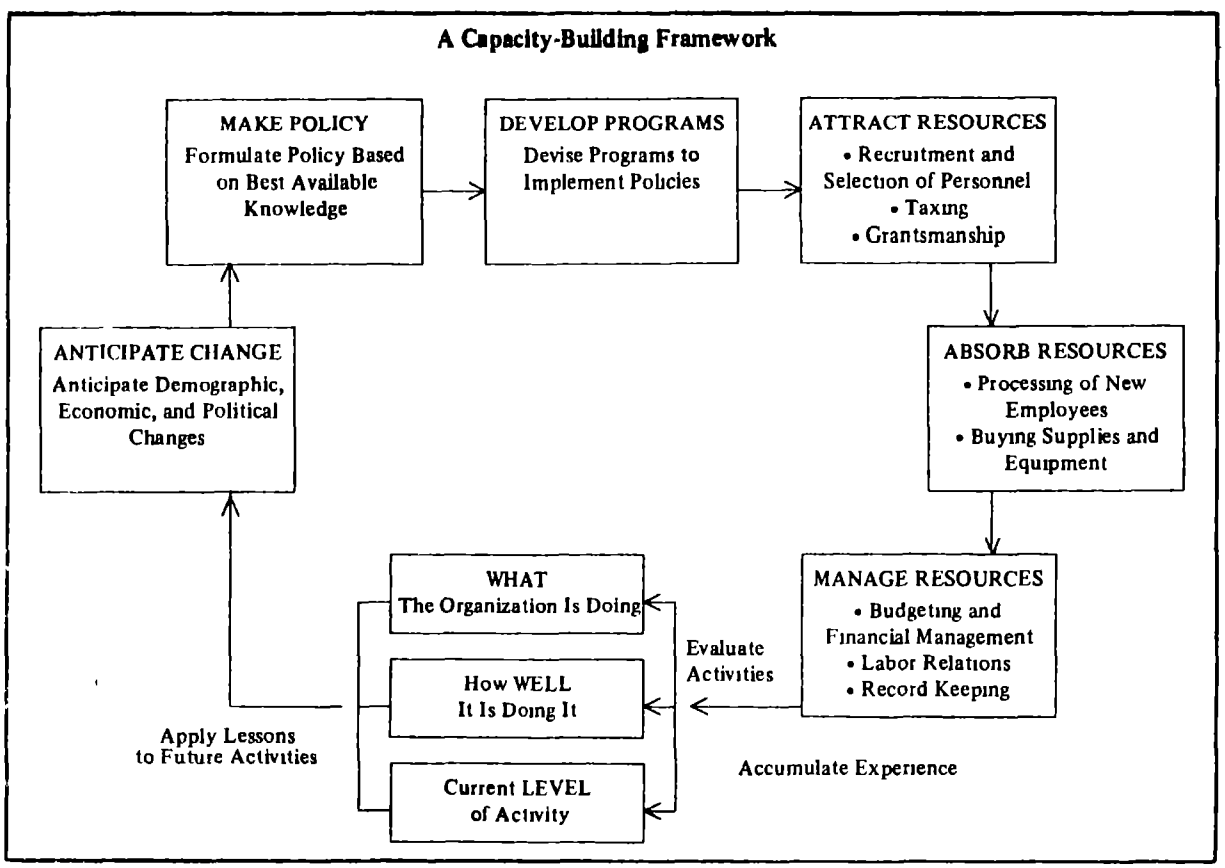

Figure 7.1. A capacity-building framework (Honadle 1981).

Honadle mentions the following organizational requirements for capacity

- the ability to forge links with other organizations,
- processes for solving problems,
- coordination among disparate functions, and
- mechanisms for institutional learning.

In summary: capable organizations have a number of activities, attracting resources being just one of them. Often many ministries, departments and other institutions are involved in water supply and sanitation. This makes it quite difficult to build institutional capacity.

USAID (1983) considered the following aspects the most critical ones in institutional development:

- the host country policy environment,
- the potential of various alternative forms of organization,
- the importance of institutional learning capacity,
- the problem of transferring knowledge and technology,
- improvement of coordination and linkages among institutions,
- improvement of management systems,
- provision of training,
- the role of local initiative and participation, and
- the role of institutions in undertaking the development of physical infrastructure.

In the all Africa Seminar in Abidjan, the Ivory Coast in 1986 the 30 Sub-Saharan governments and 15 external supporting agencies discussed the sector development (Anon 1986a). It was concluded a.o. that low-cost technologies demand the establishment of an institutional framework with effective community management of water supplies. Decentralization of responsibility means optimizing the use of public and private sector resources. The responsibility transfer to local levels and communities is now a general trend aiming as much as possible to felt ownership and community level maintenance.

Institutional capacity building in its broadest sense includes also the use and development of local consultants, contractors and other private institutions.

7.2 Major Types of External Support

In the 1950s and 1960s external support then commonly called foreign assistance or aid was mostly based on programme type support. According to Morss (1984) there were two types of support. The first one comprised large infrastructure investments like road and irrigation works. The second one was general support to a specific sector.

In water supply and sanitation this programme aid was also applied. SIDA gave general support to water sector in Kenya and Tanzania. From the mid-1960s till mid-1970s SIDA alone financed more than one half of the sector allocations in Tanzania. The support was channeled via the department and later the ministry in charge of water development. In Kenya the same donor supported quite a large rural water supply programme from the mid-1970s up to the recent years.

The experiences of the general support to the sector were, however, quite disappointing. This might have been because of the lack of sufficient supporting activities. In the late 1960s donors became more interested in achieving intended results by their support. By the beginning of the 1970s project type aid became the primary channel of support (Morss 1984). Project support is based on clearly defined objectives, planning, monitoring, and evaluation thus giving the donor good control over the use of support.

In the early 1980s the World Bank introduced the so-called "Project Cycle" for managing different stages of development projects (Baum 1982). This tool was copied partly or totally by many bilateral agencies. The figure 7.2 shows the development stages of water supply and sanitation projects based on the project cycle approach.

The project type aid has, however, its drawbacks. The high number of supporting agencies and projects in developing countries sets demands for the national institutions to absorb this support. Morss (1984) criticized this donor proliferation and hypothesized that

> "The most important difference between development assistance in the 1970s and earlier decades was not the emphasis on the rural poor and "participatory" approaches but instead the "institutional destruction" effects of donor and project proliferation".

This criticism is probably correct but we should remember that the generally very ambitious development targets were set by the developing countries themselves. These targets lead to the introduction of effective project cycle approaches. The project cycle is also of interest to the ultimate supporters, the taxpayers in developed countries.

One development expert interviewed by the author stated that the project cycle approach is applicable to large size investment projects. However, according to him this approach would be too complicated and sophisticated for small size projects typical of rural water supply.

In his critical study Lecomte (1986) analyzed project type aid. He summarized that the recipients should band together and deal as an organized group with those who are trying to assist them. To release the potential for innovation and action it is essential to move from participation in aid projects to responsibility for their own programmes. He was also quite critical about the effective preparation of aid operations by means of more comprehensive preliminary studies, monitoring and evaluation of schemes. According to him moving away from aid projects to supporting assistance means a more complex approach that would need constant refining.

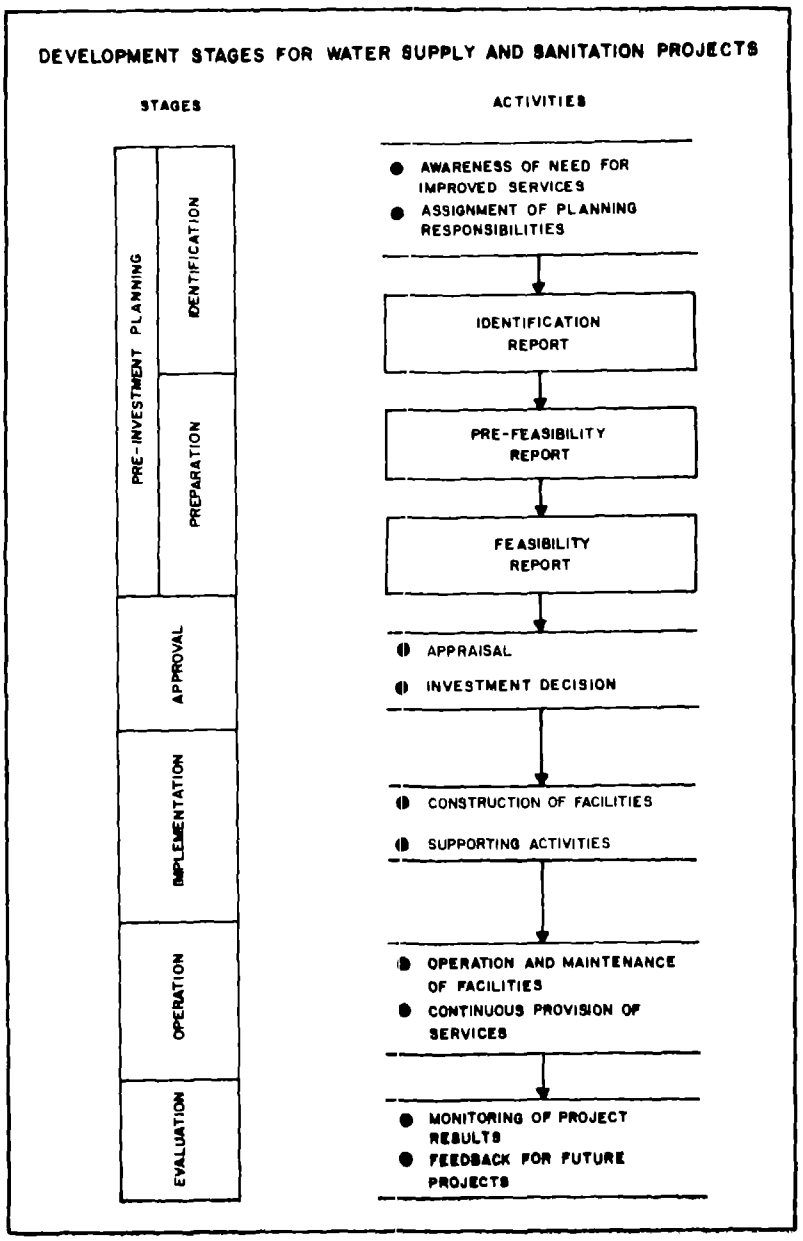

Figure 7.2. Development stages for water supply and sanitation projects based on the Project Cycle Approach (Grover 1983).

Strachan (1978) criticized the excessive emphasis on prior planning which, together with unequal power relations among the partners, has lead to more costly and less effective development assistance. Berg (1980) wrote that it is common for Ministries of Planning to state that the burden caused by donors' support prevents them from carrying out the most simple analyses. He mentioned that Sri Lanka was assisted by 74 donors and Kenya by 41 governmental donors and a huge number of NGOs. This situation has lead to a chaotic lack of coordination.

7.3 Organizational Alternatives for External Support

External support can be directed to existing entities to reinforce their functions or it can be used to create a new institution or organization.

7.3.1 Individual Experts in Existing Line Ministries or Departments

Individual experts are recruited for specific jobs in existing line ministries without creating any distinct management unit.

In 1974 the Ministry of Water Development was established in Kenya. In Tanzania in the late 1960s the sector was taken care of by the Water Development and Irrigation Division under the Ministry of Agriculture, Food and Co-Operatives. In 1971 the Ministry of Water and Power was formed. Thereafter several changes have taken place concerning the departments under the Ministry. In 1985 the Ministry of Lands, Housing, Water and Urban Development was formed. Finally in 1987 a separate Ministry of Water was established. In Malawi the Department of Lands, Valuation and Water was formed in 1982 but two years later it was divided into several units.

In the professional sense these frequent changes are not necessarily disastrous since the units are working quite independently. For proper and efficient management these changes, most probably of political nature, have negative effects.

The ministry or department in charge of water development is usually responsible for urban and rural water supply, sewerage and, in many cases, of other forms of water use such as irrigation, hydropower and industrial water use. However, rural sanitation is commonly under the Ministry of Health. This often causes administrative problems. In developed countries the horizontal cooperation and coordination between different ministries is difficult and in developing countries it is often practically non-existent.

Expert assistance

The most simple form of external support in the organizational sense is technical assistance via bilateral and multilateral experts or volunteers. The earlier focus on programme type of aid was based on having individual professional experts holding posts of advisory nature. In most cases the external agency covered all the costs of the expert's expenses. In case of acute lack of national professionals the experts can hold line positions of national civil servants like in Malawi and Zambia.

The experiences of expert assistance are diverse. A number of bilateral experts interviewed by the author have been complaining of the inadequate support and facilities to run the daily duties. Possibilities to influence professional matters seem to vary quite a lot from case to case. Now that the focus is on project type assistance, some of the individual bilateral experts have been acting partly or totally as project coordinators. They keep contact with the donor but mainly represent the client, the ministry. Lecomte (1986) points out that the role of an advisor or consultant should be kept separate from that of the supporting agency.

Some experts suggested that their duties should, at least to some extent, be linked with other external support. Some of them are very critical towards individual expert assistance whereas others find it valuable just to keep the daily routines running.

In training and research institutions experts can be given more specified jobs without necessarily integrating other activities.

In 1974 SIDA made an evaluation of personnel assistance in the water sector in Tanzania. The recommendations included, e.g.:

- more attention to personal relations,
- expatriates capable to work in different types of duties and organizations should be preferred in recruitment,
- placing too many expatriates in one section should be avoided,
- expatriates should be recruited for a longer period than 2 years,
- administrative duties should be taken care of by national personnel, and
- organizational problems should also be covered in debriefing and training of expatriates (Hydén et al 1974).

Training of national personnel via the so-called counterpart system is commonly seen as one of the key duties of an expert. In 1982 NORAD evaluated its overall expert assistance. About 65 per cent of the posts were refilled by other NORAD-experts but only 15 per cent of the posts were overtaken by a national counterpart. The lack of counterparts seems to be very common in many recipient countries (Isaksen 1982). Instead of counterparts a concept of counter officer has recently been taken into use by among others FINNIDA (1987a). The term points out the responsibility of the organization and its members in receiving external support.

The continuity of expert assistance is often undermined by the slow recruitment process of a new expert. In most cases the commonly hoped-for overlapping service period does not seem possible.

The general trend has been to decrease personnel assistance and to increase expert teams or management units, respectively.

Multilateral experts have probably better background support from the donor side. Additionally the nature of their posts might be such that gives better possibilities to influence than the bilateral expert posts. On the other hand, an international team is likely to avoid necessary criticism in professional matters and prefer a "diplomatic" approach.

Recruitment of multilateral experts is often very time consuming. Additionally the background experience required is commonly 10 to 15 years or even more. Much attention is paid to academic formal degrees and candidates representing the doctorate level can be required for even quite practical posts. There are some experiences on this bias (Viitasaari 1986a). The bias is probably caused by placing theoretical knowledge before practical engineering in developing countries. It is also likely that the organizations try to guarantee succesful recruitment simply by applying high academic standard which sometimes looks ridiculous.

Volunteers

Voluntary organizations often recruite young professionals with fairly little professional experience. Lecomte (1986) reported that as a way of passing on experience, volunteers are probably the

least useful form of technical assistance. He continued that direct action by short-term volunteers in rural communities should be discouraged. However, Lecomte found it more sensible to have volunteers in maintenance, experimentation and practical training.

Instead of individual posts, volunteers can be posted in a team of experts or a project. Like individual experts, volunteers also need adequate supporting facilities for their work.

Volunteers can serve as valuable recruitment reserves for later expert and project posts. From 1967 to 1983 SIDA had altogether 133 volunteers working in the water sector in Tanzania (SIDA 1986). Quite many of them have been recruited for other development work posts later on.

7.3.2 Distinct Project Management Units within Existing Line Ministries or Departments

A distinct project management unit within an existing government ministry can be given all or most of the resources needed to implement a project. The unit can be integrated into the line ministry or department and their decision-making bodies. The level of integration decreases when supporting services from the donor's side increase. These services can include

- purchase of imported materials, equipment and spare parts,
- possibilities to use own funds via own channels, and
- some possibilities to recruit national personnel for the project.

Transportation for the unit is typically arranged by own vehicles which will be handed over to the host institution after the project is over. This can be regarded as a minimum need for a management unit. In projects concentrated in planning the need for equipment and spare parts is small, but in implementation the unit often has the possibility to import directly the material by-passing the commonly very bureaucratic purchase system of the host institutions. The same applies to other logistic support such as fuel and spare parts.

The possibility to recruit national personnel or to have national counterparts is a double-edged matter. If national counterparts are allocated by the host institution there are good possibilities to build-up capacity for taking responsibility of the activities later. If the recruitment of counterparts and national personnel to the unit is not possible, the units tend to become isolated and the integration to the host institution becomes loose. Distinct management units can easily become semi-autonomous or autonomous.

Project management units are commonly used in planning type of activities. For example, the World Bank has had a few regional offices with Project Preparation Units (PPUs), later called Sector Development Teams (SDTs). The United Nations/DTCD has supported a number of national water resources plans.

In most parts of Tanzania regional water master plans have been prepared with lots of external support (Katko and Rantala 1981).

After most of the plans were made or were under preparation, a separate Water Master Plan Coordinattypically arranged by own vehicles of the resources needed to implement ion Unit (WMPCU) was established. The Unit was thought necessary but its position within the Ministry was unclear. After a few years the unit was totally manned by national professionals. Nowadays it acts more as a supervisory body of the externally supported projects.

7.3.3 Autonomous Implementation Units with Links to Line Ministries or Departments

An autonomous implementation unit outside the regular government can have sufficient resources of its own to implement the project. It can recruit, hire and train personnel as well as pay higher salaries than the regular civil service agencies.

Autonomous implementation units have been used in rural water projects where high production rates and efficient use of resources have been considered vital. In Tanzania the first regional shallow well project in Shinyanga was implemented by an autonomous implementatior. unit headed by a Dutch consultant. In southern Tanzania a Finnish consultant started the preparation of a water master plan in 1973 and till 1984 the project was more or less autonomous.

Autonomous implementation units can be feasible in introducing new ideas and approaches such as the utilization of ground water. This is particularly true with deep ground water inventory which requires modern and high technology.

For the implementation of rural water supply generally based on simple technology such as wells and gravity schemes, autonomous units are not appropriate. These units are not either feasible for operation and maintenance bearing in mind the general objective of sustainable projects.

Autonomous implementation units have been favoured by the supporting agencies to ensure the efficient use of resources. The recipient governments have favoured this approach because of their generally ambitious goals. This approach has offered the best chances to reach these goals which, in many cases, still seem difficult to achieve in the planned time period.

The links to national water administration such as regional, provincial or district water engineer's offices can be organized by a steering committee. It is commonly headed by a national civil servant such as a regional water engineer. The committee meetings take place a few times per annum. The committee monitors the project for example by progress reports.

7.3.4 Support to Subnational Water Authorities and Boards

Particularly for urban water supply, autonomous national or subnational water authorities have been established e.g. the National Urban Water Supply Authority (NUWA) in Tanzania. This type or organization functions as a parastatal, which In principle should be able to recover funds.

Cities and large towns commonly have their own water boards under the city council. The boards are not necessarily single discipline bodies. For example in Nigeria the Kano State Water Board takes care of irrigation and water supply (Franklin 1983). Similarly there is the National Water Supply and Drainage Board in Sri Lanka. In India there is a Water and Sewerage Board in the principal city of Bangalore. However, at least in many of the East African countries water supply and sewerage are the responsibility of two different bodies. Smaller towns are typically under the relevant water ministry or department.

External support to water authorities is mostly given on a loan or credit basis. It is possible to recover some costs by metering. Expatriate experts can be employed directly by the authorities or they can be recruited and supported financially by external agencies.

7.3.5 Support to Grass-Root Organizations

It is generally accepted that we should, if possible, have a "bottom-up" approach in rural water development. This means strong involvement of the recipient community at all stages of the project, especially in operation and maintenance.

In most cases external support is provided by national water administration and its ministries or departments. Different types of grass-root organizations can and should be used to channel this support to the local level. The responsibility has to be shared between the water development ministry, its regional offices and different types of local organizations.

Different community committees such as water or a well committee for a single well or another water source can be formed. The recent trend has been towards community ownership and responsibility of the water supply system supported by district, regional and/or central agencies when needed. In Ethiopia legally constituted peasant associations form the key administrative tool for community development (Berhane 1984).

Grass-root organizations have traditionally been supported more or less directly by missionary organizations. Bilaterals and multilaterals have become more interested in this approach.

There are different views on the effects of public participation and self-help within government programmes. Miller (1978) reported benefits and drawbacks of voluntary user involvement as seen by an OECD expert meeting.

Benefits:

- user involvement will lead to better and cheaper maintenance,
- user involvement will lead to community motivation and institution building,
- user involvement will provide water supplies at a lower cost per capita to public funds,
- user involvement will catalyse other development action in the community, and
- user involvement will lead to more efficient collection of water rates.

Drawbacks:

- user involvement will cause inefficiencies and diseconomies in the implementation phase,
- user involvement will, therefore, cause fewer water supplies to be built at a higher cost in any given time, and
- user involvement will cause a poor technical standard of construction that will lead to more frequent breakdowns.

It is thus clear that grass-root organizations alone will need the support of higher level national agencies.

Lecomte (1986) has gathered experiences mainly from Francophone Africa and suggested the following procedure for grass-root development:

(i) revolt and innovation,
(ii) motivating and disarming opposition,
(iii) leaving the group to organize,
(iv) mobilizing self-help,
(v) co-management,
(vi) finding out what is being done elsewhere,
(vii) failure and learning from experience, and
(viii) association.

Esman and Uphoff (1982) cited by Lecomte (1986) reported

> "According to our reading of dozens of case experiences, "pump-priming" of local organizations based primarily on outside resources seldom results in effective, sustainable organizations. The leadership that emerges is likely to be less well-motivated and may indeed be bent mostly on self-enrichment; members will take what is free without developing a sense of responsibility for the local organization."

They verify that the best moment to supply external resources is when the local organizations have developed sufficient capacities of their own to digest the assistance.

According to Lecomte the grass-root organizations must first become active at the community level and within a small area or several communities. To be successful at least a part of the financial assistance must be repayable. The second stage of development is to create a climate of confidence. Ties are formed between a manager and a leader. After these two basic stages the following steps should be taken:

- experience gained = capacity to plan
- experience + own funds = co-financing and borrowing capacity
- experience + own funds + balance sheet = capacity to negotiate
- self-sufficiency in management = capacity to become involved in specific programmes.

The key issue here is that participation is not the first step in the development process but belongs to the advanced stage.

The approach suggested by Lecomte is well suited to NGOs support. The long time required is often not possible for governmental external support channeled via national water administration.

On the other hand, one can ask whether the promotion and formation of proper organizations will be possible without simultaneous construction at least in pilot-scale, i.e. giving practical examples of how to construct a well or a latrine.

Kenya Water for Health Organization (KWAHO) is the only NGO based in Kenya involved in improved water and sanitation on a self-help approach. It has been contracted to provide sociological input for two sub-programmes supported by SIDA. There are also other parties involved in the programmes in Eastern Province and Kwale district like the Ministry of Culture and Social Services (MoCSS), the Ministry of Health (MoH) and the Ministry of Water Development (MoWD). Five Kenyan sociologists are working in these two programmes. In Kwale district informal water and health committees are registered with MoCSS as Water and Health Groups (WHGs) (MoWD, Kenya and SIDA 1985; Norconsult... 1985).

7.3.6 Support to Integrated Rural Development Agencies or Projects

In Malawi the use of different ground water sources has been called the "integrated project" approach (Anon 1982b). This approach, quite limited in the sense of integration, is to

- protect suitable existing dug wells,
- rehabilitate existing boreholes where feasible,
- construct new protected dug wells,
- construct new low-cost boreholes, and
- establish a maintenance structure for all waterpoints.

A wider level of integration combines water supply, sanitation and health education. In this approach water supply has mostly been the core field of development, the other two activities being more of a supporting nature. Since these two sub-sectors have traditionally been administered by different authorities, it is not easy to have horizontal cooperation. In fact it has also been quite difficult in the developed countries, for example, between the Ministry of Environment and the Ministry of Agriculture in Finland (Viitasaari 1986a).

In Sri Lanka FINNIDA (1983) is supporting a rural water supply project where sanitation and health education form two parts of the project. These two activities are under the Local Health Authorities. The project's task is to coordinate all three sectors.

In western Kenya FINNIDA (1985) is supporting two separate projects in the same area, namely the rural water supply and primary health care projects. This separation has its own drawbacks, although it would probably be quite difficult to combine these two activities under one single project.

In southern Tanzania FINNIDA (1984a) has supported one of its longest development cooperation projects, the Rural Water Supply Project in Mtwara and Lindi Regions. The project has since the first phases (water resources inventory and water master plan) included only the water supply component. In 1985 a pilot sanitation component was included in the project. The project was implemented by quite an autonomous unit. From 1988, however, the project will be totally integrated to the activities of the regional water offices. During the water supply project it became evident that basic infrastructure development, particularly road construction, could have helped the implementation. This could be quite easily combined to the project (Homanen 1986).

In the mid 1970s the FINNIDA supported plan of integrated rural development in the two regions was made. ODA (United Kingdom) supported the Agricultural Development Programme which did some experimental agricultural work on a pilot scale. Recently FINNIDA decided to start supporting an integrated rural implementation project in the two Tanzanian regions. FINNIDA has become quite interested in the integrated approach shown by Karanko (1984). In Sri Lanka FINNIDA is going to support an integrated programme.

Integrated rural development projects can include

- infrastructure development like road, bridge and railway construction,
- productive sectors like agriculture, forestry, fishery, and small-industries development, and
- socially oriented services like water supply, sanitation and primary health care.

Morss and Gow (1981) studied the implementation problems of integrated rural development projects supported by USAID. They found nine most frequent and significant problems, namely

(i) lack of beneficiary participation and inadequate decentralization,
(ii) non-use of information systems programmed in the project design,
(iii) political, economic and environmental factors beyond the control of project management,
(iv) the scarcity of strong leadership, sophisticated planning skills, efficient logistical support and a wide range of specialities in support of technical assistance,
(v) inappropriate organizational placement and linkages among participating agencies,
(vi) excessive start-up time, inaccurate time estimates and inappropriate phasing of project activities,
(vii) shortages of local counterparts to work with the expatriates,
(viii) differing project agendas among project implementors, and
(ix) sustaining IRD project benefits after project termination.

Ruttan (1975) analysed integrated rural development programmes and gave the following generalizations

(i) Rural Development Programme (RDP) must be organized around activities and services with well-defined technologies and objectives,
(ii) RDPs must be organized to utilize the relatively unskilled human resources in rural areas,
(iii) effective implementation of RDPs depends on the institutional capacity to mobilize the limited political and economic resource,
(iv) the problem of welfare remains more a problem at the level of output per person than of distribution, and
(v) RDPs will rarely be able to mobilize political and economic resources necessary for massive structural reform. Therefore development will be characterized by unequal rates of development between rural and urban areas and among rural areas.

In Senegal, for example, the country is divided into six agro-ecological zones each having a public enterprise to manage rural development schemes. The enterprises have a degree of financial autonomy, flexibility in administration, and freedom in staff recruitment and control (Armor et al 1979). In Tanzania Rufiji Basin Development Authority (RUBADA) is dealing with hydropower, flood control and agricultural activities. It has been supported a.o. by NORAD.

Day (1985) suggested that rural ground water supply could become an integral part of the river basin and agricultural development organizations, and thereby an integral part of their financing and management.

Mickelwait et al (1983) studied the implementation of integrated and development programmes in Africa and Asia and had four major strategies

- "the Individual strategy" based on personal contract
- "the Academic strategy" based on university contract
- "the Bodyshop strategy" based on private firm contract only with temporary staff
- "the Management team strategy" based on private firm contract with permanent chief of party and involved home office.

They concluded that the management team strategy offers the best possibilities to implement complex projects in an environment with scarce resources.

Missionary organizations have traditionally integrated many productive sectors and services in their supporting programmes. The time frame of their work is much longer and the goals much lower than those of governmental organizations and other NGOs. The latter ones typically support and implement integrated community based development programmes.

On the whole, integrated rural development programmes appear to have concentrated mainly on planning rather than implementation.

7.3.7 Development of Private Sector Institutions

Roth (1984) classified the involvement of the private sector into two main groups: piped water supply and non-piped water supply. The alternatives in these categories are:

(i) Piped water supply
- regulated monopolies
- management contractors
- rural cooperatives

(ii) Non-piped water supply
- vending (carrying and selling) of water

Piped water supply

According to Roth (1984) in most cases piped water supply is in the monopoly position in the public sector. This is also true historically, probably because of political and defense reasons. However, there are a few examples in the least developed countries where private firms are supplying water with tariffs regulated by municipalities.

Regulated monopolies include the concession system and the affermage system. In the concession system the public authority makes a contract with a private operator of construction and operation. The concessionnaire finances, constructs and operates at its own risk. The operator must replace worn-out equipment and recover invested capital. In the affermage system the public authority contracts out operation and maintenance only.

In northern and western Francophone Africa concession and affermage systems were used earlier but, after the independence, most of them were taken over by local authorities. Two former affermage systems, in the Ivory Coast and in Vanuatu are still in use. New ones have been established in French overseas territories and Latin America.

In some cases private firms manage the water supply systems on management contracts. In this case investments are made by public agencies. There are also examples of rural water cooperatives (Roth 1984).

In the rural areas of a developed country like Finland the water supply development has been started by the consumers who hence formed water associations and cooperatives.Now during the Water Decade there is a growing government interest in the sector.

Non-piped water supply

For centuries water vending has been used all over the world. According to Roth (1984) there were about 20 000 water vendors in Paris alone at the time of the French revolution.

Zaroff and Okun (1984) stated that in the developing countries some people have to spend 30 per cent of their earnings for vended water, often of low quality. They suggest that vending could be organized and institutionalized by supplying wheels or

vehicles, water containers etc. By this institutionalization the prices of water could be controlled at least to some extent and thus it would be more fair for the consumers. There have been also quite critical views towards vending such as those by Suleiman (1977).

Roth (1986) stated that

> "The combination of rich people receiving subsidized piped services, while the poor pay for expensive water from vendors, is likely to remain until governments allow economic markets to work in water supply, as they already work in many countries for the supply of food, clothing, etc."

In China sanitation in urban areas has traditionally been based on manual collection of night-soil (human faeces and urine). The rural methods like pit latrines are less feasible in urban areas. The collection of night-soil, if properly planned and organized, has proved to be as hygienic as waterborne sewage (Mara 1978). With the present migration from rural to urban areas and with the fast population growth, urban slums or squattered areas will expand a lot. In these areas vending of water and waste carrying will probably be the only alternatives.

USAID evaluated institution building aspects of about 300 projects in different sectors. Experiences were more positive with cases that had private entities as targets. This is possibly due to a difference in size: in financial terms private projects were on average half the size and therefore easier to manage and monitor (Barnett and Engel 1982).

7.3.8 Twinning

The "twinning" of institutions in developing countries means cooperation with similar but more mature and experienced organizations in developed countries. The Wessex Water Authority with the support of ODA (United Kingdom) has had twinning cooperation with the Central Water Authority in St. Lucia in the Caribbean. The cooperation started in 1979 and has included (Roberts 1984)

- medium-term managerial and accounting assistance,
- short-term technical support, and
- medium and longer-term training and monitoring.

A wholesale revision of sources, quality standards, tariff systems and management systems yielded 15 per cent savings in operating costs and internationally accepted water quality. By 1982 the major phase of the twinning project was completed and St. Lucian successors took the responsibility. However, regular monitoring, training and short term technical assistance will continue.

The Committee on Cooperation in Development under the International Water Supply Association (IWSA) reported that by 1985 little progress had been achieved in twinning. Twinning could normally be possible between large cities as they have similar problems (Doshi 1985).

Cooper and IWSA (1986) pointed out that professional relationships between operating entities offer advantages like flexibility over time. Twinning alone, however, may not be sufficient. Technical assistance may be most effective when using several types of support, either together or separately.

Cooper and IWSA added that both parties may need quidance in arranging twinning. A part of the funding could be arranged through multilateral or bilateral organizations. IWSA has enormous possibilities to assist cooperation between water supply companies and organizations all over the world by

- promoting bilateral cooperation between water supply companies,
- assisting in recruitment of suitable persons for international assignments,
- forming committees and developing technical manuals and quidelines,
- offering neutral objective assistance, and
- helping in obtaining financial assistance from supporting agencies

The idea of twinning was widely approved by European donor consultations held in 1984 (WHO and BMZ 1985). In the IWSA Conference in Rome in 1986 experiences of some German water supply enterprises were reported. Their cooperation, although not called "twinning", has not been too successful (Viitasaari 1986a).

7.4 Management Aspects

In 1983 WHO together with BMZ (Federal Republic of Germany) organized a consultation to review progress at the beginning of the Decade. As a part of the consultation an opinion survey was carried out among the participants listing the following factors affecting human performance, namely

- skill and knowledge,
- working conditions,
- tools and equipment,
- standards and procedures,
- motivation,
- attitude and ability,
- incentives,
- supervision,
- feedback, and
- opportunity to perform.

In the case of "skill and knowledge" as well as "attitude and ability" the individual plays the key role. For the remaining eight factors management and organization have the controlling influence (WHO and BMZ 1985).

Management weaknesses

Management and effectiveness related matters were seen as major constraints by foreign experts as shown in Chapter 4.

During this study a number of professional African water engineers have complained that the most acute deficiency in the sector is proper management. Because management is such a wide concept, this shortage covers the whole sector.

According to Dumont (1966) the greatest obstacle to progress remains the lack of elementary morality - work, honesty and dedication to the country. He also pointed out the dangers of nepotism which, at that time, still existed in many developing countries. The last issue related to tribalism is still clearly undermining the water sector in some developing countries.

Moris (1977) has compiled features of African field administration from the standpoint of the western management tradition as follows

(i) recruitment occurs through personal influence,
(ii) distinction between public and private goods in not maintained, corruption is common,
(iii) special equipment and facilities are seldom available, they are used for more urgent needs,
(iv) maintenance is so poor that despite low labour costs the operation costs remain two to four times higher than in the developed world,
(v) professional norms are rarely enforced,
(vi) there is an intense internal politicization of junior officers,
(vii) top officials use the transfer of subordinates as the main administrative solution to almost every problem,
(viii) downward communication is facilitated, lateral communication forbidden and upward communication not sought,
(ix) work performance is highly unreliable because of low morale and haphazard supervision,
(x) higher officials have chronic work overload because each officer is responsible for all actions of subordinates,
(xi) there is a flexible attitude toward scheduling,
(xii) there is a flexible attitude towards plans,
(xiii) disagreement over issues is tolerated but never if expressed in public,
(xiv) in place of open channels for advancement, great stress is placed upon the minutiae of formal qualification,
(xv) administrative system appears unable to learn from its past mistakes,
(xvi) decision-making takes place among a relatively small circle of people at the top of each organization. Before decisions matters are "sensitive" and "confidential" and after decisions they are "policy", equally sacrosanct, and
(xvii) system as a whole is very slow to react to changing external circumstances.

Moris notes that this list is a caricature and luckily no one national system contains all these weaknesses. In East Africa the author has noticed particularly weaknesses (iv), (x) and (xvi). The low labour costs have not perhaps been fully utilized in operation and maintenance. Duties are not delegated to subordinates

because of various reasons. Utilization of data and necessary information is hindered by the "confidential" attitude not typical only in developing countries but also of some supporting countries. This attitude undermines possibilities for technical and organizational research and development.

The list of common bureaucratic weaknesses has three implications (Moris 1977)

- they have a particularly virulent effect on public professional services,
- a majority of them are of systemic origin and therefore they are not subject to alteration by individual actions, and
- possibilities for achieving an effective managerial practice by training alone seem to be slim.

The author's view is that the listed weaknesses often occur in developed countries as well but they are not so visible and easy to identify. The cumulative effects of bad working conditions or even missing supportive infrastructure as stated by Moris makes the tasks of managers more demanding in developing countries. In the water sector the managers are often relatively young with limited working experience and professional training. For instance, regional or provincial water engineers in East-Africa are typically 30 - 35 years old when appointed when the respective ages are 50 - 55 years in developed countries.

According to the author's findings one of the key managerial problems is the lack of economic incentives. The typically low salaries of the public sector engineers do not provide sufficient motivation. Dumont (1966, p. 259) stated

> "the majority of the officials in Brazzaville found that appearing for three or four hours - I have not said working - was sufficient."

With the low salaries it is understandable that the civil servants spend a part of their working hours for other purposes. When external support and the use of counterparts are planned this should be seriously considered.

Work-related values

Hofstede (1980) has studied culture-dependent differences in thinking and acting. He pointed out the importance of understanding these differences in international collaboration. He found out four main dimensions of values which affect human thinking, organizations and institutions. The Nordic countries and the Netherlands had quite similar values like

- unauthorized leadership,
- relatively high tolerance of uncertainty,
- stressing of individualism, and
- soft values and low masculinity.

As an example of the indicators used in the study figure 7.3 shows positions of countries on the Uncertainty Avoidance and Masculinity Scale. The former index describing the tolerance of uncertainty was based on three indicators: rule orientation,

employment stability and stress. Thus on the extremes of the horizontal axis are ego needs and affiliation needs. Masculinity index shows whether the biological differences between the sexes should or should not have their roles in social activities. Thus on the extremes of the vertical axis are the hope of success and the fear of failure.

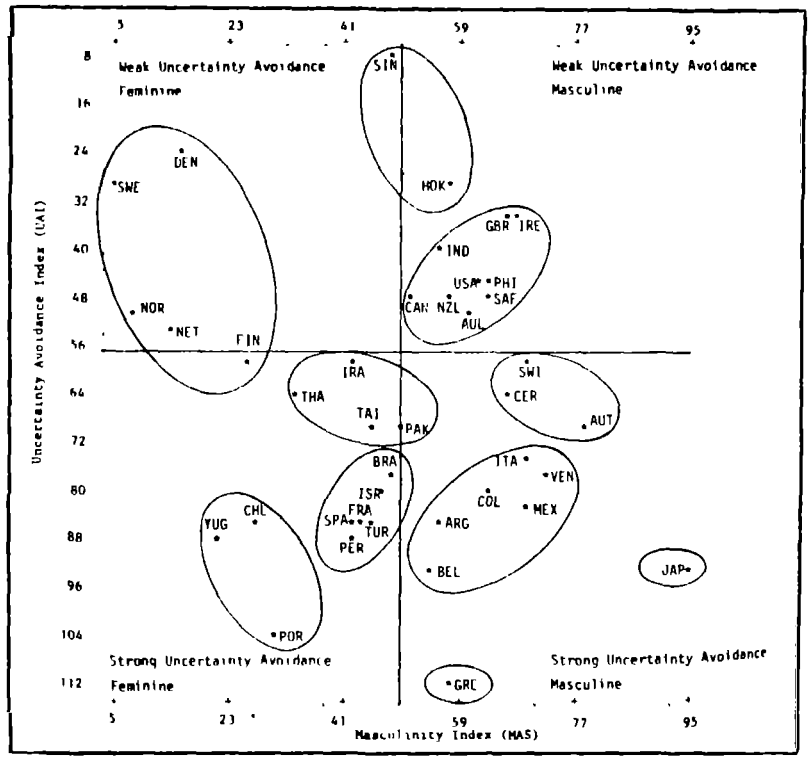

Figure 7.3. Positions of the 40 countries on the Uncertainty Avoidance and Masculinity scales (Hofstede 1980).

The Nordic countries and the Netherlands form clearly one clustering. The Anglo countries and former UK or USA colonies are "masculine risk-takers". The African region was not included in the study. The author's view is that in case of the lack of incentives these developing countries would probably be close to "masculine risk-avoiders". The differences in work-related values can clearly be seen in development cooperation projects and the ways they are organized and managed. These together with political and historical differences of the external supporters make it quite difficult to organize coordination and cooperation between supporting agencies and the recipient.

Nurmi (1984) states that

> "Western and black African traditional core values have been developed over long periods of time. While Euroculture emphasizes material values, in the Afroculture the highest value lies in the interpersonal relationship between men. Western organizations, western companies and western development cooperation reflect western material values, which have done them a good service in the western countries. But when they meet African core values, conflicts are inevitable."

Nurmi suggests that instead of one-sided transfer of western things and ideas a long, cumbersome and mutual learning process is necessary.

Desired qualities of a manager

Kansi (1985) has studied the views of East-African engineers on good qualities of a manager. The desired qualities according to their frequency are as follows:

(i) knowledge, education, intelligence,
(ii) maturity, experience,
(iii) innovativeness, creativity,
(iv) social adaptability,
(v) respect to other people and cultures,
(vi) ability to understand problems and solve them quickly, and
(vii) good behaviour.

On the whole, the high valuation of experience and age probably decreases innovativeness in technical and managerial matters.

According to Kansi the most desired manager's qualities by the Finnish people are:

(i) maturity (stability),
(ii) mental energy,
(iii) independence in judgements (not easy to influence), and
(iv) intelligence and ability to learn.

It is of interest to note that the latter qualities (i), (ii) and (iv) appear practically in all studies made in developed countries. However, the quality (iii) seems to be typical of Finnish managers.

Management of integrated programmes

Armor et al (1979) pointed out in their paper on integrated rural development programmes that project designs commonly pay little attention to management details. In a rural development project management they divided the problems into two viewpoints

- development administration or organizational point of view, and
- organizational development or behavioural point of view.

In development administration of integrated programmes there must be a clear division of responsibilities between different parties. The problem of cooperation and coordination between different parties has often been discussed. African water engineers have criticized the evident lack of coordination between donors whereas the donors have complained about the lack of cooperation between different sectors and within these sectors.

Additionally Armor et al (1979) also listed the following problems:

- tendency of subordinates towards non-compliance,
- lack of incentives for cooperation, and
- one way direction of information flow (top-down).

They continued that in problem diagnosis we have to find out whether the problem has a technical or inter-personal bias.

7.5 Discussion on Organizational Alternatives for External Support

It is obvious that the use of individual experts and volunteers without the necessary supporting facilities and services is quite questionable. They should preferably be linked in one way or another to other externally supported projects or programmes.

A team of experts fully integrated into the local administrative system can be utilized in planning and research activities.

Distinct project management units within the line ministries or departments have access to supporting services like imported equipment, spare parts, independent financial channels and possibilities to recruit national personnel. The more complex and large the units are the more these services are needed. There is a tendency for these units to become autonomous. If the technology used in the country is unfamiliar such as ground water resources inventory techniques, autonomous units can be justified. However, these units should be integrated into the national administrative and institutional framework as early as possible.

Mickelwait et al (1983) studied integrated rural development projects. They found out that unless short-term assistance personnel are an integral part of the implementation team their recommendations will hardly be followed. The author has noticed this several times in large rural water supply projects.

It seems obvious that the private sector together with the public sector development can highly contribute to the field of water supply. This can mean local manufacturing of hand-pumps by joint ventures or manufacturing of simple water treatment units. It can also mean institutional support in operation and maintenance. De Faria cited by Viitasaari (1986b) suggested increased inputs for the sector to reach the Decade objectives (Figure 7.4). According to him the role of the private sector would be of major importance after the adequate initial public input.

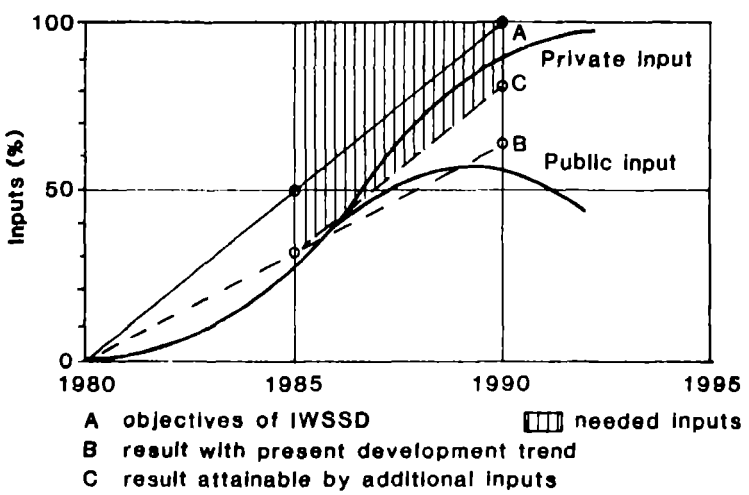

Figure 7.4 Hypothetical view of the inputs used and needed for the water supply from the public and private sector (de Faria cited by Viitasaari 1986b).

Integrated rural development approach, often including water resources development, seems to be increasing. Water supply and sanitation can be included in these projects but directly productive uses of water like irrigation and hydropower are probably of more importance in integrated rural development.

When integration is limited to include water supply, sanitation and health education, the first one seems to be the key technical function onto which the other two can be linked.

Franklin (1983) reminds that the organization which has been successful in one country, or another industry like electricity supply, cannot necessarily be duplicated. In each case organizational alternatives must be critically examined.

Naturally institutional and organizational alternatives are very closely linked with the resources available (human, material and water) and the technology used. Roek and van der Mandele (1986) stressed that technological and organizational options should be evaluated together to find an appropriate choice. The nature of the project, i.e. the type and level of technology needed is, in the author's view, one of the most important matters in selecting an organization. Another point is the need for continuous organizational development and change. This is especially true with long-term projects and assistance in a large area.

In Malawi the building of a rural gravity scheme programme took one decade. The first phase (pilot phase) was meant to assess and stimulate genuine public demand. The second phase concentrated on a slightly larger scale to consolidate the technology and organization. After these had been developed succesfully the third phase of expansion was started. The fourth phase handles maintenance. By increasing the volume of construction step by step it was possible to utilize the experiences by trained technical staff. In selection of candidates to be trained as field technicians special attention was paid to the level of motivation to work in a rural area (Glennie 1983).

The Malawi experience is no doubt one of the most well-known successes in the sector. The author's view is that with the technology of gravity piped schemes the increasing of activity step by step is feasible. This is because the piped supplies with taps are easy to introduce to authorities at different levels and to consumers. However, hand-pump wells and other such technology are probably more difficult to introduce to all the parties. Therefore, the step by step approach is not necessarily applicable to non-piped water supply.

The ultimate goal of development support in water supply and sanitation is to build local capacity so that responsibility is taken by consumers and local level administration as much as possible. According to Pescod (1983) in most cases a shared responsibility between the agency and the community is required. He continues that technical assistance given by the water department or ministry will always be needed.

FINNIDA's (1984b) evaluation mission stated that the missionary organizations normally have long-term projects in the same area whereas the other NGOs mostly concentrate on short-term projects. Bilateral projects are limited by the regulative rules of the supporting governments affecting fund allocations. The general trend seems to be towards longer-term projects and sudden withdrawals or handing-overs of projects are getting rare. Thus this improves the continuity which can still be undermined by the lack of overlapping or sudden organizational changes. The evaluation team suggested that small NGOs should consider increasing cooperation e.g. in material supply and monitoring.

Development assistance funds have, to some extent, been used for the services of foreign consultants and exporters. It has been said that development assistance should not be used to support commercial export activities. However, the author's opinion is that there are fields where foreign exports are the only alternative. These export activities can be supported if the technology offered is appropriate for the conditions of the developing country. Besides, the Finnish trade with developing countries is extremely low compared with most other developed countries.

The importance of knowledge of local conditions is now recognized by foreign exporters, too. Joint ventures with the foreign exporter and the local partner have many advantages. Among others local production of hand-pumps could be realized by joint ventures.

Jurvelius interviewed by Malmsten (1986) pointed out that increasing costs and prolonged project schedule are generally caused by neglecting to investigate local circumstances. Koskinen interviewed by Malmsten (1986) laid stress on long-term commitment, flexibility and ability to cooperate. The importance of local partnership and local expertise is considered vital in project export activities. The client wants to get increasingly involved in implementation. This has changed the roles of foreign project personnel. A "shadow" organization could be also needed (Anon 1985).

Viitasaari (1984) pointed out that it is important to reinforce the absorption capacity of the recipient countries. The engineers implementing the projects have commonly been criticized of the failures. However, in many cases the projects themselves have very few possibilities to affect these failures or constraints. It is often the question of political decisions in the ministries. Viitasaari suggested that this level should be supported to increase the absorption capacity.

Mustonen (1984) pointed out that proper project identification and preparation requires a lot of personnel. This means that the external support agencies should be reinforced by professional specialists from different fields. It is not enough to increase the use of consultants only. As for research Mustonen stressed the importance of development of appropriate technology for the conditions of developing countries. He suggested that we should select a few development sectors which are linked to each other. The support should be concentrated on these sectors.

On the whole the localization in project export is deemed very vital. There are probably numerous similarities between organizing development assistance and export activities. They should not be seen as contradictory but rather as supporting each other.

8 CONCLUSIONS

(i) Justification of improved water supply and sanitation

Improved water supply and sanitation in developing countries is **justified** because

- There is sufficient evidence on **health benefits** gained through improved water supply. The benefits can be increased by proper sanitation and health education.
- In addition to health benefits also the **economic effects,** mainly savings in time and energy as well as productive use of water resources, should be considered.
- Only improved health conditions will make it possible to introduce **family planning** programmes to decrease the very high population growth in the developing world.

(ii) External support in the sector

The **financial trends** in external support to the water supply and sanitation sector indicate that

- Drinking water supply and sanitation allocations of bilateral and multilateral organizations typically amount to **two to four** per cent of their total assistance.
- The Water Decade has not managed to attract additional external resources to the sector. The governments of the developing countries are not going to be able to increase their allocations, either. Therefore **low-cost technology** and **cost-recovery** in monetary or non-monetary form have to be developed further.

(iii) Major constraints in water supply in developing countries

A survey was done on the **major constraints** in water supply, particularly on the rural sub-sector in Kenya, Malawi, Sri Lanka and Tanzania. In spite of differences between the selected countries and the different areas in each country, there are remarkable similarities.

- **The difficulties in operation and maintenance** combined with logistics are the most severe constraints in all countries as seen both by the national governments and by foreign experts.
- The developing countries lay more stress on the **lack of trained personnel and funding,** whereas the foreign experts and particularly donors are more concerned about **inadequate cost-recovery.**
- The external support by the external agencies can partly abolish the constraints. However, the large number of agencies and projects seems to breed other constraints particularly the **difficult issue of coordination.**

(iv) Appropriate technology

Appropriate technology is a common slogan. However, it is often mistakenly seen as a synonym for low-cost technology.

- Appropriate technology has technical, environmental, economical, financial, social and cultural dimensions. In the implementation of **rural** water supply in developing countries, **low-cost** technology is in most cases appropriate.

- The low-cost technology approach is now accepted by all parties. However, in practice, too sophisticated schemes are still being constructed. In rural water supply **also high technology**, for instance, in the inventory of deep ground water resources, is needed.

- The author is very **concerned** about the promotion of **boiling** of water even by international agencies. Due to the common lack of fire wood, boiling is appropriate under epidemic conditions only. Instead we should start with the use of **ground water** and protection of the most available water sources.

- **Applied technical research** in practical water engineering should be increased. The solutions developed mainly in and for temperate or cold climates do not necessarily work in hot climates and rural areas of developing countries.

- If most of the water supply schemes constructed in the developing world were kept operative, it would be impossible to find funds for new investments. Thus it is likely that the governments in developing countries **have escaped bankruptcy** in the sector only because **most of** the **water schemes are not operative.**

- **Women,** the main drawers of water, must be involved at different stages of water supply and sanitation programmes.

(v) Human resources development

Human resources development contains planning, training and management aspects.

- The location and quantity of water resources vary a lot in different areas of developing countries. In spite of the lack of water resources, especially in drought-hit areas, the **water resources** have not been **sufficiently** explored.

- The developing countries have made great efforts to train their national personnel. The number of trained personnel has increased, but the **content of training programmes** should be more directly applicable to the actual conditions in the developing countries.

- Lack of training is probably not the most severe constraint, as is often expressed by representatives of developing

countries. Instead more attention should be paid to the **capacity of national institutions** to manage all the necessary activities. If the performance of the individual is to be improved, **managerial and organizational factors** must be considered in addition to skill training.

- In externally supported projects training is seen as a key element. These projects are often criticized for inadequate training efforts. It is, however, obvious that the **national training institutions** should be mainly responsible for training in the sector.

(vi) Organizational alternatives for external support

There are many organizational alternatives for external support in the water sector.

- Because of historical and policy reasons, multilateral, bilateral and non-governmental **agencies** have their **own preferences** in the sector. All of the agencies are needed but because of their huge number **coordination** is imperative.

- Individual experts and volunteers need adequate supporting services and facilities. Their work could be linked with other external support. **Experts** and **expert teams** are more suitable for **planning and research activities.**

- In large projects with fairly **advanced technology** such as ground water inventory, **distinct and autonomous project** management units are needed. However, they should be integrated into national institutions as early as possible. Grassroot organizations are the key channels for supporting rural water supply development.

- The private sector could contribute more, e.g via joint ventures and promotion of small-scale industries. Consumer associations and small-scale industries could give support in operation and maintenance.

- There is **good potential** for cooperation in **"twinning"** between water supply boards, companies and training institutions in developed and developing countries.

- Different organizational forms of assistance are not contradictory but rather **support** each other.

(vii) General findings

- The governments of developing countries do not seem to be able to increase allocations to the sector. The external support, on the other-hand, is rather declining than increasing. The low-cost technology, often the most appropriate in the rural areas, is now generally accepted. There is need for continuous technical development but costs can hardly be dramatically reduced yet. The lack of proper operation and maintenance is the most severe constraint in the sector. For all these reasons it is quite obvious that consumers must contribute to their water supply in one way or another. Thus the strategies used so far in the sector must be rethought. Ways for coping with constraints culminate in cost-recovery issues.

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